BUSITEMA UNIVERSITY
Pursuing Excellence

FACULTY OF AGRICULTURE AND ANIMAL SCIENCE,

DEPARTMENT OF CROP PRODUCTION AND MANAGEMENT

Doctor of Philosophy of Science in Global Change and Sustainable Agriculture (GSA)

FEBRUARY 2022

Proposed curriculum for

Doctor of Philosophy in Global Change and Sustainable Agriculture (GSA)

(Research Publications and Thesis)

Table of Contents

EXECUTIVE SUMMARY

Low agricultural productivity continues to be a key factor in unsustainable production systems, despite decades of research on soil conservation, breeding and other sustainable agricultural practices. The challenge facing University training, researchers and policy analysts is to understand the processes causing low agricultural productivity and how to design mechanisms or a combination of technologies and practices that will provide farmers in developing countries with the economic incentives needed to adopt more sustainable land use and management practices. Today, tropical agriculture means talking about food insecurity and hunger driven by land degradation, climate change and population pressure on land. This calls for sustainable land and water resources management to avert the negative trend in the tropics. Tens of millions of lives can be saved from hunger. Practical scientific solutions exist. Agriculture based on area expansion is always detrimental and cannot be designated sustainable unless the forgone ecosystem services are accounted for somehow. Sustainable agricultural development remains an elusive goal and incompletely understood concept by the current generation of agricultural scientists, particularly in many of the world's poorest regions where adoption is low. Many practising African agricultural scientists today have been trained in a single discipline approach such as soil science, crop science, animal science or food science and therefore lack an Interdisciplinary/ multi-disciplinary approach to address the problem of low agricultural, food insecurity and sustainable development. There is a perception that everything is fine when agriculture is sustainable, even for generations to come. However, that is a simplistic idea because agriculture competes with other land uses in terms of space and ecosystem services. Sustainable agriculture for ten (10) million people is not the same as sustainable agriculture for forty-five (45) million people, making it a difficult concept. A Doctor of Philosophy graduate program in Global Change and Sustainable Agriculture (GLOSA) seeks to unravel the always incomplete concept of sustainable agriculture through generating a critical mass of high-quality, world-class scientists that have practical intellectual and leadership capacity to offer solutions to the challenges of low agricultural productivity (including people, plants, animals, soil, water, and other resources), environmental health and poverty in the developing world. The program duration is four (4) years, comprising eight (8) semesters devoted to major research work leading to a thesis. The existing human resources in natural and social sciences and facilities provide effective teaching, research, supervision, and mentorship to the PhD candidates. The program's philosophy stands on the concept that depth within a specialty and interdisciplinary breadth are critical to shaping the minds of future generations of scientific leaders. Therefore, the program's emphasis is to develop independent thinkers by fostering creativity and channelling curiosity through scientific training. Students taking the PhD by Research option will be offered additional support opportunities to develop specific professional skills throughout their tenure in the graduate school through discipline-specific courses and foundational cross-cutting courses. This program will also include interdisciplinary interactions among students supplemented by seminars and other activities (retreats and symposia). Students gain

knowledge and experience in diverse discipline areas and holistic approaches necessary to understand and develop sustainable agriculture to support rural development, alleviate poverty and reach food security, especially in the developing world. The programme focus is aligned with vision 2040, NDPIII and The Sustainable Development Goals (SDGs), number 1 and 2. Vision 2040 stresses Science, Technology, Engineering and Innovation (STEI) and industrialization. The NDPIII has its vision as "A Transformed Ugandan Society from a Peasant to a Modern and Prosperous Country within 30 years". SDGs number 1 and 2, have everything to do with agriculture: poverty and hunger have to be halved by 2030. The program is built under a multi-disciplinary research in five major systems: land, water, agriculture, climate and human dimension (society and economic development). The graduate program focuses on investigating the internal operational challenges of these systems and the dynamics of their interaction at multiple scales to produce food. Solutions are proposed for their sustainable deployment, focusing on the conservation of; soil resources, biodiversity, and water, in the frame of combating land degradation and climate change. Experiments, participatory research, statistics and mathematical models are the primary investigative tool in our teaching and research to bridge natural and social sciences. The training also prepares students to be hardworking, dedicated and self-reliant individuals with the ability to work with diverse groups of people. In addition, the program cultivates written and verbal communication skills, which enables them to be self-motivated and fit into all walks of life. The program has in-built strategic and long-term productive collaborations beyond research contacts through international conferences, professional workshops and seminars aimed to establish deep professional ties, trust and shared benefits that will work to bridge the sharp cultural divide between academia and field practices.

DEFINITION OF TERMS

A Semester is a period of study of normally not less than 17 weeks or such a period as may be determined by the Senate for any academic year.

A Unit of Study is a one-hour lecture or two hours of tutorials/seminars per week or three hours of practicals per week for the semester.

An Academic Year shall normally consist of two semesters and may include a third semester to cater for practical attachment, teaching practice and other field courses as may be determined by Senate.

Curriculum means an organized program of study for a given degree, diploma or certificate award incorporating all matters including rationale of the program, purpose, expected learning outcomes, academic resources for the support of the program, academic organization of the program, admission requirements, mode of delivery, program content requirements and assessment process requirements.

Department means an academic division into which a school is divided for purposes of teaching, examinations and administration.

Doctoral means a work relating to the PhD

Doctorate means the PhD degree

Lecture Hour means a period equivalent to one hour and representing one such continuous hour in lecture form, two in a tutorial or open learning session, three in a laboratory practical or practicum and five in the field or similar practice.

Program of Study means the prescribed syllabus that students must be taught at each stage.

PhD/Ph.D. means the Doctor of Philosophy

1.0. DOCTOR OF PHILOSOPHY IN GLOBAL CHANGE AND SUSTAINABLE AGRICULTURE (GLOSA)

1.1. PROGRAM BACKGROUND

Research is one of the three major pillars of higher education. According to the World Economic Forum, about 40% of new doctorates awarded in the OECD area are science, technology, engineering and mathematics (STEM). According to the report, doctoral programs are particularly oriented toward natural sciences and engineering in France (59%), Canada (55%) and China (55%). In 2017, South Africa graduated over 2000 PhDs, whereas, in 2018, Uganda graduated less than 100PhDs, of which less than 5% were STEM-based!

As Uganda endeavours to transform into a knowledge-based economy, higher-level training in human resources will increase the socio-economic potential of the country through the production of new knowledge that cannot be overemphasized. It is the responsibility of the universities to produce the knowledge needed as a core ingredient for the sustained development of Uganda's Vision 2040 to be accomplished. There is a skill shortage in higher degree qualifications, especially at doctoral levels. The programme focus is aligned with vision 2040, NDPIII and the Sustainable Development Goals (SDGs), number 1 and 2. Vision 2040 stresses Science, Technology, Engineering and Innovation (STEI) and industrialization. The NDPIII has its vision as “A Transformed Ugandan Society from a Peasant to a Modern and Prosperous Country within 30 years”. SDGs number 1 and 2, have everything to do with agriculture: poverty and hunger have to be halved by 2030. However, more than 80% of Uganda's population, mostly smallholder farmers, rely on subsistence, primarily rain-fed agriculture, mired in unproductive low-input/low-output farming systems and producing food barely sufficient for their consumption, with a limited marketable surplus. Despite decades of research on soil conservation, breeding and other sustainable agricultural practices, low

agricultural productivity persists in Uganda and developing countries due to unsustainable production systems. One of the major barriers to their operationalization of sustainable agricultural systems is the lack of a critical mass of interdisciplinary/ multi-disciplinary scientists to interpret, lead, and implement sustainable agricultural technologies and practices and customise them to suit various circumstances. From this standpoint, the PhD program in Global Change and Sustainable Agriculture system was designed by the Crop Production and Management department at Busitema University. The graduate programme is geared towards generating a critical mass of next-generation interdisciplinary/ multi-disciplinary scientists capable of research and leadership for addressing the always incomplete concept sustainable agriculture and power the overall agricultural development process in the developing world.

1.2. Justification of the Program

Persistent peasant agriculture and high population growth mean that food production needs must grow to feed the growing world population by 2030. In terms of native soil fertility, Uganda and tropical agricultural systems are simply less endowed than Europe. Moreover, despite decades of research on soil conservation, breeding and other sustainable agricultural practices, low agricultural productivity persists in Uganda and developing countries due to unsustainable production systems. New science and interdisciplinary/ multi-disciplinary agricultural professionals are required to operationalise sustainable agricultural production in Uganda and developing countries. These professionals should be capable of articulating and implementing more sustainable agriculture in the face of global change and unproductive low-input/low-output farming systems in developing countries to enhance the sustainable development agenda. Busitema University's considered view is that crop of the currently trained agriculturalists has skills gaps in grasping the science-policy-practice interface of agricultural and economic development issues. Many professionals working in the government sector, NGOs, and the private sector were trained in traditional specialities and therefore have limited or no interdisciplinary/ multidisciplinary competencies required for handling agricultural transformation development, which is critical for the country's sustainable development programs. These agricultural professionals were trained in a single agricultural approach such as soil science, crop science, animal science or food science and therefore lacked a multi-disciplinary approach to address the problem of low agricultural food insecurity and sustainable development. They are well placed to deal with agricultural extension objectives only but are ill-equipped to provide technical leadership and understanding of the factors and processes causing low agricultural productivity or the use of unsustainable agricultural production practices. They cannot design mechanisms that will provide farmers in developing countries with the economic incentives needed to adopt more sustainable land use and management practices in the face of global change challenges facing agricultural development. This is why subsistence agriculture dominates over 90% of the farming community in developing countries. Subsistence agriculture does not make money, does not make

farmers rich but keeps them food insecure and poor. This deficiency was well highlighted during I@mak.com feasibility studies (Adipala e/ al., 2001; Gombya-Sembajjwe et al., 2001). Therefore, the proposed PhD program is a response to client demand and is in line with government's policies of decentralization, parish development model, and poverty eradication that aim to improve incomes and quality of life for rural communities, improving household food security and provision of gainful employment. The emerging rural development issues call for well-rounded rural development researchers and practitioners. These practitioners must have communication and negotiation skills at the local, national, and international levels. They must also have the skills to actively participate in cross-sectoral/multidisciplinary activities and implement and monitor development programs. National policies like decentralization and the parish development model have also created new challenges prompting the university's responses, including a graduate degree program that will produce graduates with integrated multi-disciplinary thinking and agricultural development approaches. The philosophy of the proposed program is to develop high quality and sustainable training strategies that will produce grassroots practitioners and leaders who are prepared to address agricultural development challenges. Uganda's agricultural industry needs a generation of creative minds with the necessary scientific interdisciplinary/ multi-disciplinary background to understand the science behind modern sustainable agricultural development in the face of global change.

Currently, there is no institution where such training is offered in Uganda or anywhere in the Eastern African region. Busitema University's Faculties of Agriculture and Animal Sciences can fill the training gap based on qualified staff, training facilities, and relevant experience in teaching, research, and community outreach. The PhD of Science in Global change and sustainable agriculture (PhD. GSA) is tailor-made to answer the challenge of elusive goal and misunderstood concept of sustainable agricultural development by the current generation of agricultural scientists in Uganda and other parts of the world whose adoption is low. The graduate program will deliver innovative approaches to increase the capacity of national districts and sub-counties to handle the new roles that have emerged. The Course is designed to be interdisciplinary/ multi-disciplinary, combining a wide range of inter-related subjects, reflective of the complexity of sustainable agricultural management and emancipation for rural development. Secondly, the Course aims to provide a sound understanding of the underpinning theories of the development processes in rural communities, linking these theories to practical applications and examples used in contemporary sustainable agricultural management and rural development. The strategy is viewed as an innovative and more flexible approach to responding to the emerging needs of society in areas of sustainable agriculture and rural-resources development and management in general. The course is intended to offer career development opportunities for master's degree graduates new to agricultural multi-disciplinary studies and provide new skills for existing development practitioners.

