Food and Agriculture Organization of the United Nations

AVSI People for development

CLIMATE SMART AGRICULTURE
Curriculum/Module

for

B. Agr. Sc. and M. Agr. Sc Degree Programme

at
Yezin Agricultural University

in
Myanmar

CLIMATE SMART AGRICULTURE
Curriculum/Module

for

B. Agr. Sc. and M. Agr. Sc Degree Programme

at
Yezin Agricultural University

in
Myanmar

Sustainable Cropland and Forest Management in Priority Agro-ecosystems of Myanmar Project (GCP/MYA/017/GFF)

Published by
the Food and Agriculture Organization of the United Nations
and
AVSI Foundation
Naypyidaw, 2019

Required citation:
FAO. 2019. *Climate Smart Agriculture Curriculum/Module for B. Agr. Sc. and M. Agr. Sc Degree Programme at Yezin Agricultural University in Myanmar*. Yangon. 28 pp. Licence: CC BY-NC-SA 3.0 IGO

CONTENTS

ACRONYMS

AESA	Agro-ecosystem Analysis
AVSI	Association of Volunteers in International Service
CA	Conservation Agriculture
CARTC	Central Agricultural Research and Training Center
CSA	Climate Smart Agriculture
DAR	Department of Agricultural Research
DoA	Department of Agriculture
FAO	Food and Agriculture Organization
FFS	Farmer Field School
GAP	Good Agricultural Practices
GEF	Global Environment Facility
GHG	Greenhouse Gas
IPM	Integrated Pest Management
MoALI	Ministry of Agriculture, Livestock and Irrigation
MoNREC	Ministry of Natural Resources and Environmental Conservation
NGO	Non-government Organization
SAI	State Agricultural Institute
SALT	Sloping Agricultural Land Technology
SFM	Sustainable Forest Management
SLM	Sustainable Land Management
YAU	Yezin Agricultural University

Climate Smart Agriculture Course Curriculum

1. Background

The Food and Agriculture Organization of the United Nations (FAO) is implementing a project entitled **"Sustainable Cropland and forest management in priority agro-ecosystems of Myanmar (SLM-GEF)"** in coordination with the Ministry of Natural Resources and Environmental Conservation (MoNREC) and the Ministry of Agriculture, Livestock and Irrigation (MoALI) with funding from the Global Environment Facility (GEF).

The project aims to facilitate and strengthen sustainable land management (SLM), sustainable forest management (SFM), and climate-smart agriculture (CSA). The project facilitates the adoption of climate smart agriculture (CSA) policies and practices that will help to sustainably increase productivity, enhance resilience (adaptation), reduce/remove GHGs (mitigation) and enhance achievement of national food security and development goals.

The project intends to establish a national CSA/SLM training program mainstreaming CSA/SLM in the agriculture related training conducted by Department of Agriculture (DoA), State Agricultural Institutes (SAI), Department of Agriculture Research (DAR) and Yezin Agricultural University (YAU). The project will work with DoA, SAIs, DAR and YAU to integrate CSA within their research, training and development programs. The training program will vary with the need and nature of the institutions, for example;(1) one month training together with other subjects for the in-service or refresher course at Central Agriculture Research and Training Centre (CARTC), (2) one week intensive training of trainers (ToT) aiming for the senior extension agents of DoA, DAR and YAU, (3) CSA component integrated into the course for diploma students at SAIs, and (4) CSA component integrated into the course for bachelor and master's level at YAU.

AVSI Foundation has been contracted to develop the Climate Smart Agriculture Curriculum and Handbook to be introduced and incorporated as a course (subject) into the existing education systems at different levels as mentioned above. This document will serve as the main resource/reference book for professors/lecturers/teachers from the different Departments at YAU to include the related topics on CSA into their courses for teaching the students.

2. Initial step before developing training curriculum

(a) Yezin Agricultural University

As a first step, the National Consultant accompanied by some responsible persons from AVSI Foundation visited YAU to explore the nature of courses being offered and explore the possibility of integrating CSA component in the existing curricula for undergraduate as well as postgraduate level at YAU. At the beginning, YAU presented a long list of 28 courses altogether (see Table 1) aimed at CSA curriculum. However, some of the subjects are existing ones but many of them are just presented as the title and the details are yet to be developed. On the other hand, it is not well organized involving too many subjects, which is almost impossible to be incorporated into the existing courses. After discussion with the Rectors and Professors, it was learned that there was no CSA course as a separate subject offered for graduate or undergraduate levels although some topics related to CSA were included in some courses offered by different departments such as Agronomy, Soil Science, Agricultural Botany, Entomology and Horticulture. However, the courses were fragmented and focusing their own subject matter, not the climate smart agriculture. That means a curriculum needs to be developed for CSA.

Table 1. CSA course curriculum (draft) proposed by YAU for B. Agr. Sc. and M. Agr. Sc. Programme

No.	Course Title	Department	Remarks
1	AGY-4201- Agrometeorology	Agro.	Undergraduate, Existing
2	AGY-4202: Integrated Farming System Management	Agro.	Undergraduate, Existing
3	AGY - 4207: Postharvest losses of Field Crops	Agro.	Undergraduate, Existing
4	AGY-5103: Tropical Pasture Management	Agro.	Undergraduate, Existing
5	Integrated Crop Management	Agro.	Undergraduate, Proposed
6	Agroforestry	Agro.	Undergraduate, Proposed
7	BPE-4107 - Plant Genetic Resources Conservation and Management	BPE	Undergraduate, Existing
8	BPE -4204 Stress Physiology	BPE	Undergraduate, Existing
9	BPE 5101 – Crop Improvement for Climate Change	BPE	Undergraduate, Existing
10	BPE-5102 Environmental Plant Physiology	BPE	Undergraduate, Existing
11	BPE-603 Biodiversity and Plant Genetic Resources	BPE	Postgraduate, Existing

No.	Course Title	Department	Remarks
12	BPE 714: Plant Genetic Resources in Crop Breeding	BPE	Postgraduate, Existing
13	Conservation Agriculture	Soil and Water	
14	Alternate Wetting and Drying	Soil and Water	
15	Integrated Soil and Plant Nutrient Management	Soil and Water	
16	Improved Fertilizer Efficiency	Soil and Water	
17	Water Saving Techniques	Soil and Water	
18	Integrated Disease Management	Patho	Undergraduate
19	Disease Resistance in Plant	Patho	Postgraduate
20	ENT-4101: Insect Ecology	Ento	Undergraduate, Existing
21	ENT-4201: Integrated Pest Management	Ento	Undergraduate, Existing
22	Insect Diversity and Conservation	Ento	Proposed
23	Horticulture and climate change	Horti	Postgraduate, Proposed
24	HSC 713 Ecophysiology of horticultural crops	Horti	Postgraduate, Existing
25	HSC 609 Improvement of horticultural crops	Horti	Postgraduate, Existing
26	Climate Smart Food Value Chain in Agricultural Food System	Agri. Eco.	Undergraduate
27	Climate Change, Agriculture and Food Security (MSc)	Agri. Eco.	Postgraduate
28	Green House Gas Inventory for Agriculture	ACARE	Postgraduate, Proposed

Note:

ACARE = Advanced Center for Agricultural Research and Education
Agro = Department of Agronomy
BPE = Department of Plant Breeding, Physiology and Ecology
Soil and Water = Department of Soil and Water Science
Patho = Department of Pathology
Ento = Department of Entomology
Horti = Department of Horticulture
Agri. Eco. = Department of Agriculture Economics

After a long discussion considering different aspects, it was agreed that Climate smart Agriculture subject should be introduced in the second semester of the third year. Introducing CSA for the first and second year may be too early as the students have not enough background knowledge to take the course. On the other hand, introducing in the fourth year may be too late as specialization started by this time. To get awareness and familiar with CSA to all students, it may be the best to introduce in the second semester of the third year when diploma graduates from State Agricultural Institutes join YAU. The supplementary curriculum for those who joined YAU as a bridging program after obtaining diploma is presented in table 2.