Through its ministerial cabinet resolution, the government of Uganda has approved the hosting of the Uganda National soil and plant Institute at the Arapai Busitema University campus. The installation of the Soil Institute at Busitema University is supported by a collaboration of the National Agricultural Research Organization (NARO) and the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). The Uganda National soil and plant Institute will allow easy upcountry and rural access to soil, plant and water testing laboratory services that are affordable and reliable. Farmers and research scientists will be able to get good quality soil analytical results and acceptable recommendations. The PhD in GLOSA will be anchored in the proposed Uganda national soil institute hosted at Busitema University Arapai Campus to accelerate soil, water and climate research and teaching. Soil, plant and water test-based nutrient management is key in efforts to increase agricultural productivity and production. The demand for soil spatial information in Uganda is growing given the challenges of averting poverty, the impacts of land degradation, climate change, population growth, food insecurity, and promoting sustainable developments. The current state of soil information (age, scale, data format) cannot adequately serve various needs, e.g., site-specific agricultural planning. Testing, digitizing, updating and enhancing the accuracy/ scale of the soil information is a pre-requisite. Busitema University seeks to bridge a gap and provide solutions to the key questions on the availability and relevance of soil, plant and water testing information in Uganda's national development process. Efforts to manage soil research and teaching are scattered in various institutions such as Makerere University, NARO Kawanda national research station and the private sector. Soil research in these institutions has been relegated to the bottom and not given the funding priority it deserves. These institutions lack standard equipment to perform standard soil, plant and water quality analyses. Although some private soil laboratories are coming up in the country, farmers and researchers still question the quality of soil analytical results and recommendations. The soil institute aims to research, teach, and provide community outreach for harmonizing and addressing the current unsustainable agricultural practices and low soil productivity issues in Uganda and Africa. About 90% of soils in Uganda are intensively weathered, often derived from Precambrian rocks. As a result, extensive layers of deep fertile topsoil are rare. Moreover, Uganda's current soil chemical and physical data are from different survey campaigns based on various non-standard laboratory tests and analytical procedures, which are often difficult to harmonize from a diagnostic perspective. In addition, the interpretation of soil tests is mostly based on expert opinion or response data from very few locations, so there are major uncertainties over the accuracy of the tests themselves.

1.2.1. Uniqueness and Relevance of the program

The Doctor of Philosophy in Global change and sustainable agriculture (PhD. GLOSA) is a new specialization in Uganda's and the developing world's higher education system. In order to harness the expected potential of an abundant labour force and expedite the formation of critical skills to facilitate faster economic development, special programs to

train in relevant skills in emerging industries and technology have been undertaken by the government. The government of Uganda has invested heavily in its education system with a focus on relevant Science, Technology, Engineering and Innovation (STEI) and Research and Development (R&D) to produce regionally and globally competitive human resources as the main driver of economic growth that leads to prosperity. Busitema University has built a modern world-class STEI education system that provides graduate students with a first-rate education compared to developed and emerging economies. The University was established to provide equitable access to higher STEI anchored education, dissemination of knowledge and advancement of learning and acceleration of the socio-economic transformation of rural communities. Busitema University is guided by a vision of being "*A centre of academic and professional excellence in science, technology and innovation*". Based on its motto, *"Pursuing excellence*," the University alumni are trained to excel and make a positive contribution to society's development. The University's mission is "*To provide high standard training, engage in quality research and outreach for socio-economic transformation and sustainable development*. The University faculty of Agricultural and Animal Sciences is a leading centre of agricultural transformation in Uganda and Africa. The GLOSA graduate is designed to produce agricultural professionals that bridge the gap between unproductive low-input/low-output farming systems and sustainable agricultural systems. The multi-disciplinary graduate training approach is a step away from the traditional single agricultural discipline training approach such as soil science, crop science, animal science or food science. The single discipline trained scientists are only well placed to deal with agricultural extension objectives but lack comprehensive skills in the science-policy-practice interface and therefore are ill-equipped to provide technical leadership and understanding of the factors and processes causing low agricultural productivity, thus using unsustainable agricultural production practices. These professionals cannot design mechanisms that will provide farmers in developing countries with the economic incentives needed to adopt more sustainable land use and management practices in the face of global change challenges facing agricultural development.

Through this program, students gain knowledge and experience in diverse areas and awareness of the necessary holistic approaches to understand and develop sustainable agricultural systems, alleviate poverty, and reach food security, especially in the developing world. Scientific knowledge and skills are provided where the students are able to design market-oriented sustainable agricultural systems that meet the desired demands of end-users under various constraints and environments, which eventually leads to increased productivity and acceptability. This is achieved by incorporating interdisciplinary coursework and a hands-on multi-disciplinary research experience in five major systems: agriculture production, land and water quality and quantity, climate change and human dimension. These systems are investigated on how they operate

internally and interact at multiple spatial-temporal scales to produce food. Students will deploy experiments, participatory research, statistics and mathematical models as the primary investigative tool in our research to bridge natural and social sciences. Mathematical modelling techniques help explore; food security dynamics, interactions between human-induced environmental change, global climate change, climate variability and the socio-economic impacts on agricultural production. As a result, the program prepares a student to meet employers' needs in addition to being job creators.

1.3 TITLE

The title of the program is: "**Doctor of Philosophy in Global Change and Sustainable Agriculture** (**GLOSA**)."

1.4 PROGRAM OBJECTIVES AND OUTCOMES

1.4.1 Overall Aim

The overall objective is to generate a new breed of rigorous and policy-oriented sustainable agricultural scientists with practical, intellectual and leadership capacity that can offer interdisciplinary/ multi-disciplinary solutions to the challenges of low agricultural productivity (including people, plants, animals, soil, water, and other resources), environmental health and poverty in the developing world.

1.4.2. Specific Objectives

The specific objectives of PhD training in Global change and Sustainable Agriculture (GSA) are to:

1. To produce competent scientists with strong theoretical and analytical skills in sustainable agricultural principles and practices
2. To meet stakeholders' demand for well-trained personnel in Sustainable Agriculture
3. To provide students with knowledge and skills to design and manage sustainable agricultural production systems locally and globally.

1.4.3. Program Outcomes

Through successful completion of the taught component and the research component, the students should also have demonstrated the following:

1. Understand, assess and apply sustainable agricultural principles and practices in agricultural research and technological innovations;
2. Comprehend and analyze the complexity of agro-ecosystems, frame problems and ask critical questions in relation to food systems and people's behaviour, the nature of their development challenges and be able to provide solutions;
3. Conduct research and develop technological innovations in global change and sustainable agriculture for increased agricultural productivity and environmental protection;

4. Support community farms towards greater competitiveness and socio-economic sustainability in the agro-ecosystem system and value chain;
5. Use different research methodologies and tools embedding multidisciplinary and interdisciplinary perspectives to design sustainable agricultural systems for increased agricultural productivity and environmental protection.

Typically, holders of the PhD qualification will be able to:

a) Contribute to the original research that broadens the boundary of knowledge.
b) Think critically and take leadership in their chosen area of expertise.
c) Show a systematic comprehension, independence and an in-depth understanding of the discipline.
d) Communicate effectively with peers, scholarly communities and society.
e) Demonstrate ability to use technologies and make appropriate innovations.
f) Undertake pure or applied research and development at an advanced level, contributing substantially to the development of new techniques, ideas, or approaches;
g) Demonstrate qualities and transferable skills necessary for employment requiring the exercise of personal responsibility and largely autonomous initiative in complex and unpredictable situations, in professional or equivalent environments.

1.5. OPPORTUNITIES FOR THE GRADUATES

The Global Change and Sustainable Agriculture graduate program is designed to provide students with rigorously interdisciplinary/ multi-disciplinary sustainable agricultural education emphasizing experiential learning opportunities. Our program builds on a solid foundation of agricultural science while providing courses and professional development opportunities in the biological, chemistry, physics, social, and economic elements of sustainability. In addition to getting an excellent education, our graduates have the necessary skills and knowledge to apply their interests and experience toward agricultural development practices. There are many possible areas in which graduates can find opportunities which include: Researcher/Instructor/Extension Agent/Farm Advisor/ Extension & Outreach Specialist; Sustainable Agriculture Consultant; Agronomist, agricultural production expert; Sustainable Agriculture Research scientist, Environmental Compliance Officer; Agricultural Law and Policy Experts, Conservation Officer; Sustainable Livestock Production/Ranch and/or Rangeland Manager; Sales, Marketing & Outreach officer; Organic/Sustainable Retail & Support Services (organic fertilizers, seeds, equipment); Organic & Sustainable Certification Services; Agricultural Education/Program Coordinator; Sustainability Coordinator; Agricultural Entrepreneur; International Agricultural Development Advisor, Sustainable and Crop Land Management Consultant, Sustainable Development Advisor, Agricultural and Natural Resources Communications,

Food security Analyst/ Advisor, Research Scientists, Disaster Risk Management Expert, Agricultural Loan Officer, Watershed Scientist, Climate Change Adaptation and Mitigation Advisor, Precision Agricultural Specialist, Rural Development Specialist, Agricultural Extension Educator, Food and Agricultural Science Editor, and Natural Resources Conservation Specialist.

1.6. PREPARATORY ACTIVITIES

The following preparatory activities were undertaken:

- Consultation of stakeholders (Academics at Universities: Makerere University, Kyambogo University, Gulu University, Egerton University, Ndejje University, Uganda National Farmers' Association (UNFA), among others.
- Two-day workshop with the stakeholders at Hotel Paradise, Jinja (the minutes of the workshop in appendix)
- The curriculum was taken through (i) Department Board, (ii) Faculty of Agriculture and Animal Science Board; Higher Degrees and Research Committee, and (iii) Board of Graduate Studies, Research and Innovations, a committee of the Senate.

1.7. KEY KNOWLEDGE AREAS/ CONCENTRATIONS

The "**Doctor of Philosophy in Global change and sustainable agriculture (PhD. GLOSA)**" has the following tracks/concentrations:

1.7.1. Fields of Concentrations

Sustainable land management; Organic farming; Conservation farming; Regenerative agriculture; Agroecology; Integrated Pest Management; Biological control; Agroforestry; and Climate-Smart Agriculture.

2.0. CONDUCT OF THE PROGRAM

2.1. Program home

Prospective students for the PhD program will be recommended for admission by the Faculty of Agriculture and Animal Sciences Higher Degrees Committee through the Board of Graduate Studies, Research and Innovations (DGSRI) to the Senate. In the same vein, the management, administration and assessment of the cross-cutting courses will be the responsibility of the DGSRI.

2.2. Program Coordinator

The doctoral program shall have a coordinator based in the department. The coordinator shall be knowledgeable in the area and will be the overall head of the program and report to the Head of Department.

2.3. Appointment of Supervisors

The supervisors' appointment procedure as laid out in the Busitema Graduate Handbook shall apply.

2.4. Program Structure

For the cross-cutting courses, the candidates must obtain 26 credits before proceeding to the research and thesis writing stage. The candidates will be required to publish at least two papers from the piece of research project/study in an international peer-reviewed journal(s) with an impact factor equal to and above one (1) before sending the thesis for assessment by an independent/external examiner.

2.5. Cross-cutting Courses

The cross-cutting courses shall give the students the required skills for problem-solving, empower them for critical thinking, and give them the necessary communication and negotiation capabilities to succeed in their careers.

In order to balance first-class theoretical education with extensive development experience to prepare students for a challenging and diverse career, the program is designed as follows:

In the first year, students have to complete the cross-cutting courses and orient themselves on the research topic with the help of their assigned supervisor. The second year is dedicated to research activities and participation in specialized seminars. The third and fourth year is for the completion of the research and drafting of the final thesis.

Table 1.: Individual Study Plan

Year I	*Year II*	*Year III/IV*
Cross-cutting courses	Thesis Research	Thesis Research and Defense
Thesis Proposal & Defense	Thesis Research	
Graduate Seminar	Graduate Seminar	

The individual study plan will be reviewed every year by the doctoral committee together with the student.

2.6. TARGET GROUP

The Doctor of Philosophy in Global change and sustainable agriculture (PhD. GSA) is aimed at master's graduates in the field of; Soil Science, Crop Science, Animal Science, Horticulture, Food Science, Chemistry, Biology, Physics, Agricultural extension, Agricultural Engineering, Botany, Plant Biotechnology, Forestry, Ecology, Conservation Biology, Natural Resources, Sociology, Geography, Agribusiness, Economics and Social Sciences who wish to expand their knowledge and involve themselves in deep research in the field of sustainable agriculture.