Table 2. Curriculum for the Second Semester of Second Year B.Agr.Sc. (for those who got Dip. Agri. Certificate) in 2015-2016

Course Number	Subject	Hours per week		
		Theory	Practical/ Tutorial	Total
AGY-221(Pre)	Rice Production	2	-	2
BTY-221(Pre)	Cytology	2	-	2
AGC-221(Pre)	Introductory Soil and Water Science	2	-	2
PTY -221(Pre)	Plant Pathology	2	-	2
ENT-221(Pre)	Rice Pests and Their Control	2	-	2
HSC-221(Pre)	Horticultural Science	2	-	2
AEC-221(Pre)	Introductory Agricultural Economics	2	-	2
AGE-221(Pre)	Farm Machinery & Farm Surveying	2	-	2
ASC -221(Pre)	Animal Hygiene	2	-	2
	Field		15	15
	Total	18	15	33

Note:
AGY = Agronomy
BTY = Botany
AGC = Agricultural chemistry
PTY = Plant pathology
ENT= Entomology
HSC = Horticulture
AEC = Agricultural Economics
AGE = Agricultural Engineering
ASC = Animal Science

The existing curriculum courses for the third year B.Agr.Sc. are presented in table 3 & 4 to get some idea how far agricultural subjects have been touched so far. For the first semester, the topics for each subject were outlining basic principles to get familiar with respective subjects. The sound background knowledge gained from this semester will be helpful to grasp the concept of CSA and fully understand the technologies to tackle the problems caused by climate change.

Table 3.Curriculum for the First Semester of Third Year B.Agr.Sc.in 2015-2016

Course Number	Subject	Hours per week		
		Theory	Practical/ Tutorial	Total
AGY-311	Experimental Agriculture	3	2	5
BTY-311	Seed Biology	2	2	4
AGC-311	Soil Chemistry and Soil Microbiology	2	2	4
PTY-311	Crop Diseases and Control I	3	2	5
ENT-311	Pests on Industrial Crops and Control	3	2	5
HSC-311	Vegetable Science and Fundamental of Fruit Science	3	2	5
AEC-311	Microeconomics	3	2	5
	Field		15	15
	Total	19	29	48

Table 4.Curriculum for the Second Semester of Third Year B.Agr.Sc.in 2015-2016

Course Number	Subject	Hours per week		
		Theory	Practical/ Tutorial	Total
AGY-311	Agricultural Extension and Rural Sociology	3	2	5
BTY-311	Genetics	2	2	4
AGC-311	Mineral Nutrition of Plants	2	2	4
PTY-311	Crop Diseases and Control II	3	2	5
ENT-311	Storage Pests and Control	3	2	5
HSC-311	Floriculture and Introduction to Tissue Culture	3	2	5
AEC-311	Agricultural Trade and Marketing	3	2	5
	Field		15	15
	Total	19	29	48

The CSA curriculum can be introduced and incorporated into the second semester of the third year for B.Agr.Sc at YAU. With the existing curriculum, most of the topics can be offered sharing between two departments, viz. Department of Agronomy and Depart of Agricultural Chemistry, and the small portion remained may be complemented by other departments.

Although it is sound appropriate and everything seems to be very smooth, another problem which is unexpected and unforeseen appears again because YAU is introducing credit system for the undergraduate students with the technical assistance of Japan International Cooperation Agency (JICA) in 2017. With this new system, specialization will take place in the third year, that is one year earlier than the old system. Therefore, the idea of incorporating CSA curriculum into third year courses may not be realized to fulfilling the idea of teaching to all B.Agr.Sc students. In

this newly introduced credit system, there are so many subjects involve, for example more than 100 subjects for the first year and it will swell up to 293 subjects for eight semesters. To make sure all the students take the CSA course, YAU authorities are requested to set CSA as a core (compulsory) subject for the second year or third year before specializations start.

(b) State Agricultural Institutes

The meeting with the responsible Director for training and the Principals of SAIs also revealed that CSA course is yet to be incorporated into their diploma courses although some topics such as soil conservation and conservation agriculture were touched very lightly but not with the concept of climate smart agriculture. The curriculum for the diploma courses are presented in table 5.