2.6.1. Projected Student Numbers

It is proposed that the program starts with 5 students in the 2022/23 academic year, and the number shall be increased gradually by 10 students per intake over a period of 3 years, as shown in Table 2. The increase in student number will take into account both infrastructures and human and financial resource capacity to handle the program.

Table 2.: Projected student numbers

Activity	2022/23	2023/24	2024/25	2025/26
Student numbers admitted	10	10	10	10
Cumulative student numbers	10	20	30	30

2.7. PROGRAM DURATION

The Doctor of Philosophy in Global change and sustainable agriculture (PhD. GSA) will be a four-year (4) program by research. Foundational cross-cutting courses will be conducted by the Directorate of Graduate Studies, Research and Innovations within the first fifteen weeks of the semester. PhD applicants whose previous experience is inadequate in Global change and sustainable agriculture science may be required to take some selected undergraduate agricultural and MSc. GSA modules where necessary.

Mode of Study	Duration
Full-time	3-4 years

Part-time	5-7years

2.8. DESIGNATION OF THE AWARD

The degree of **Doctor of Philosophy in Global Change and Sustainable Agriculture** shall be awarded to a candidate who fulfils the following minimum requirements:

a) 12 Credit Units of foundational and crosscutting courses
b) 14 Credit Units of research methods and seminar series
c) Written research proposal describing the work to be completed for the thesis. The proposal will be presented orally and defended before the doctoral committee.
d) Oral presentation of research accomplishments, approximately mid-way through the thesis research at the Seminar series.
e) The thesis is defended orally to the doctoral committee, which will also approve the final written document. Completion of the thesis is the culminating experience of the PhD program.
f) A minimum of two (2) international journal manuscripts published in international high impact factor journals plus two national/international conference presentations.

2.9. TUITION FEES

Students will be charged Five Million Uganda Shillings Only (UGX 5,000,000) per semester to attend the program, excluding functional fees.

3.0. PROGRAM REGULATIONS

3.1. Mode of Study

The principal mode of study for the Doctoral programs will be both full time and part-time. The full-time mode is designed to cater to candidates with sufficient time to continue the program without interruption. While part-time targets constituencies who are employed. Each mode of study will be indicated in the admission letter (where appropriate).

3.2. Credit Transfer

Candidates may request for transfer of credits from other universities. The guidelines for credit transfer as approved by the university senate shall apply.

3.3. Admission Requirements

The requirements for admission to the PhD program are:

a) A master's degree in Soil Science, Crop Science, Animal Science, Horticulture, Food Science, Chemistry, Biology, Physics, Agricultural Extension, Agricultural Engineering, Botany, Plant Biotechnology, Forestry, Ecology, Conservation Biology, Natural Resources, Sociology, Geography, Agribusiness, Economics and Social Sciences. **Note: The master's degree should be one of coursework and a thesis**.

b) An applicant whose first language is not English must demonstrate appropriate English language proficiency.

c) A research concept paper shall be submitted as part of the application dossiers.

3.4. ASPECTS OF GENDER AND EQUITY

Uganda is actively promoting gender and equity at all levels because it is a pre-condition for sustainable development. Busitema University has a strong affirmative policy. The current female enrolment at the graduate level at the Faculty of Agriculture and Animal Science is about 30%. The program will specifically target female candidates to increase the percentage to 50%.

3.5. EXAMINATION REGULATIONS

3.5.1. GENERAL REGULATIONS

The general graduate degree regulations of Busitema University, as stipulated in the Graduate Studies Handbook, shall apply.

3.5.2. METHOD OF ASSESSMENT OF TAUGHT COMPONENT

Assessment of cross-cutting courses offered by the DGSRI will be through assignments, classroom and take-home tests, field study trips with trip reports, project work and presentations and a written examination. Course work will carry 50%, and written examination will carry 50%. The overall pass mark is 60%.

3.5.3. GRADING OF COURSES

Each Course shall be graded out of a maximum of 100% marks and assigned an appropriate letter grade as shown below: To record a pass mark in a course unit, a student must achieve a minimum mark of 60%. The student must also have attended at least 75% of all scheduled classes and practicals.

Marks % Point	Letter grade	Grade	Remarks

90-100	A+	5.0	Exceptional
80-89	A	5.0	Excellent
75-79	B+	4.5	Very good
70-74	B	4.0	Good
65-69	C+	3.5	Fairly good
60-64	C	3.0	Pass
55-59	D+	2.5	Marginal fail
50-54	D	2.0	Clear Fail
45-49	E	1.5	Bad fail
40-45	E-	1.0	Qualified fail
Below 40	F	0	Qualified fail

3.5.4. CALCULATION OF CUMULATIVE GRADE POINT AVERAGE (CGPA)

The Cumulative Grade Point Average at a given time shall be calculated based on using the Equation (1) shown below:

$$GPA = \frac{\sum_{i=1}^{n}(PG_i \times CU_i)}{\sum_{i=1}^{n} CU_i} \quad \text{.....(1)}$$

Where $PG_i$is the Grade Point score in Course, i; $CU_i$is the number of Credit Units, of Course, i; and $n$is the number of courses taken in that semester or recess term. CGPA is calculated using a formula similar to the one above, but *n* is the number of courses taken from the beginning of the program up to the time when the CGPA is calculated.

3.5.5. COURSE RETAKING

i. A student shall retake a Course or Courses when next offered again in order to obtain at least the Pass Mark (60%) if he/she had failed during the first assessment in the Course or courses.
ii. A student who has not done course work will not be allowed to sit for final examinations
iii. A student who has failed to obtain at least the Pass Mark (60%) during the Second Assessment in the same Course or Courses retaken shall receive a warning.

iv. A student may retake a Course or Courses when next offered again in order to improve his/her Pass Grade(s) if the Pass Grade(s) got at the first Assessment in the Course or Courses were low. A student who fails to attain higher marks after retaking to improve, the examination results of the first sitting are recorded on the transcript and shall not be recorded as **Retake**.
v. Where a student misses to sit examinations for justified reasons, his/her results shall be recorded as **Retake** when the examination(s) is/are next offered.
vi. Attend all the prescribed lectures/ tutorials/ practical/fieldwork in the Course or Courses;
vii. Satisfy all the requirements for the course-work component in the Course or Courses; and
viii. Sit for the University Examinations in the Course or courses.
ix. A student who accumulates more than four (4) Retake Courses will be requested to stay put.
x. Students are required to register for retake course(s) first before registering for new courses offered in that semester. The retake courses should fit into the approved normal load to avoid timetable clashes.
xi. When a student has retaken a course, the better of the two Grades he/she has obtained in that Course shall be used in the computation of his/her cumulative Grade Average (CGPA).
xii. The Academic Transcript shall indicate so whenever a course or courses has/have been retaken.
xiii. Pay for retakes

3.5.6. ACADEMIC PROGRESS

At the end of every semester and recess term, students' progress shall be classified into Normal Progress, Probationary Progress, and Discontinuation.

3.5.6.1. Normal progress

This occurs when a student has passed (Grade point of 3.0) all the courses that he/she has taken so far since the beginning of the program.

3.5.6.2 Probationary Progress

A student who has obtained the Grade Point (GP) of less than 3.0 shall be placed on probation. Such a student shall be allowed to progress to the next semester/academic year but shall still retake the Course (s) he/she has failed the assessments later on and obtained at least the pass mark (60%) in the Course (s).

3.5.6.3 Discontinuation

When a student accumulates three consecutive probations based on CGPA, he/she shall be discontinued.

i. A student who fails to obtain at least the Pass Mark (60%) during the Third Assessment in the same Course or courses retaken shall be discontinued from his/her studies at the University.
ii. A student who has overstayed on the program by more than six (6) years shall be discontinued from his/her studies at the University.

3.6. THESIS

Thesis assessment is at the heart of doctoral degree standards. All the candidate's achievements and research-relevant attributes are tested in the final doctoral thesis assessment, which includes a thorough review of the submitted written materials (and artefacts if appropriate), normally followed by a viva, or oral examination, at which the candidate defends the thesis. The importance of the single major research project as the principal output of a doctoral degree is demonstrated by the rigour and format of the final assessment process. Approval of the research proposal is the responsibility of the DGSRI.

The proposal shall satisfy the Board of Graduate Studies' Research and Innovations requirements concerning the registration of doctoral research programs, including consideration of the relevant Research Good Practice and Ethics policies.

Research Project registration scrutiny and approval by the Board of Graduate Studies shall normally take place prior to the commencement of the research component, recognizing that the development of the research proposal may typically be undertaken by the candidate in the context of the taught component.

The thesis or other form of assessable output should be of the same quality, rigour and volume required of a normal PhD in a relevant field, normally between 50,000 and 80,000 words. Where a prototype constitutes a component of the assessable submission, these shall be accompanied by a thesis which shall not normally exceed 50% of the volume of a normal PhD thesis in a relevant field. The research component will normally be examined according to the University's regulations and requirements for PhD degrees.

A minimum of two examiners are usually present, one internal and a minimum of one external.

3.6.1. Approval of Research

The research proposal shall be presented for approval to the Board of Graduate Studies no later than the conclusion of the taught component.

3.6.2. Supervision
The Higher Degrees Committee will assign a qualified supervision team with the relevant subject and professional expertise in accordance with the Graduate Student's Handbook.

3.6.3. Submission
The doctoral candidate has to submit a substantial body of original work for assessment. This may vary in length according to the candidate's work

3.6.4. Passing the Thesis
To pass a submitted thesis, the candidate shall satisfy the examiners in both the written report and viva voce.

3.6.5. Revised thesis
A candidate who fails to satisfy examiners shall re-submit a revised dissertation within the time recommended by the examinations board.

3.7. CLASSIFICATION OF THE AWARD
The degree of Doctor of Philosophy in Global Change and Sustainable Agriculture shall be awarded to a student who fulfils all the requirements for the program. The PhD degree shall not be classified.

3.8. QUALITY ASSURANCE
Like the other programs in the Faculty of Agriculture and Animal Science in particular and Busitema University in general, the quality assurance practices shall apply. A student will be required to attend at least 75% of the lectures given in a course and pass all the coursework assignments, tests and laboratory exercises before he/she can sit for a written examination. The performance of each of the lecturers assigned to teach the students shall also be closely monitored to ensure they comply with the curriculum requirements. This will be partly achieved by giving the students assessment forms to assess their teaching staff on the content taught, mode of delivery, self-explanation, appearance for lectures, tutorials and at practical field study trips sessions.

4.0. PROGRAM STRUCTURE

4.1. CROSS-CUTTING COURSES
Table 1: Year 1, Semester 1

The program shall be run on a semester system, and the structure is summarized below:

Candidates are advised to take at least three (4) relevant MSA foundational courses in consultation with the Supervisors and the Department.

Course structure Year 1, Semester I

CODE	COURSE NAME	LH	TH	PH	CH	CU
DME 8101	Philosophy of Knowledge (Epistemology)	30	30	00	45	3
DME 8102	Research Methodology and Seminars	45	00	30	60	4
DME 8103	Institutional Pedagogy	45	00	30	60	4
DME 8104	Scholarly Writing and Publication Skills	45	00	30	60	4
MSA 7105	Sustainable Agriculture	30	10	30	45	3
MSA 7106	Computer Applied Statistics and Biometrics With R And Rmarkdown	30	10	30	45	3
MSA 7206	Ecological Organic agriculture	30	10	30	45	3
MSA 8102	Climate Smart Agriculture and green growth	30	10	30	45	3
PSA 8201	Thesis					60
	Total					**86**

5.0 DETAILED COURSE DESCRIPTION

5.1 **Course Name: PHILOSOPHY OF KNOWLEDGE (EPISTEMOLOGY)**
Course Code: DME 8101
Contact Hours:45
Credit Units: 3

Brief Description

This course unit is expected to equip the candidates with the knowledge of philosophy and appreciate its role in generating knowledge. They are also expected to appreciate man's motivation in philosophy and appreciate the three modes of philosophy, i.e. speculative, prescriptive and analytic. In the layman's sense, philosophy as distinct from the technical conception will also be examined. Modern epistemology generally involves a debate between rationalism and empiricism, or the question of whether knowledge can be acquired *a priori* or *a posteriori*: Axiology and Education, Selected Schools of thought on education

Course objectives

This course aims at helping the students to:

1. Explain the various branches of Philosophy, i.e. metaphysics, epistemology and axiology and their bearings on the theory and practice of education.