Table 5 The curriculum for different years of diploma course at State Agricultural Institutes

Sr. No.	Subject	First year	Second year	Third year
1	Agronomy	✓	✓	✓
2	Horticulture	✓	✓	✓
3	Animal husbandry	✓	✓	✓
4	Agricultural chemistry	✓	✓	✓
5	Agricultural botany	✓	✓	-
6	Plant protection	-	✓	✓
7	Farm mechanics	-	✓	✓
8	Agricultural extension	-	-	✓
9	Farm management and Account	-	-	✓
10	Mathematics	✓	-	-
11	Physics	✓	-	-
12	English	✓	✓	-

After discussion, it is agreed that CSA curriculum should be introduced in the third year. The course outlines of Agronomy and Agricultural Chemistry for third year are as follows:

Agronomy

1. Introduction to agricultural research and experiment
2. Introduction to **cropping pattern**
3. **Organic farming**
   - Kyusei nature farming
   - Conventional farming
   - Alternative agriculture production technology

4. **Postharvest technology** for field crops
5. **Seed technology**

Agricultural Chemistry

1. Fertilizers
2. Submerged soils
3. Soilless culture
4. Soil conservation
5. Water management
6. Fertility management
7. Problem soils and their management
8. Environmental education
9. Environmental Conservation

Some of the topics highlighted under each subject are related to CSA. Initially it was agreed that half of the lecturing hours for both subjects will be replaced with CSA curriculum without affecting the essence of all subjects as usual. The Director and responsible personnel for curriculum development of SAIs prefer to assign only one department (Agronomy) for teaching CSA. When the existing curriculum is observed, it may be more appropriate to share within two departments, Agronomy and Agricultural Chemistry. Some other departments such as Horticulture, Agricultural Botany and Plant Protection may teach the remaining portions as a complementary manner. As CSA curriculum was developed for 24 hours lecturing, Department of Agronomy and Agricultural Chemistry may take 10 hours each and the remaining four hours may be taken by other departments as mentioned above.

(c) Central Agricultural Research and Training Centre

The intention of introducing CSA training into existing regular training program at CARTC was reported to the Director General of DoA and obtained his permission to do so. The training schedule at CARTC was designed in advance in the early months of a year, so the permission was taken for one-week intensive training course for ToT at CARTC. A detailed discussion was made with the Principal of CARTC to offer one-week intensive training and the incorporation of CSA course into the one-month regular in-service training. In fact, CARTC has been giving CSA training for sometimes but the courses were not well organized. Subject specialists were lecturing in their own way emphasizing their own subject matter. For example, someone who knows about soil science talked about soil conservation in detail. Similarly, conservation specialist talked about conservation agriculture only but nothing else. The agronomist, plant breeder, irrigation specialist, plant protectionist, horticulturist and climatologist do the same

thing. So far, a well organized course on CSA has never been offered at CARTC. This means CARTC needs a new CSA curriculum to address the problems of climate change using comprehensive approaches.

The Director General and some officials from the Department of Agricultural Research (DAR) were also consulted with at their head office to get some idea about what DAR has been contributing to CSA by their research and breeding program to produce some crop varieties as well as certain cropping patterns to be able to adapt and also to mitigate the problem of climate change.

(d) Follow-up meetings

After the preparation of the first drafts of training curriculum on CSA, follow up visits were made to all respective institutions again and presented the draft and received feedback. For this trip, a Professor of Agricultural Economics from the University of Milan, Italy, accompanied the team. All the feedbacks were taken into account and the curriculum was revised to incorporate their specific needs.

By doing so, these training curricula will be very useful tools and sound foundation in paving a way to fight back the problems of climate changes in Myanmar complementing the government program like NAPA for achieving three main goals of CSA practices such as sustainably increased productivity, enhancing resilience (adaptation), reducing/ removing GHGs (mitigation) where possible, and enhances achievement of national food security and development goals.

3. Urgent need to develop training curriculum of CSA

Introduction

The Government of Myanmar has initiated economic reforms to achieve a higher per capita income for the rural populace, whose major source of livelihood is agriculture, and Myanmar's economy was growing at 7.3% in 2012 to 2013. However, these economic gains are being threatened by climate change. Myanmar is annually affected by climate extremes, particularly floods, droughts, and tropical cyclones, threatening the livelihoods of poor people living in rural areas, as well as food security in the country.

Examples of observed changes in climate related hazards in Myanmar and their consequences include:

- An increase in the prevalence of drought events
- An increase in intensity and frequency of cyclones/strong winds
- Rainfall variability including erratic and record-breaking intense rainfall events
- An increase in the occurrence of flooding and storm surge
- An increase in extreme high temperatures

According to the *2016 Climate Risk Index*, Myanmar is the second most vulnerable country in the world to the effects of climate change. The intensity and regularity with which cyclones make landfall have increased with every year, with the delta region affected by tropical storms and the dry zone impacted by debilitating droughts.

Impact of climate change

The long-term effects of climatic change will seriously impact agricultural production and food security, requiring substantive adaptation of agricultural systems over time. Moreover, agriculture significantly contributes to greenhouse gas (GHG) emissions. Therefore, the vulnerability of agriculture to climate change and food security is an issue of major importance that needs the attention of the national authority as well as local community. For achieving food security to offset the impacts of climate change, the implementation of climate smart agriculture through the sustainable crop production, adaptation and mitigation measures will be the solution.

Efforts of Government to tackle the problems

Government of Myanmar is trying its best to cope with the adverse effects of climate change with a National Adaptation Program of Action (NAPA) covering eight sectors, namely: 1) agriculture, 2) early warning systems, 3) forests, 4) public health; 5) water resources, 6) coastal zones, 7) energy and industry, and 8) biodiversity. Agriculture, early warning systems and forests have the highest priority. However, it is critical to get awareness of the climate change impact among the farmers who are the main stakeholder for food crop production. On the other hand, the extension staffs as well as the policy makers need to be educated to help tackle the problems of climate change. The final solution is the knowledge and adoption of CSA practices.

In this case, all the stakeholders from the agricultural sectors need to be trained to get familiar with climate smart agriculture. The duration of the training course and the content involved in the training will vary with the level of target group and type of organization as the training course

is designed to address the need of individual institution and target groups. For in-service training, only basic concept will be introduced but it will be extended for ToT, diploma level, bachelor level and master's level one step after another.

Firstly, the awareness on climate change and its impact should be raised among the farmers using different media. On the other hand, a course on CSA should be introduced to the institutions for the students and extension staff working with Department of Agriculture. CSA has never been introduced as a subject at the university or training centers in Myanmar. Therefore, it is timely to develop curricula for different levels of agricultural institute and university.

The CSA training curriculum will provide students with the skills and tools for developing agricultural practices, policies and measures addressing the challenge that global warming poses for agriculture and food security worldwide.

4. Brief outlines of the training curriculum

The curriculum is divided into (4) parts based on the nature of the content:

I. Basics
II. Practices
III. System approaches
IV. Enabling environment

I. The basics

Climate-smart agriculture (CSA) is an integrative approach to address these interlinked challenges of food security and climate change that explicitly aims for three objectives:

A. Sustainably increasing agricultural productivity, to support equitable increases in farm incomes, food security and development;

B. Adapting and building resilience of agricultural and food security systems to climate change at multiple levels; and

C. Reducing greenhouse gas emissions from agriculture (including crops, livestock and fisheries).

II. Practices

Although there are many aspects of CSA practices under this section, only certain areas will be introduced as follows:

(a) Soil management

Conservation agriculture, biomass recycling and soil health, integrated farming –nutrient management

(b) Crop management,

Use of diverse and appropriate varieties, crop and livelihood diversification, organic farming for sustainable agriculture, participatory seed production and seed saving, seed system

(c) System of Rice Intensification

- Introduction
- operations
- contributions to CSA
- lessons learned

(d) Crop and livelihood diversification

- Crop diversification to reduce risk in adversely affected areas
- Integrated farming system (fish-rice, duck – rice, cow, goat, pig raising)
- Mixed, Inter, Relay cropping & Cropping System

(e) Water management

Water harvesting and saving techniques, Improved Micro irrigation for vegetables Alternate Wetting and Drying (AWD) techniques for rice cultivation

(f) Agroforestry

Agroforestry, Sloping Agricultural Land Technology (SALT), community forestry

III. System approaches

To achieve the multiple objectives of productivity and food security, enhanced farmer resilience and reduced greenhouse gas emissions, CSA must adopt various systems perspectives. These include:

(a) Landscapes and ecosystems - The landscape approach is categorized into three components for operationalization, viz.: i) landscape goals embracing multiple objectives at different scales, ii) adaptive planning, management, and collaboration, and iii) comprehensive sector involvement.