2. Discuss how different views on the major branches of philosophy led to the formulation of world views, or philosophical schools of thought, with their attendant positions on the role of the teacher, pupil, school, curriculum and teaching methodology in education.
3. Articulate the educational ideas and thoughts of grandmaster philosophers representing different ages and times, from the classical periods of the Greeks and Romans to John Dewey; and their contributions to current educational practices.
4. Demonstrate skills, techniques, and tools of philosophical analysis and apply the same in treating educational concepts in daily use in the world of education and discussing issues and problems germane to education.
5. Contribute meaningfully to the nations' education policy-making and make a critical analysis of the National Policy on Education.
6. Articulate historical perspective on knowledge science and research to stimulate them to relate their own research to this perspective.
7. Competently give an opinion about the concepts of knowledge, science and research.
8. Analyze concepts of causation, correlation, scientific explanation, and scientific law.

Expected Learning Outcomes

At the end of this course, students should be able to:

1. Apply the hypothetical-deductive-inductive process in knowledge creation.
2. Identify the main reference points of contemporary Epistemology.
3. Distinguish between the characteristics of social sciences in the context of general science.
4. Appreciate knowledge and theory-building process in learning
5. Critically analyze claims, reasons, assumptions, and evidence in the rhetorical process.
6. Assess conventional and non-conventional knowledge production processes.
7. Formulate new theoretical lines of inquiry in research.
8. Write and present a paper based on an in-depth exploration of the literature on an aspect of the Course.

Mode of Delivery

The course will use lectures, course workshops and presentations, seminars, tutorials, and assignments as delivery techniques.

Mode of assessment

All students are expected to attend not less than 90% of the lecture hours, participate actively in class, course work will include one written assignment and a test, that is:

Coursework mark	40%
Examination	60%
Total	**100%**

The written assignments and the test will be marked out of 20 each and will finally contribute 40% to the final mark. Late assignments will be penalized, with 1 mark subtracted for each day beyond the deadline.

Detailed Course content

s/n	Topic/Sub-Topic	Contacts Hours
1	Is knowledge justified true belief? **The Human Creative Process in History;** The conditions of creativity; The birth and death of ideas; The process of creative thinking; conformity and creative thinking; The human journey in history: From the Emergence of *homo sapiens,* THROUGH the Development of social organization, culture, religion, To the Global Society.	**4**
2	Causal and Reliabilistic Theories of Knowledge. Satisfying basic needs, like food, shelter, clothing and the discoveries of fire, metal, wheels, the taming of animals, agriculture. Following the urge to search, explore, migrate, travel, and the inventions related to land, sea, and air transport (vehicles, roads, maps, logistics). Mapping (places and times) of specific inventions: The history of technology and science and its philosophy. The present technological age.	**3**
3	Epistemology: The nature of scientific activity. The research process. Inductive generalization. Scientific theories and causal hypotheses. Creativity in science: abduction. The border between science and non-science. Rhetorical aspects of scientific text. The analysis of arguments. Textual construction and methodological practice. Model building. Scientific proof. Epistemology of social sciences. Value judgment in the social sciences. Method. Individualism and social tendencies. Facts and interpretations. Objectivity. Special sciences. The inner wars of science.	**3**
4	Counterfactual Theories. Can knowledge be analyzed in terms of Nozick's notion of truth tracking? **Sources of Knowledge:** Skepticism and certainty; The empiricist tenets; The rationalist tenets; Naturalism (preconceptions for categorization). **Theories of Truth,** The correspondence theory; The coherence theory; The coherence theory; The pragmatic theory; The meta-linguistic theory; The redundancy theory.	**4**
5	Scepticism: Do you know that you have hands? Do you know that you are not a brain in a vat? Do sceptical arguments make unreasonable demands on knowledge? Valid Knowledge: Its Source and Purpose A. Nature and Method of Knowledge. Defining characteristics of knowledge; Knowing 'how' and knowing 'that'; Knowledge, opinion, and belief; Knowledge, data, and information; Common features of knowledge; Scientific discovery and artistic creation.	**4**
6	Epistemic Contextualism Q: Is the predicate 'know' context-sensitive? Can contextualism resolve sceptical puzzles? **Purpose of Knowledge:** The empirical-analytical disciplines linked to technical control; The historical hermeneutic disciplines linked to social interaction; Critical theory linked to emancipation	**4**
7	Subject-Sensitive Invariantism. Do one's practical interests influence what one knows? **Causation, Explanation, Laws.** Explanation and Prediction; The Nature of Laws; Observation, Observational sentences, Data**. Theory and Praxis. Theory and**	**4**

	Praxis.	
8	Coherentism and Foundationalism. Must knowledge have infallible foundations? Must it have any sort of foundation?	**3**
9	Evidence as Knowledge Q: Does E=K? What could one's evidence be if not one's knowledge? Pre-theoretical approaches: science and politics in the ancient civilizations of Babylon, Egypt, and Greece; The Babylonia record of observed facts; Greek development of theory and hypothesis: Theory and Technai, theory and phronesis in politics; The positivistic conception of theory and praxis in the modern period	**3**
10	Reliabilism, Internalism and Proper Basing Q: What does it mean for a belief to be based on a reason? Is the basing relation epistemologically significant? **Historical Analysis of Epistemology. Ancient and Modern** The maieutic method of Socrates (469-399 B.C.); The dialogical method of Plato (427-347 B.C.; The inductive and deductive (logic) method of Aristotle (384-322 B.C.) **Contemporary.** Hermeneutics (Hans-Georg Gadamer, 1900)	**3**
11	Must we justify our inductive practices? If so, why? And how can we? **Present Situation of Epistemology. Karl Raimund Popper's Method of falsifiability.** The Logic of Scientific Discovery.**i**) Structure of a theory (ii) Cognitive growth and theory change iii) Paul K. Feyerabend's anarchistic theory of knowledge. Larry Laudan's methodology of research traditions. Frankfurt School and critical theory. **Applied Methodology. Methods in Science.** Typical examples from the sciences like medicine, physics, technology, Influence of the social sciences (Hobbes, Comte).	**3**
12	A priori knowledge Q: Is there any a priori knowledge? If so, are all and only analytic propositions knowable a priori? How do you know that 1+1=2?	**3**
13	The relationship between talk, thought and action; theory and practice; and research and action. Theory building in Mgmt. Logical deduction. Inductive reasoning. Conventional and critical knowledge. Metaphors and metaphorical understanding. Evidence-based Mgmt.	**4**
	Total weighted hours	**45**

Reading List

Gettier, E. L. (2000). 'Is Justified True Belief Knowledge?', Analysis 23 (1963), 121-123. Reprinted in Bernecker & Dretske: 13-15.

Feldman, F. (2000). An Alleged Defect in Gettier Counter-Examples, *Australasian Journal of Philosophy 52 (1974), 68-69.*

Feldman, R. and Conee, E., (2000). Evidentialism, *Philosophical Studies* 48(1985):15-34.

Williamson, T., Knowledge and Its Limits, Oxford: OUP, ch. 9 – 'Evidence

Goldman, A., (1979). *What is Justified Belief?,* in: Pappas, G. (ed), Justification and Knowledge, Dordrecht: Reidel,

Korcz, K.A., (1977). Recent Work on the Basing Relation, *The American Philosophical Quarterly* 34(2) (1997): 171-191.

Hume, D. (1748), A Treatise of Human Nature, Book 1, Part III, esp. pp11-14.
Russell, B., (2000). *The Problems of Philosophy (OUP, 1959),* ch. 6, pp. 60-69. Reprinted in Bernecker and Dretske.
Reichenbach, H., (2000). *The Pragmatic Justification of Induction*, reprinted in Bernecker and Dretske. Goodman, N., Fact, Fiction and Forecast (Harvard UP, 1954), pp. 72-83. Reprinted in Bernecker and Dretske 2000.
Kripke, S. (1980). *Naming and Necessity,* Oxford: Blackwell, , pp. 34-39, 48-50, 53-58, 99-105, 108-109 and reproduced as 'A Priori Knowledge, Necessity, and Contingency' in Bernecker and Dretske 2000.
Kitcher, P., 'A (2000). Priori Knowledge, *The Philosophical Review 89(1980):* 3-23.

5.2 Course Name: RESEARCH METHODOLOGY AND SEMINARS
Course Code: DME 8102
Contact Hours: 60
Credit Units: 4

Course Description
This course introduces students to advanced research methods for PhD. The Course looks at the qualitative and quantitative research methodologies. Through the qualitative research methodologies, students are introduced to the skills of problem identification, importance of literature review, the various research designs, sampling techniques and interview methods. Through the quantitative research methodologies, students are introduced to statistical analysis of education data.

Course Objectives
This Course aims at helping the students to:

a) Identify the nature, structure and scope of research problems in Education Leadership and Indigenous Studies environments.
b) Explain the importance of literature review in theory building, conceptual framework building as well as instrument development.
c) Explore how quantitative research methodologies and statistical tools are used in Education Leadership and indigenous Studies.
d) Explain how qualitative research principles are used in Education Research studies.

Expected Learning Outcomes
At the end of this course, students should be able to:
a) Demonstrate knowledge of qualitative research methodologies in Education Leadership and Indigenous Studies.
b) Demonstrate skills of problem identification, developing a conceptual framework and critiquing literature in Education Leadership and Indigenous Studies.
c) Apply qualitative data analysis methods in conducting research in Education Leadership and Indigenous Studies.
d) Apply statistical tools in analyzing research in Education Leadership and Indigenous Studies.

Mode of Delivery

The mode of delivery shall be seminar series, conference presentations and workshops, discussion method, writing reflection papers and critical review of assigned readings, small group projects.

Mode of Assessment

The mode of assessment of this Course shall be coursework, field reports and final examinations. For the Course Work, there shall be at least one-course test or assignment, accounting for 40% of the final score. For the field reports, upon successful field visit(s), students shall write a field report which shall either contribute to course work or substitute course work. The final examination shall constitute 60% of the final mark.