(b) Value chain analysis

A value chain is simply a useful way of understanding how the world of producing, buying and selling things works. The conceptual framework of agricultural value chains includes a sequence of value adding activities, from production to consumption, through processing and marketing. Each segment of a chain has one or more backward and forward linkages. A value chain in agriculture identifies the set of actors and activities that bring a basic agricultural product from production in the field to final consumption, where at each stage value is added to the product.

Increasing rice production and upgrading the rice value chain will enhance the export volume, increase food security, reduce urban migration and give more of the regions' youth valuable employment opportunities.

From the systems perspective, it is important to pursue synergies between the different elements of the system, analyze and address trade-offs, and perform cost and benefits analysis. By doing so, it can be determined the actions to achieve the desired outcomes.

IV. Enabling environment

Enabling environments for CSA are the framework conditions that facilitate and support the adoption of climate-smart technologies and practices. They include;

(a) crop insurance
(b) integrated pest management
(c) climate information services
(d) infrastructure
(e) policy engagement
(f) institutional arrangements and
(g) gender and social inclusion

5. The design for teaching

The course will not be offered by only one department, but many departments will take part to share their own expertise and discipline to the course. For example, soil conservation will be lectured by Soil Science department, crop management from Agronomy department, integrated pest management from Entomology and Plant Pathology departments, and so on. Ownership will be given to all departments that are relevant to the course. Only short lecture will be given,

followed by short questions and answers, group discussion to be able to digest and grab the basic concept leading to practical application. The topics may be similar or may be the same with certain subject from the regular course, they won't be repeated but it will be correlated to CSA goals- sustainable increased production, adaptation to the climate change or the mitigation of GHG emission for each topic as much as possible.

As the practical work may not be easy to incorporate for every topic, group discussion or assignment will be given individually or as a group depending on the time limit. Excursion to the area severely affected by climate change will be organized to witness the impact of climate change on agriculture and the livelihood of rural community. At the same time, trips will be organized to the places where people are trying to fight back the problems of climate change to learn lessons from the farmers who have firsthand experience.

6. Consultation workshop with relevant stakeholders

A consultation workshop with relevant stakeholders was held in Nay Pyi Taw on 24th July 2018 to get feedback and for the validation of CSA curricula for different levels for various organizations. The workshop was very successful with the active participation of all relevant stakeholders including responsible FAO Experts and team, Resident Advisor of Advanced Centre for Agricultural Research and Extension (ACARE), Professors from YAU, Deputy Director General and Directors from DoA, Directors and Principals of SAIs, Principal and Vice-principal from CARTC, Staff Officers from the project areas and responsible officer from DAR. CARTC and SAIs requested to include their staff for the ToT programme so that they can give cascade training for their own departments in the future.

All the feedback, suggestions and comments were taken into consideration and CSA curricula were modified to meet the needs of respective training programmes for different organizations. However, certain topics could not be accounted for as they are outside the scope of the CSA definition by FAO. It has been agreed that all CSA curricula to be incorporated into the existing system of the respective organizations except ToT programme where it will stand alone.

Climate Smart Agriculture Curriculum for B.Agr.Sc. and M.Agr.Sc. Programme at YAU (Module 1)

Course Objective	To understand the holistic nature of agriculture production and the main principles and techniques of Climate Smart Agriculture
Teaching	2 Lectures + Assignment/discussion
Module distribution	1 hr x 2 d/wk x 16wk = 32- hr lecture /semester Practical may be field visit to specific sites for SWOT analysis or seminar
Duration	4 months (16 weeks)
Source of instructors	Instructors from different departments of YAU
Type of delivery	Short lecture (+take home exercise)
Type of content	Theory (+ case studies)

Unit		**Course code and title**
	I Basics	
1	**Agro-ecological zones of Myanmar** Types of Agro-ecological Zones in Myanmar Topography and weather conditions Cultivated crops and cropping patterns Climate change and its impact on agriculture **(**disaster prone areas and the extent of damage)	AGY 101 – Field crop production I
2	**What is CSA** Definition **Principles of Climate Smart Agriculture** The three pillars of climate smart agriculture (a)Sustainably maintain and increase productivity (b) Adaptation and resilience and (c) Mitigation – reducing and/or removing greenhouse gas emission **Key characteristics of CSA** CSA addresses climate change	AGY 4201 - Agrometeorology

Unit		Course code and title
	CSA integrates multiple goals and manages trade-offs CSA maintains ecosystems services CSA has multiple entry points at different levels CSA is context specific CSA engages women and marginalized groups	AGY 4201 - Agrometeorology
	Climate Change Impact to Crops/Farmers High temperature, Irregular/erratic rainfall, Sea level rise, Drought and flood, Salt intrusion, Crop damage and failure **Why CSA?** 1. Food security, misdistribution and malnutrition 2. The relationship between agriculture and poverty 3. The relation between climate change and agriculture	AGY 4201 - Agrometeorology
3	**II Practices** Integrated Knowledge to manage CSA approach **Soil management** Key aspects of healthy soil / Soil as a living organism The impacts of climate change on soil and land resources - the need for sustainable management Sustainable soil and land management for climate-smart agriculture in practice - Afforestation Preventing and mitigating land degradation Controlling soil erosion / Wind erosion Managing Soil Organic Matter for soil carbon sequestration Improving water use and management in agriculture	AGC 221 - Soil Physics: Water Management AGC 421 Soil Fertility Evaluation and Management SWS 5102 - Soil Microorganisms for Sustainable Agriculture

Unit		Course code and title
	Problematic soils, their impacts on crop production, and amelioration **Conservation Agriculture (CA)** What is conservative agriculture 1. Continuous minimum mechanical soil disturbance, 2. Permanent soil cover, 3. Diversification of crop species grown in sequences and/or associations (Crop rotation), Managing Soil Organic Matter for soil carbon sequestration 4. Zero (minimum) tillage + mulching	AGC 311 - Soil Chemistry and Soil Conservation SWS 5101 - Soil and Water Conservation
	Soil Conservation as a measure to increase yield and sequester carbon	***Case study**
	Biomass recycling and Soil health – Definition, Carbon pool in the soil, Soil organic matter, Microbial activity, microbial biodiversity and resilience, Bioavailability of environmental contaminants,	AGC 421 Soil Fertility Evaluation and Management SWS 5102 -Soil Microorganisms for Sustainable Agriculture AGC 606 -Chemistry of Soil Organic Matter AGC 725 -Soil and Water Pollution Control
	Integrated farming and efficient use of fertilizer Concept and common practices of Integrated farming Nutrient turnover and terrestrial carbon sequestration, Organic matter turnover The function of plant nutrients Balancing and efficient use of fertilizer	AGY 5101 - Integrated Farming System AGC 321 - Mineral Nutrition of Plants SWS 4203 - Integrated Nutrient Management

Unit		Course code and title
		AGC 608 - Fertilizer Technology
4	**Crop production (management)** Contribution to CSA Lessons learned **System of Rice Intensification (SRI)** Introduction Procedure and operations Contributions to CSA Lessons learned	AGY 102 – Agronomy of Major Cereals
	Use of diverse and appropriate varieties Rice, maize, pulses Drought tolerant, Salt tolerant, Flood tolerant, Pest and disease tolerant varieties and their application to the relevant area (Improving the conservation and use of plant genetic resources, Developing improved and adapted varieties, Improving seed production and distribution)	BPE 5101 – Crop Improvement for Climate Change
	Disease resistant and early maturing chickpea to boost production / SRI / AWD / Urea Deep Placement	***Case study**
	Crop and Livelihood diversification Crop diversification to reduce risk in adversely affected areas Integrated farming system (fish-rice, duck – rice, cow, goat, pig raising); Rice-vegetable pattern Mixed, Inter, Relay cropping & Cropping System	AGY 101 – Field Crop Production I HSC-5102 Organic and Sustainable Horticultural Crop Production
	Organic farming for sustainable agriculture Principles of organic farming 1. The cyclical principle,	AGC 606 -Chemistry of Soil Organic Matter