Proposed Paper Outline

No.	COURSE CONTENT	CH
1.	**Introduction to Qualitative Research Methods** 1.1 Defining education research and sources of knowledge in education research. 1.2 Purpose and types of education research 1.3 The Research Process; Steps in problem identification and identifying variables in Education Research. 1.4 Nature of Indigenous and Social Justice Research Methodology 1.5 Developing a conceptual framework, Characteristics of Research Objectives.	4
2.	**Literature Review** 2.1 Defining a Literature Review. 2.2 The Significance, Types and sources of literature review. 2.3 Advantages and disadvantages of literature review. 2.4 The significance of an Outline in Academic Writing. 2.5 Using the Internet and Library for literature search	4
3.	**Research Philosophies, Approaches and Designs** 3.1 Neo-positivism Vs Positivistic Methods. 3.2 Qualitative, Quantitative & Mixed Methods Approaches. 3.3 Advantages and Disadvantages of Qualitative and Quantitative research approaches. 3.4 Types of Qualitative Research designs (Historical Analysis Designs, Grounded Theory as a Design; Indigenous Research; Phenomenological Designs, Narrative Designs, Ethnographic Designs, Critical Discourse Analysis, Interpretative Paradigm, Philosophical Research Design); Narrative Designs. 3.5 Types of Quantitative Research Designs (Descriptive, Survey Designs, Correlation, Experimental Designs).	6
4.	**Sampling and Data gathering in Research** 4.1 Meaning of Sampling; Sample and Study Population.	5

	4.2 Proportionate & Disproportionate sampling methods. 4.3 Data Collection Methods. 4.4 Quality Control Measures (Validity and Reliability)	
6.	**Qualitative Data Analysis and Interpretation** 6.1 Coding and Grounded Theory (Glaser, Strauss and Charmaz). 6.2 Content Analysis and Thematic Analysis. 6.3 Critical Discourse Analysis, Clustering Ideas, In-vivo codes. 6.4 Importance of a theoretical framework in qualitative data analysis; 6.5 Theory building in qualitative data; Logical inference; Discussing findings.	5
7.	**Data Analysis: Descriptive Statistics (Univariate Analysis)** 7.1 Define Univariate Analysis. 7.2 Why perform Univariate Analysis. 7.3 Distributions of Numerical Variables. 7.4 Listing, Summarizing and Sorting observations (Histograms, Line graphs; Stem and Leaf Plots). 7.5 Distributions of Categorical Variables (Pie Charts, Bar graphs, Frequencies Distribution and Percentages).	6
8.	**Measures of Centrality and Variability** 8.1 Mean, Mode and Median. 8.2 Measures of variability (Standard Deviation, Variance, and Range). 8.3 Importance of measures of centrality and variability.	4
9.	**Relationships (Bivariate Analysis)** 9.1 Define Bivariate Analysis, Significance Tests and importance. 9.2 Bivariate Relationships between Two Categorical Variables (Cross Tabulations, Bar Charts). 9.3 Bivariate Relationships between two Numerical Variables (Correlations, Scatter Plot). 9.4 Pearson Correlation Coefficient, Spearman's Correlation Coefficient. 9.5 One-Way Analysis of Variance, Graphing results of an ANOVA 9.6 Post-hoc Tests. 9.6 Assumptions of ANOVA (Independence Assumption, Normality Assumption). 9.7 T-Tests (Independent T-test, Paired Samples T-test).	6
10.	**Multivariate with Linear Regression** 10.1 Define Multivariate Analysis. 10.2 What is linear Regression. 10.3 Advantages of Multivariate Analysis. 10.4 Bivariate linear regression; interpreting linear regression Coefficients. 10.5 R-Square Statistic; Using linear Regression to make predictions. 10.6 Graphing Bivariate Regression lines; Multiple linear regression.	7
11.	**Multivariate with Logistic Regression** 11.1 Define logistic regression 11.2 Advantages of logistic regression.	7

	11.3 Relationships through Probabilities. 11.4 Interpreting Odds Ratios & Logistic Regression lines. 11.5 Model Chi-Squares and Goodness of Fit. 11.6 Multivariate logistic regression and predictions.	
12.	**Factor Analysis** 12.1 Define Factor Analysis & Importance of Factor Analysis. 12.2 Confirmatory Factor Analysis. 12.3 Eigen Values; Scree Plot; Component Matrix. 12.4 KMO and Bartlett's Test. 12.5 Relevance of Factor Analysis in Educational Research. 12.5 Using Factor Analysis to validate instruments.	6
Total Contact Hours		**60**

Key: SH=Seminar Hour; WH=Workshop Hour; PH=Practical Hour; NH=Nominal Hour

Study Materials

- Textbooks
- Power-point slides
- Charts
- Manila Paper
- Chalk and Talk
- Videos
- Pictures

Recommended Readings

American Psychological Association (2019). Publication manual of the American Psychological Association (7th ed.). Washington, DC: Author.

Charmaz, K. (2006). Constructing grounded theory: A practical guide through qualitative analysis, Los Angeles, LA: SAGE publishers.

Creswell, J. W. (2003). Research designs: qualitative, quantitative and mixed approach (2nd ed.). London, Thousand Oaks: Sage publishers.

Creswell, J. W. (2014). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Sage publications, LA.

Creswell, J.W. (2007). Qualitative inquiry and research design: Choosing among five approaches (2nd ed.). California, CA: Sage Publications, Inc. Creswell, J.W. (2009). Research design: Quantitative, qualitative and mixed methods (3rd ed.). Singapore: Sage publications, Inc.

Duchscher, J.E.B. & Morgan, D. (2004). Grounded theory: Reflections on emergence versus forcing debate. Journal of Advanced Nursing, vol. 48(6), 605 – 612. Duncan, C., Cloutier, J. D., & Bailey, P. H. (2007). Concept analysis: the Importance of differentiating the ontological focus. Journal of Advanced Nursing, 58, 293-300.

Heiman, G. W. (2001). *Understanding research methods and statistics: An integrated introduction for psychology* (2nd ed.). Boston: Houghton Mifflin.

Howard, B. (1984). Writing for the Social Sciences. Chicago, IL. University of Chicago.

Howell, D. C. (1989). *Fundamental statistics for the behavioral sciences* (2nd ed.). Boston: PWS-KENT.

Pelham, B. & Blanton, H. (2002). *Conducting research in psychology: Measuring the weight of smoke*. Second Edition. Pacific Grove, CA: Brooks/Cole Publishing Company.

Sarantakos, S. (1993). *Social Research*. London: The Macmillan Press

Stanovich, K. (2003). *How to think straight about psychology*. Seventh Edition. Allyn & Bacon Publishers.
Toothaker, L. E., & Miller, L. (1996). *Introductory statistics for the behavioral sciences* (2nd ed.). Pacific Grove, CA: Brooks/Cole.
Utts, J.M., & Heckard, R.F. (2004). *Mind on statistics* (2nd ed.), Nelson: Brooks/Cole.

5.3 Course Name: INSTITUTIONAL PEDAGOGY
Course Code: DME 8103
Contact Hours: 60
Credit Units:4

Course Description
This course introduces students to the science and methodology of teaching and management of higher education institutions. Since most PhD students end up taking a career in teaching and research in higher education, it is important to give them the knowledge of institutional pedagogy. This course focuses on how to design a curriculum or program of study, how to implement the curriculum, and how to review and evaluate the curriculum. The course also explores the methods of effective teaching or classroom delivery at higher education institutions.

Course Objectives
This course aims at helping the students to:

a) Be introduced to the process of curriculum design, management and development.
b) Be equipped with the skills of effective teaching and learning at higher education institutions.
c) Explain how to implement, evaluate and review a curriculum.
d) Be introduced to the 21st Century Skills of teaching in higher education institutions.

Expected Learning Outcomes
At the end of this course, students should be able to:
a) Demonstrate knowledge of curriculum design, implementation, evaluation and review.
b) Demonstrate skills in curriculum and program design and review.
c) Demonstrate skills of effective teaching and learning at higher education institutions.
d) Apply the 21st Century teaching and learning skills in higher education.

Mode of Delivery
The mode of delivery shall be lecturing, seminar series, conference presentations and workshops, discussion method, writing reflection papers and critical review of assigned readings, small group projects.

Mode of Assessment

The mode of assessment of this Course shall be coursework, field reports and final examinations. There shall be at least one course test or assignment for the Course Work, accounting for 40% of the final score. For the field reports, upon successful field visit(s), students shall write a field report which shall either contribute to course work or substitute course work. The final examination shall constitute 60% of the final mark.

Detailed Course Outline

SN	Content	CH
1.	**Introduction to Institutional Pedagogy** 1.1 What is Pedagogy? 1.2 What is Institutional Pedagogy? 1.3 Importance of Pedagogy? 1.4 Pedagogy of Higher Education Institutions 1.5 Pedagogical Challenges of Higher Education	10
2.	**Philosophy, Society and Pedagogy** 2.1 Linking Philosophy and the Pedagogy 2.2 Philosophical Dimensions in Pedagogy 2.3 Learning Theory and Pedagogy 2.4 Objectives of the Pedagogy 2.5 Theoretical Curriculum and the 21st Century Pedagogy	10
3.	**Learning Theory** 3.1 Cognitivism 3.2 Contructivism 3.3 Behavioralism 3.4 Andragogy 3.5 Relevance of Learning Theory to Pedagogical Development	10
4.	**The 21st Century Teaching and Learning Skills** 4.1 Problem-Solving 4.2 Communication 4.3 Innovation and Creativity 4.4 ICT skills 4.5 Analytical Skills 4.6 Critical Skills	10
5.	**The Program Design and Development Process** 4.1 Institutional and Societal Philosophy 4.2 Program Rationale 4.3 Program Description 4.4 Program Regulations 4.5 Resources 4.6 Program Outline	10
6.	**Vroom's Taxonomy of Educational Objectives** 6.1 Comprehension	10

	6.2 Knowledge 6.3 Analysis 6.4 Synthesis 6.5 Evaluation	
	Total Contact Hours	**60**

Key SH=Seminar Hour; WH=Workshop Hour; PH=Practical Hour; NH=Nominal Hour

Study Materials

- Power point presentation
- Textbooks
- CDs
- Video

Recommended Readings

Angeli Ch. & Valanides, N. (2004). The Effect of Electronic Scaffolding for Technology Integration on Perceived Task Effort and Confidence of Primary Student Teachers. *Journal of Research on Technology in Education*, 37, 29-43.

Bailey, K. M. (1990). The Use of Diary Studies in Teacher Education Programs. In J. C. Richards and D. Nunan (eds.)., *Second Language Teaching Education*, pp.215-240. CUP.

Bartlett L. (1990). Teacher Development through Reflective Teaching. In J. C. Richards and D. Nunan (eds.)., *Second Language Teaching Education*, pp. 202-214. CUP.

Bereiter, C. & Scardamalia, M. (1993). *Surpassing Ourselves: An Inquiry into the Nature and Implications of Expertise*. Chicago: Open Court.

Berk, L. (2002). *Child Development*. 5th Ed. Boston: Allyn and Bacon Bodrova, E. & Leong, D. (1996). *The Vygotskian Approach to Early Childhood*. Columbus, Ohio: Merrill, an Imprint of Prentice Hall.

Berliner, D. C. (2002). Learning about and Learning from Expert Teachers. *International Journal of Educational Research*, Vol. 35, pp. 463-482.

Murtaza Gondal, Sumera Mushtaq, Amir Shahzad, Zareen Zaidi, Shaheen Moin, Ahsan Mukhtar Gillani (2011). Introducing Communication Skills Teaching into the Curriculum. *Journal of Rawalpindi Medical College (JRMC), Vol. 15(1):42-44*

Yun Ho Shinn (1997). Teaching strategies, their use and effectiveness as perceived by teachers of agriculture: A national study. Iowa State University.

Blanton, M. L., Westbrook, S. and Carter G. (2005). Using Valsiner's Zone Theory to Interpret Teaching Practices in Mathematics and Science Classrooms. *Journal of Mathematics Teacher Education,* 8, pp. 5-33.

Beer, C. G. (1980). Perspectives on animal behavior comparisons. In M. H. Bornstein (Ed.), Comparative methods in psychology (pp. 17-64). Hillsdale, NJ: Erlbaum. Bitterman, M. E. (1975). The comparative analysis of learning: Are the laws of learning the same in all animals? Science (Washington, D.C.). 188, 699-709.

Bilbao, P. P., Lucido, P. I., Iringan, T. C., and R. B. Javier (2008). Curriculum development. Philippines: Lorimar Publishing, Inc.

5.4 Course Name: SCHOLARLY WRITING AND PUBLICATION SKILLS
Course Code: DME 8104
Contact Hours:60
Credit Units:4

Course description

The course introduces students to the writing philosophy and publishing processes required in postgraduate education. This is a cross-cutting course which provides skills and methodologies on how to communicate effectively as a scholar. As students prepare to write their dissertations and publish their works in scholarly journals, it is necessary to give them some tips on how to write effectively, avoid plagiarism, critical inquiry and the methods of publishing in scholarly journals.

Course Objectives

This course aims at helping the students to:

a) Explain the meaning of critical thought and critical thinking in academic writing.
b) Explore the methods used to avoid plagiarism in scholarly writing.
c) Identify the steps in critical thinking and self-criticism in scholarly writing.
d) Explain the tools of academic writing such as grammar, style, writing a mind-map and organization of ideas.
e) Explain the different referencing styles used in academic writing.
f) Determine the process used in publishing an academic output in a scholarly journal.

Expected Learning Outcomes

At the end of this Course, students should be able to:

a) Demonstrate knowledge of the steps in critical thinking and critical inquiry in scholarly writing.
b) Demonstrate knowledge of different referencing styles used in academic writing.
c) Demonstrate the skills of self-criticism and self-appraisal in scholarly writing.
d) Apply the skills of avoiding plagiarism, self-criticism and critical thinking to academic writing.

Mode of Delivery

The mode of delivery shall be lecturing, seminar series, conference presentations and workshops, discussion method, writing reflection papers and critical review of assigned readings, small group projects.

Mode of Assessment

The mode of assessment of this Course shall be coursework, field reports and final examinations. For the Course Work, there shall be at least one course test or assignment, accounting for 40% of the final score. For the field reports, upon successful field visit(s), students shall write a field report which shall either contribute to course work or substitute course work. The final examination shall constitute 60% of the final mark.

Detailed Course Outline

SN	Content	CH
1	**Critical Thought and Critical Thinking**	9

	1.1 What is Critical Thought? 1.2 What is Critical Thinking? 1.3 Distinguish between critical thought and critical thinking 1.4 Creative Thinking & Intellectual Thinking 1.5 Intellectual Curiosity and Self-discipline 1.6 The eight steps in Critical Thinking	
2	**Self-Criticism and Self Appraisal in Scholarly writing** 2.1 What is Self-Criticism and Self-Appraisal in Scholarly writing? 2.2 Clarity and Accuracy 2.3 Precision and Relevance 2.4 Depth and Breadth 2.5 Logic, Significance and Fairness	9
3	**Academic Writing** 3.1 Elements to academic writing: Organization of Ideas, Organization of Prose, and Self-Analysis. 3.2 Types of Assignments: Information-based, Thesis/opinion-based, Methods-based, Literature Review-based 3.3 Interrogate your topic and know your instructions 3.4 The Audience in academic writing 3.5 Clustering, mind-mapping and outline	10
4	**Organizing you Prose (The Writing Process)** 4.1 The Thesis Statement 4.2 Paragraph Structure 4.3 Parts of an Essay 4.4 Information-Based Essays 4.5 Thesis-based Essays 4.6 Research/methods-based Essays	12
5	**Self-Analysis in Writing** 5.1 Writing Style 5.2 Clarity & Precision 5.3 Tightness & Objectivity 5.4 Contractions in Writing 5.5 Use of Numbers and Universal Language 5.6 Passive Voice, Grammar & Fragments 5.7 Long sentences and Ambiguity 5.8 Contradictory Clues and Dangling constructions 5.9 Jargons, verbosity, Repetition and Sexist Language 5.10 Use of informal English 5.11 Use of logical connecting words	10
6	**Plagiarism and Referencing** 6.1 What is Plagiarism? 6.2 Strategies to avoid plagiarism: Quoting, Paraphrasing & Summarizing 6.3 Referencing Styles	10
7	**Publishing Process**	10

	7.1 Academic publishing 7.2 Publishing Houses 7.3 Roles of Editors and Script Reviewers 7.4 Journal and Book Publishing 7.5 How to avoid Predator Journals 7.6 Publishing in High Impact Journals 7.7 Publishing Politics 7.8 Publishing Ethics	
	Total Contact Hours	**60**

Key SH=Seminar Hour; WH=Workshop Hour; PH=Practical Hour; NH=Nominal Hour

Study Materials

- Textbooks
- Laptop
- Power-point slides
- Flip Charts
- Manila Paper
- Chalk and Talk
- Videos
- Pictures

Recommended Readings

Kirszner, G. Laurie & Mandell, R. Stephen (2004). Patterns for College Writing. (9th Ed.). New York, NY: R.R. Donnelley & Sons Company.

Nakanyike, B. Musisi & Edgar Taylor III (2010). What is Academic Writing? Kampala: Fountain Publishers.

Nakanyike, B. Musisi & Edgar Taylor III (2010). What is Critical Thinking? Kampala: Fountain Publishers.

Nakanyike, B. Musisi & Edgar Taylor III (2010). What is Plagiarism? Kampala: Fountain Publishers.

Petre, Marian & Rugg, Gordon (2010). The Un-written Rules of PhD Research (2nd Ed.). New York, NY: McGraw-Hill.

5.8 FOUNDATIONAL COURSES

5.8.1 COURSE NAME: SUSTAINABLE AGRICULTURE

COURSE CODE: MSA 7105
CREDIT UNITS: 3

COURSE OVERVIEW

In view of global change spanning from population growth, migration, and urbanization to climate change, land degradation and water scarcity, the sustainable use of human and natural resources for the continued provision of quantitatively and qualitatively adequate food poses a major challenge to all stakeholders involved in agricultural production worldwide. This course therefore addresses the basic concepts and principles of sustainability and sustainable agriculture, in its ecological, economic and social dimensions. Approaches to determine the bio-physical and socio-economic sustainability of a land use systems and of agricultural value chains are evaluated, and possibilities to implement sustainable management strategies along

the continuum of water, soils, plants, animals, producers and consumers are discussed, thereby also accounting for relevant temporal and spatial scales.

COURSE OBJECTIVES

- To explain the concepts of sustainable Agriculture
- To explain the causes of unsustainable Agricultural practices

LEARNING OUTCOMES:
At the end of this course the students should be able to: -

- Understand the concepts of sustainable Agriculture
- Understand the causes of unsustainable Agricultural practices
- Identify practice and adopt different sustainable agricultural practices
- Construct and use appropriate technologies for sustainable agriculture
- To start and manage an organic farm

DELIVERY MODE AND TIME ALLOCATED
This course has 3 Credit Units: 45 Contact Hours (CH) per semester; 30 lecture hours (2 contact hours per week for 15 study weeks) and 30 tutorial hours (1 contact hour per week for 15 study weeks).

S/N	Topic	Content	CH
1	Definition and principles	Introduction to Sustainable Agriculture; principles sustainable agriculture;	2
2	The three "E's" of sustainability	Common themes of sustainable agriculture; The three "E's" of sustainability (a. Economic viability, b. Environmental health, c. Equity (social)).	2
3	conventional and non-conventional agricultural production	Differences between conventional and non-conventional agricultural production Advantages and disadvantages of sustainable agriculture	2
4	History of Sustainable Agriculture:	Worldwide, Regionally; Advent and crises of modern agriculture;	4
5	Sustainable ways of agricultural production	Sustainable ways of agricultural production like; Organic farming, Integrated Pest Management, Biological control,	4
6	Sustainable ways of agricultural production...	Agroforestry, Conservation farming, Regenerative agriculture	4
7	Sustainable ways of agricultural production...	Agroecology,	4
8	Sustainable ways of agricultural production...	Sustainable land management, Climate Smart Agriculture.	4
9	Impacts of conventional agriculture on the environment	Non sustainable ways of Agricultural production and causes for this	2

10	Approaches and supporting initiatives to sustainable agriculture	Sustainable management strategies along the continuum of water, soils, plants, animals, producers and consumers value chain. Crop-livestock integration	4
11	Indicators of Sustainable Agriculture	Yields, Economics, Ecological Processes, and Social Issues	3
12	Reasons Why We Should Support the Revitalisation of Small Farms in the Global South	Reasons Why We Should Support the Revitalisation of Small Farms in the Global South; The SDG 2: Promoting Food security, Nutrition and Sustainable Agriculture;	2
13	Barriers to developing agriculture sustainability	The development challenge of transforming agriculture;	4
14	The potential of sustainable agriculture for climate change adaptation	sustainable agriculture for climate change adaptation Bio-physical and socio-economic sustainability of a land use systems and of agricultural value chains	11
	Total		**45**

MODE OF ASSESSMENT

Continuous Assessments: This evaluates the continuous performance of students before sitting the final examination. It is done in form of tests, assignments and tutorials. It constitutes 40% of the final student's score.

University Examination: This covers 60% of the final score. It includes a written examination (essays, structured, multiple-choice questions or a presentation of research paper).

REFERENCES

- Mkomwa, Saidi, and Amir H. Kassam, eds. *Conservation Agriculture in Africa: Climate Smart Agricultural Development*. CABI, 2022
- Powers, Laura E. and McSorely, Robert, Ecological Principles in Agriculture. Delmar, 2000. Gliessman, Stephen R., Agroecology: Ecological Processes in Sustainable Agriculture. Sleeping. Bear Press, 1998.
- Hemenway, Toby, Gaia's Garden: A guide to Home-scale Permaculture. Chelsea Green Publishing co., 2000.
- Edwards, C.A. et al. (ed.) 1990. Sustainable agricultural systems. Soil and Water Conservation Society. Akeny, IA.
- Gliessman, S.R. 2001. Agroecosystem sustainability: Developing practical strategies. CRC Press, Boca Raton, FL
- Powers, L.E., and R. McSorley. 2000. Ecological principles of agriculture. Delmar. Albany, NY.
- Bell, S. & Morse, S., 2008. Sustainability indicators: measuring the immeasurable? Earthscan, London, UK.
- Beets, W.C. 1990. Raising and sustaining productivity of smallholder farming systems in the tropics: A handbook of sustainable agricultural development. AgBbe Pub., Alkmaar, Holland.
- Buresh, R.J., P.A. Sanchez, and F. Calhoun. (ed.) 1997. Replenishing soil fertility in Africa. SSSA Spec. Publ. No. 51. SSSA and ASA, Madison, WI.
- Conway, G. 1998. The doubly green revolution: Food for all in the Twenty-First Century. Comstock Publishing, Cornell Univ. Press. Ithaca, NY.

- Scheewe, W. Nurturing the soil - feeding the people. Rex Publishing,Philippine
- Buffett, Howard. 2013. 40 Chances: Finding Hope in a Hungry World. Simon and Schuster, 1st ed. ISBN 13:978-1451687866
- Sumberg, J. et al. (2013) Why agronomy in the developing world has become contentious. Agriculture and Human Values, 30(1):71-83 http://bit.ly/2k7qdii
- AGAR, J C. -- TEWARI, V P. Agroforestry: anecdotal to modern science. Springer Nature: Singapore, 2017. ISBN 978-9811076497.
- HEMENWAY, T. The permaculture city: regenerative design for urban, suburban, and town resilience. White River Junction, Vermont: Chelsea Green Publishing, 2015. ISBN9781603585262.
- RAMAN, S. Agricultural sustainability: principles, processes and prospects. New York: FOOD PRODUCTS, 2006. ISBN 1-56022-310-3.
- SHEPARD, M. Restoration agriculture: real-world permaculture for farmers. Austin: Acres, 2013. ISBN 978-1-60173-035-0.

5.8.2 COURSE NAME: COMPUTER APPLIED STATISTICS AND BIOMETRICS WITH R AND RMARKDOWN
COURSE CODE: MSA 7106

CREDIT UNITS: 3

COURSE OVERVIEW

The aim of this course is to provide an introduction to R, a computer language and environment for statistics and graphics. The course will cover statistical tools and experimental designs, computer statistical packages. Emphasis is on a practical approach to the proper conduct of agricultural field and laboratory experiments in crop, soil, and animal sciences. Procedures and techniques of data analysis, interpretation, and presentation will be discussed.

COURSE OBJECTIVES

- To get familiar with the R environment by means of RStudio,
- To use R for manipulation and exploration of data and to perform all statistical analyses learned in the basic and advanced statistic courses,

LEARNING OUTCOMES

After successful completion of this course students are expected to be able to:

- read data into R from various sources;
- carry out statistical analyses as learned in previous statistical courses, with the help of the R language and environment for statistical computing and when necessary extend its basic functionality with specific packages;
- adapt and combine standard functions from basic R and packages to solve a given problem;
- adequately use standard programming constructs: loops, if-then-else statements, repetition, selection, functions, etc., to write basic program scripts to fully automate the statistical

analyses;

- visualize results from statistical analyses, when possible, with the basic R graphics system;
- write reports in Rmarkdown language in which the statistical analyses and results visualization are integrated (as being part of Reproducible Research).

DELIVERY MODE AND TIME ALLOCATED

This course has 3 Credit Units: 45 Contact Hours (CH) per semester; 30 lecture hours (2 contact hours per week for 15 study weeks) and 30 tutorial hours (1 contact hour per week for 15 study weeks).

S/N	Topic	Content	CH
1	Programming in R	Introduction and basic functionalities, coding styles, functions and programming,	2
2	Programming in R …	data management, data visualization, dynamic report generation	2
3	Statistical analyses in agricultural sciences	Review of statistical concepts (boxplots, QQ plots, distributions, classical tests, correlations, analyses of count and proportion data)	4
4	Statistical analyses in agricultural sciences ….	• Regression (simple linear and multiple linear regression models, polynomial, non-linear, logistic)	4
5	Statistical analyses in agricultural sciences …	• Statistical modelling, model types and model simplifications • Transformations	3
6	Statistical analyses in agricultural sciences …	• Field social/economic and agricultural surveys, identification of target populations, data attributes and population parameters.	2
7	Statistical analyses in agricultural sciences …	• Experimental designs, sampling and sample estimates, design of survey instruments and data collection procedures, data verification and data management,	2
8	Statistical analyses in agricultural sciences …	• Data analysis and statistical applications, testing of hypothesis, error in research	4
9	Statistical analyses in agricultural sciences …	• General aspects of hypotheses formulation and testing • Data distribution (normal, categorical, Poisson) and model selection criteria	3

10	Statistical analyses in agricultural sciences …	• use of parametric statistical tests: Analyses of variance for CRD, RCBD and factorial designs, ANCOVA, MANOVA, PCA, post-hoc tests	4
11	Field practical	Field practical on experimental layout and research presentation	3
12	Statistical analyses in agricultural sciences …	• Non-parametric test procedures (e.g Chi square, Mann whitney U test), probability statistics, and analysis of categorical data.	4
13	Statistical analyses in agricultural sciences …	• Mixed model procedures (linear, non-linear)	4
14	Statistical analyses in agricultural sciences …	• Formulation of statistical models and basic programming in R as well as visualization of results in R	4
	Total		**45**

MODE OF ASSESSMENT

Continuous Assessments: This evaluates the continuous performance of students before sitting the final examination. It is done in form of tests, assignments and tutorials. It constitutes 40% of the final student's score.

University Examination: This covers 60% of the final score. It includes a written examination (essays, structured, multiple-choice questions or a presentation of research paper).

REFERENCES

1. An Introduction to Statistical Methods & Data Analysis by R. Lyman Ott and Michael Longnecker (ISBN 978-1-305-26947-7: 7th edition); Lecture notes (WUR shop).
2. Crawley, M.J. 2012: The R book. 2nd edition, Wiley; Field, A., Miles, J., Field, Z. 2012: Discovering
3. Statistics using R. Sage Everitt, B., Hothorn, T. P. 2011. An Introduction to Applied Multivariate Analysis with R. Springer, New York Field, A., Miles, J., Field, Z. 2012. Discovering Statistics using R, SAGE

5.8.3 COURSE NAME: ECOLOGICAL ORGANIC AGRICULTURE
COURSE CODE: MSA 8102
CREDIT UNITS: 3

COURSE OVERVIEW
Organic Agriculture – Why? Concern about food safety and security and environmental sustainability is increasing. Organic farming is an integrated system of agricultural production

based on ecological principles, promotion of biodiversity, biological cycles and organic matter recycling to maintain and improve soil fertility and environmental sustainability. Organic agriculture helps to build sustainable livelihoods through sustaining natural resources, increase agricultural productivity and earn a price premium for their certified organic produce. This raises farmers' household income which is reinvested in health, education and food. The regulations for organic crop cultivation prohibit the use of chemo-synthetic pesticides, mineral fertilizers, growth promoters and Genetically Modified Organism. Indiscriminate use of these chemicals in conventional farming poses a serious threat to the quality of produce as well as the environment. In view of this, the course is designed to train students on organic farming practices, quality analysis of the products, environmental impact assessment, health benefit of the organic food etc. The course covers the following topics:

COURSE OBJECTIVES

To train students on sustainable organic farming practices, quality analysis of the products, environmental impact assessment, health benefit of the organic food etc.

LEARNING OUTCOMES

At the end of the course learners should be able to:

- the students should be able to design resource efficient farming system for small and marginal farmers for improving their economy while meeting the quality food demand in a sustainable environment.

DELIVERY MODE AND TIME ALLOCATED

This course has 3 Credit Units: 45 Contact Hours (CH) per semester; 30 lecture hours (2 contact hours per week for 15 study weeks) and 30 tutorial hours (1 contact hour per week for 15 study weeks).

S/N	Topic	Content	CH
1	Organic Agriculture – Why?	Concern about food safety and security and environmental sustainability is increasing.	**2**
2	Organic Farming principles	Concepts and principles of organic farming.	3
3	Key indicators of organic farming	Biophysical indicators of organic agriculture	2
4	Organic agriculture Input management	Compost production, vermicomposting, Compost quality, Compost utilization and marketing, Mulching; Green manuring; Cover crops; Organic fertilisers.	3
5	Organic crop management	field crops, horticulture and plantation crops.	3
6	Plant protection measures	Biopesticides, natural predators, cultural practice. Selecting appropriate techniques of control; Weed identification.	3
7	Transition to organic agriculture	Rotation design for organic system, Transition to organic agriculture, farming system.	3
8	Opportunities, challenges and	Opportunities, challenges and barriers existing for beginning and established farmers; Strengths, weaknesses, opportunities and	3

	barriers of organic agriculture	threats.	
9	Quality analysis of organic foods	Antioxidants and their natural source, organic food and human health.	4
10	Organic Certification	Standards of organic food and marketing/ Organic Certification	3
11	Organic agriculture and sustainable livelihoods	- sustaining natural resources, increase agricultural productivity and earn a price premium for their certified organic produce.	4
12	Feeding the world with Organic agriculture	Can organic agriculture feed the world?	4
13	Project presentations …	Group Project presentations	4
14	Project presentations …	Group Project presentations	4
	Total		**45**

MODE OF ASSESSMENT

Continuous Assessments: This evaluates the continuous performance of students before sitting the final examination. It is done in form of tests, assignments and tutorials. It constitutes 40% of the final student's score.

University Examination: This covers 60% of the final score. It includes a written examination (essays, structured, multiple-choice questions or a presentation of research paper).

REFERENCES

1. Benefits of organic farming. (2002, June 21). Science News. Retrieved from: http://www.sciencenews.org
2. Rigby, D., and D. Cáceres. 2001. Organic farming and the sustainability of agricultural systems. Agricultural Systems 68:21-40.

5.8.4 COURSE NAME: CLIMATE SMART AGRICULTURE

COURSE CODE: MSA 7213

CREDIT UNITS: 3

COURSE OVERVIEW

Agriculture contributes significantly to global warming through large scale greenhouse gas emissions. At the same time many agriculture systems are vulnerable to climate change and without adaptation global food production could significantly reduce affecting food security. In response to these challenges the concept of climate smart agriculture has been developed. During the course the students will learn about the main principles of climate smart agriculture.

COURSE OBJECTIVES

To help students understand that;

- Agriculture contributes significantly to global warming through large scale greenhouse gas emissions. At the same time many agriculture systems are vulnerable to climate change and without adaptation global food production could significantly reduce affecting food security.
- In response to these challenges the concept of climate smart agriculture has been developed

LEARNING OUTCOMES

At the end of the course learners should be able to:

- apply the main principles of climate smart agriculture;
- analyse the impacts of climate variability and climate change on agricultural systems;
- describe the essential processes that are important in crop-climate interactions;
- develop and critically assess adaptation and mitigation measures related to agricultural systems;
- integrate adaptation and mitigation measures into a climate smart agricultural system.

DELIVERY MODE AND TIME ALLOCATED

This course has 3 Credit Units: 45 Contact Hours (CH) per semester; 30 lecture hours (2 contact hours per week for 15 study weeks) and 30 tutorial hours (1 contact hour per week for 15 study weeks).

S/N	Topic	Content	CH
1	Why climate-smart agriculture, forestry, livestock and fisheries	1. Climate change impacts on: crop, livestock, fisheries and Apiculture. 2. Learn how agricultural systems including both plant and animal systems contribute to climate change through the emissions of CO2, N2O and CH4. Main processes causing these emissions and which mitigation measures can be used to reduce greenhouse gas emissions.	2
2	Climate change adaptation and mitigation strategies	Integrating adaptation and mitigation into existing farming systems, subsectors (e.g., crop, livestock, fisheries and Apiculture), and land and water use practices to transform Agriculture and food systems in order to meet the related challenges of food security and climate change. Mitigation climate change: Managing landscapes for climate-smart agricultural systems: Managing agriculture, forestry and fisheries at a landscape scale through appropriate land-use planning and decision making based on a participatory, consensus-based and people-centred approach.	3
3	Agricultural Water management under climate change	Water management in both rainfed and irrigated agriculture (crop evapotranspiration, changes in the amount of rainfall, and variations in river runoff and groundwater recharge) taking into account including: increased water demand by all sectors; the degradation of water quality; and heightened competition for water at various levels (community, river basin and aquifer).	2
4	Soils and their management for climate smart agriculture.	Management practices that increase soil organic carbon (SOC) content through organic matter management rather than depleting it will bring win-win benefits. These practices will maintain productive soils that are rich in carbon, require fewer	3

		chemical inputs and sustain vital ecosystem functions, such as the hydrological and nutrient cycles.	
5	Sound management of energy for CSA.	Reducing this dependency on fossil fuels and energy, smart food systems to lower GHG emissions (clean Energy: solar & biogas).	3
6	Conservation and sustainable use of genetic resources	Conservation and sustainable use of genetic resources for food and agriculture as a raw material that farmers, breeders and researchers to respond to new conditions, including changes in climate and well-being of present and future generations.	3
7	Climate-smart crop production system.	Sustainable crop production provides farmers with options for farming sustainably, taking into account the local ecosystem. Integrated approaches—such as crop-livestock systems, rice-fish systems and agroforestry—diversify food sources and consequently strengthen the resilience of farmers' livelihoods.	3
8	Climate-smart livestock	Livestock's role in adaptation practices relates primarily to the management of organic matter and nutrients, and the diversification of incomes. Including practices such as grassland restoration and management (e.g. sylvopastoral systems), manure management (e.g. recycling and biodigestion) and crop-livestock integration.	3
9	Climate-smart forestry	Delivery of goods and ecosystem services from forests and trees that are essential to livelihoods and food security, to environmental sustainability, and to national development (Sustainable forest use, art & craft, honey, hunting, tourism, fruits, water).	4
10	Climate-smart fisheries and aquaculture	Maintaining the resilience aquatic systems and the communities that rely on them to allow the sector to continue contributing to sustainable development; and ways to reduce effectively the vulnerability of those most likely to be negatively impacted by climate change.	3
11	Developing sustainable and inclusive food value chains for climate-smart agriculture	improve performance along the value chain from input supply, to food production, to post-harvest handling and storage, processing, distribution, marketing and retail, consumption and disposal patterns of waste. Reduction, reuse and recycling of foodstuffs, including waste as compost or to generate energy from, for example, biogas. Green technologies.	4
12	Disaster risk reduction plans, laws and policies	strengthening livelihood resilience; Proven DRR technologies and practice, legislation, institutional structures, policies and plans for a strong supportive enabling environment.	4
13	Policy Tools for the Transition to Low	Emissions- Green Growth Initiative. Implementing the Paris Climate Agreement and Net-Zero emisions. Mainstreaming Climate-smart agriculture into National Policies and Programs; Climate-smart agriculture within policy frameworks	4
14	Group Project presentations	During the course the students will design different adaptation and mitigation measures which need to be integrated into a climate smart strategy for their case e.g., crop, livestock, fisheries and Apiculture).	4
	Total		**45**

MODE OF ASSESSMENT

Continuous Assessments: This evaluates the continuous performance of students before sitting the final examination. It is done in form of tests, assignments and tutorials. It constitutes 40% of the final student's score.

University Examination: This covers 60% of the final score. It includes a written examination (essays, structured, multiple-choice questions or a presentation of research paper).

REFERENCES

FAO, 2013. Climate Smart Agriculture: Source Book, 557 pgs. Rome

6.0. RESOURCES AND INFRASTRUCTURE

6.1. HUMAN RESOURCE

Busitema University Faculty of Agriculture and Animal Science already has qualified staff with PhDs in natural resources, sustainable agriculture and other relevant areas. Relevant qualified staff are also available in sister faculties such as the Faculty of Science, natural resources and Education and management Sciences. The above staff will offer fulltime teaching and research services of the program. **See Appendix B.**

6.2. TECHNICAL AND INFRASTRUCTURE FACILITIES

6.2.1. Teaching and learning facilities Laboratory facilities

Busitema University Arapai Campus that will house the program has two spacious well-equipped soil and crop science research laboratory and a computer laboratory that serve as the advanced training facilities. These facilities are vital for practical and hands-on teaching and learning and shall be used by students for learning, training and during their research project works.

Lecture rooms:

The campus also has adequate lecture rooms, spacious lecture halls to support this program.

Modern library and ICT facilities:

Busitema University Arapai campus is equipped with library with a "state-of-the arts" ICT- based library with E-learning facilities, linking together all campuses of the university.

6.2.2. Research and innovations facilities

Busitema University Arapai Campus has libraries, computer laboratory with internet connection. The university farm at Arapai provides field hands on facilities. The faculty of Agriculture and Animal Sciences (FAAS) of Busitema University has had strong research, learning and training collaborations with the following institutions: National Agricultural Research Organization (NARO) centers in the region such as; National Semi Arid Resources Research Institute (NaSARRI), Buginyanya Zonal Agricultural Research and Development Institute (BUZARD), National Agricultural Research Laboratories (NARL-Kawanda), National Crops Resources Research Institute

(NaCRRI). Besides, the university also has linkages and partnerships with world class institutions running similar programs: MAAIF, UNFF, Makerere University, Uganda; Gulu University, Uganda Martyrs university; Moi University, Kenya; Egerton University, Kenya; Uppsala University of Sweden; Wagennigen University and research, Netherlands; Ohio University, USA; Cornell University, USA; Dar es Salaam University, Tanzania, Sokoine University, Tanzania, UNFAO, SG2000 (Table 4). The installation of a graduate programme on Global and Sustainable Agriculture strengthens the collaboration and opens up further opportunities in join collaborations in research, learning, training and resource mobilization to support agricultural transformation in the future.

Table 4. Collaborating Institutions

Institutions	***Mandate***
Ministry of Agriculture, Animal Industry and Fisheries (MAAIF)	• Ensuring collaboration with all relevant government and non-government agencies in the sector, • Financing and Participation in the collaborative research Projects, • Supporting technology dissemination and field training, • Directorate of Agricultural Extension Services (DAES) is responsible for coordination of public agricultural advisory and extension services
National Agricultural Research Organisation (NARO)	• Financing and Participation in the collaborative research Projects, • Ensuring dissemination and application of agricultural research results, organising conferences and workshops
Uganda National Farmers Federation (UNFF)	• Young graduate support; • Ensuring dissemination and application of agricultural research results, organising conferences and workshops; • Promote agricultural shows and trade fairs; • Promote commercialization and Industrialization of agriculture innovations;
United Nations Food and Agricultural organization (UNFAO)	• Financing and technical support through participation in the research Projects and training; • Supporting technology dissemination and field training.
Sakasakawa Global (SG2000)	• Financing and Participation in the collaborative research Projects, • Ensuring dissemination and application of agricultural research results, organising conferences and workshops

6.2.3. Outreach and knowledge transfer facilities

Busitema University Arapai campus has established the crop, soil and animal clinics centers where farmers bring specimens and seek guidance on case-by-case management. The center will serve as a site for practical testing, modification and fine tuning of developed technologies of graduates therefore leading to entrepreneurship

and strengthening the capacity of the country in agricultural innovations from laboratory to the market place.

6.3. PROGRAM FUNDING

The main source of funding for the program shall be through tuition fees (self or private institutional student sponsorships). **See Appendix A**. Various resources shall also be generated by faculty staff under the program through bankable research and outreach projects, consultancies and donor support, some of which resources will be used to strengthen program facilities and activities.

APPENDIX A: PROGRAM BUDGET

The budget for the Doctor of Philosophy in Global Change and Sustainable Agriculture has been developed based on costs chargeable to Uganda students admitted to the course. The two budget are based on the assumption that 10 students are admitted to the course. Each of the budgets includes recurrent expenditures and projected staff costs (both academic, administrative and support staff), as well as capital expenditure and other running costs.
The Doctor of Philosophy in Global Change and Sustainable Agriculture will be funded through:

i. **Tuition fees.**
   See Table 5 below
ii. **Government funding.**
   Support through the Ministry of Science, Technology and Innovation.
iii. **Development partners**
   - Project Proposals to DAAD, AGRA, USAID, BTC and other donor partners.
   - Position the program for the upcoming Africa Mobility Scheme proposals.
   - Engage SIDA for possible support.

The tuition fees for the Doctor of Philosophy in Global Change and Sustainable Agriculture have been developed based on costs chargeable to Uganda students admitted to the course. The budget is based on the assumption that 5 students are admitted to the course. Each of the budgets includes recurrent expenditures and projected staff costs (both academic, administrative and support staff), as well as capital expenditure and other running costs.

Table 5. Proposed program budget

Assuming intake of 5 students		
REVENUE PER SEMESTER	**Semester I**	**Semester II**
Tuition fees	Amounts (UGX)	Amounts (UGX)
Student's fees	5,000,000	5,000,000
(UGX 10,000,000 per annum)		
Tuition fees for 5 students @UGX 5,000,000	20,000,000	20,000,000
Total	***25,000,000***	***25,000,000***
B. EXPENDITURE PER SEMESTER		
University Council 5%	1,000,000	1,000,000
Teaching Expenses 50%	10,000,000	10,000,000
Administrative Expenses 5%	1,000,000	1,000,000
Office Expenses 3%	600,000	600,000

Library Materials 2%	400,000	400,000
Faculty levy 5%	1,000,000	1,000,000
Utilities/Furniture 2%	400,000	400,000
Staff Development 2%	400,000	400,000
Testing Equipment levy 14%	2,800,000	2,800,000
Air ticket for visiting professors 12%	2,400,000	2,400,000
Total 80%	***20,000,000***	***20,000,000***
Balance brought forward	***5,000,000***	***5,000,000***

APPENDIX B: HUMAN RESOURCES

SN	NAME OF STAFF	GENDER	HIGHEST QUALIFICATION	AWARDING INSTITUTION	ACADEMIC QUALIFICATIONS	FIELD OF SPECIALIZATION	Staff Status
1	Assoc.Prof. Dr. Victor A. Ochwoh.	Male	PhD	University of Pretoria, SA	BSc. Agric., MSc, PhD	Sustainable Agriculture	Permanent
2	Dr. John E. Wasige	Male	PhD	University of Twente, Netherlands	BSc Agric.(Mak), MSc. (Mak), PhD (WU)	Soil science	Permanent
3	Assoc. Prof. Dr. Michael Masanza	Male	PhD	Wagenningen University & Research, Netherlands	BSc. Agric., MSc, PhD	Entomology	Permanent
4	Prof. Deo Olila	Male	PhD			Vetnary sciences	Permanent
5	Mr. Turyasingura Geoffrey	Male	MSc.	Makerere University, Uganda	BSc.EDUC and VOC studies (KYU), MSC Agric. Extension (Mak)	Agricultural extension/ sociology	Permanent
6	Dr. Peter Opio	Male	PhD	Chiba University, Japan	BSc (Agric), MSc, PhD	Horticultural sciences	Permanent
7	Dr. Asha Nalunga	Female	PhD	Michigan State University, USA	BSc (Agric), MSc, PhD	Agric. statistics	Permanent
8	Dr. David Magumba	Male	PhD		BSc (Agric), MSc, PhD	Agric. statistics	Permanent
9	Dr. Ronald Kabbiri	Male	PhD	University of Ghent, Belgium	BSc Agric. (SOK), MSc HORT(), PhD	Agric economics	Permanent
10	Dr. Simon Okiror	Male	PhD	Makerere University, Uganda	BSc (Agric), MSc, PhD	Agric Policy	Permanent
PART-TIME LECTURERS							
11	Prof. Twaha A. Basaamba	Male	PhD	Norwegian University of Life Sciences	BSc Agric.(Mak), MSc. (Mak), PhD (NMBU)	Agricultural production	Part-time
12	Dr. Isaac Newton Alou	Male	PhD	University of KwaZulu-Nata, SAI		Agricultural systems mondeling & Analysis	Part-time
13	Dr. Onesmas SSemalulu	Male	PhD			Sustainable Land Managemement	Part-time
14	Dr. Geofrey Lubadde	Male	PhD	University of KwaZulu-Nata, SAI	BSc Agric. (Mak), MSc CROP(Mak), PhD (UKZN)	Plant Breeding	Part-time
16	Dr. Saul D. Ddumba	Male	PhD	Michigan State University, USA	BA. Georg, MSc. (Reading, Uk), PhD (M)	Meteorology	Part-time
17	Dr. Geofrey Gabiri	Male	PhD	University of Bonn, Germany	BSc.Agric., MSc.Water mgt, PhD	Hydrology	Part-time
18	Mr. Akodi David	Male	MSc.	University of Ghent, Belgium	Bsc. Land Use, Msc,	Soil physics	Part-time
19	Mr. Nicholas Munu	Male	MSc.	Makerere University, Uganda	Agricultural Engineering	Agric. Mechanisation	Part-time
20	Ms. Gumisiriya Costa	Female	MSc.	Makerere University, Uganda	BSc. Agric., MSc. Crop Science	Crop science	Part-time
21	Ms. Dorothy Alibo	Female	MSc.	Makerere University, Uganda	BSc. Agric., MSc. Crop Science	Agronomy	Part-time
22	Mr. Ojuu David	Male	BSc	Makerere University, Uganda	DCP, Bsc Agric, Msc. (Crop Sci.)	Crop science	Part-time

STAFF ON ONGOING PhD TRAINING							
23	Mr. Charles Andiku	Male	MSc.	Makerere University, Uganda	Dip. Agrof. Bsc Hort.(MAK), MSc. Crop	Plant breeding, Agronomy	Permanent
24	Mr. Robert Amayo	Male	MSc.	Makerere University, Uganda	Bsc Agric, Msc crop, (PhD)	Plant pathology	Permanent
25	Mr. Denis Besigamukama	Male	MSc.	Makerere University, Uganda	Bsc. Land Use, Msc, (PhD)	Soil science	Permanent
FIELD & TECHNICIANS FOR LABORATORY EXPERIMENTS							
26	Mr. Musoba Andrew	Male	Diploma	Busitema University, Uganda	Diploma in Crop Production &Mgt, BSc (Agric)	Dairy production Pastures	Permanent
27	Ms. Akol Susan	Female	Diploma	Busitema University, Uganda	Diploma in Bee Production & Mgt, BAPM	Apiculture, Entomology	Permanent
28	Mr. Buluma David	Male	Diploma	Busitema University, Uganda	Diploma in Crop Production &Mgt, (BS Agric candidate)	Crop production & Management	Permanent
29	Mr. Oonyu Source Peter	Male	Diploma	Busitema University, Uganda	Diploma in Crop Production &Mgt, (BS Agric candidate)	Crop production & Management	Permanent
30	Mr. Muhindo Williams	Male	Diploma	Busitema University, Uganda	Certificate in Crop Production & Mgt, Diploma in Animal Production	Crop production & Management	Permanent
31	Mr. Ekaru Sam	Male	Diploma	Busitema University, Uganda	Diploma in Crop Production & Management, Bsc Agriculture	Crop science	Permanent

REFERENCES

Adipala, E., Nampala, P., Tumutegyereize, J.K., Osiru, M. and Tnywa, J.S. 2001. Developing a client-responsive agricultural training, research and dissemination program for the Faculty of Agriculture and decentralised districts: A strategy. *A feasibility study report by the Faculty ofAgriculture submitted to J@mak. corn.* 24 pp.

Gombya-Sembajjwe, Ndemere, P., Tumwebaze, S., Nabanoga, G. and Banana, A. 2001. Developing a curriculum for in-service training in participatory and integrated local level management of natural resources of sustainable development. *A feasibility study report by the faculty of Forestry & Nature Conservation submitted to J(ãD,mak.com.*