Unit		Course code and title
	2. The precautionary principle and 3. The nearness principle, Organic agriculture nurtures soil biodiversity, Energy use, The potential of organic farming	HSC 5102 - Organic and Sustainable Horticultural Crop Production
5	**Participatory Seed Production & Seed Saving** Use of quality seeds and planting materials of well-adapted crops and varieties emphasis on particular issue of local concern – salt tolerant varieties / flood tolerant varieties/ taking feedback from farmers **Seed system** Conservation of plant genetic resources (Natural selection) , Crop varietal development, Seed production and delivery including Classes of seeds (Breeder, Foundation, Registered, Certified) Village / Community Seed Bank	AGY 4103-Seed Technology HSC – 4115 Horticultural seed production BPE 321 Principles of Plant Breeding BPE 4107 – Plant Genetic Resources Conservation and Management
6	**Water management** **Alternate Wetting and Drying (AWD) techniques for rice cultivation** Background Procedure Contribution to CSA **Water harvesting and saving techniques** – Rain-fed cropping systems (Rainwater harvesting), Groundnut cultivation with green manure crop and wind break trees in dry zone, afforestation, *Sterculia* (Shaw Phyu) growing, replacement fuel for firewood Irrigated cropping systems (Deficit irrigation for high yield and maximum net profits, Knowledge-based precision irrigation) Mulching, cover crops for moisture conservation	AGY 221 Field crop production III SWS-4202 Crops Water Management SWS- 5101 Soil and Water Conservation

Unit		Course code and title
	Improved Micro Irrigation for Vegetables - drip irrigation / sprinkler/sub-irrigation Background Relationship to CSA Impacts and lessons learned	AGC-724 Integrated Water Management HSC – 4114 Horticultural crop production
	Moisture harvesting for groundnut with windbreak trees in dry zone area	***Case study**
7	**Agroforestry** **Agroforestry and Sloping Agricultural Land Technology (SALT)** History of agroforestry, Agroforestry and ecosystem, Myanmar Agenda 21, Greening activities, Shifting cultivation to Agroforestry (for hilly region), SALT for Upland/Hills zone such as Mindat, Chin State, Appropriate Land-use policy Mangrove to offset deforestation for Irrawaddy Delta leading to production of aquatic food, policy to change firewood system **Community forest in Myanmar** Current situation Government support The benefit to the community	AGY 101 Field crop production I AGY 4201 – Agrometeorology Visiting Lecturer from Forestry University Visiting Lecturer from Forestry University
	Biogas to replace firewood in rural area	***Case study**
	The role of SALT for soil conservation and crop production	***Case study**
8	**III System approaches** Introduction Unsustainable management of natural resources Climate change threat to ecosystems in Myanmar Perspectives on the landscape approach	AEC 4201 Natural resource and

Unit		Course code and title
	Some governance issues in implementing	environmental economics
9	**Value chains** Introduction to sustainable and inclusive food (value) chains **Three elements** – Diversification**,** Climate-proofing**,** Supply chain efficiencies Sustainable and inclusive food value chains in practice: the case of food losses and waste Step-by-step approach for chain actors to improve their performance along the sustainable and inclusive food value chain Conclusions **Rice / Green gram value chain analysis** The key player in the value chain Value Chain Analysis of Rice End Markets Opportunities Major Constraints and Bottleneck along the Value Chain How to make it more profitable **Harvesting & Post-harvest management** Small farm implements for moisture saving Mechanization for timely harvest, Drying for quality improvement, Post-harvest systems, Food security and post-harvest Agriculture, Factors influencing the adaptive capacity of post-harvest systems Suitable seed/Grain storage techniques	AEC - 321 Agricultural marketing and trade AEC - 321 Agricultural marketing and trade AGY 4204 Post Harvest Technology HSC – 4114 Horticultural crop production

Unit		Course code and title
	The role of mechanization to offset climate change	***Case study**
10	**IV Enabling environments** Introduction	
	Crop insurance in Myanmar Background Current situation Lessons learned from other countries **Integrated Pest Management (Integrated Crop Management)** Crop varietal resistance, Timing and spatial management, Ecosystem based strategy – Use an ecosystem approach, Undertake contingency planning, Analyse the nature of pest outbreaks, Determine how much production is at risk, Undertake to track pest pattern in real time, Reduce insecticide use / Alternatives to pesticides Use or encourage natural enemies	AEC 311 - Microeconomics ENT 4101 - Insect Ecology ENT 4201 -Insect Pest Management ENT 4202 - Plant Resistance to Insect PTY 4102 - Control of Plant Diseases I PTY 4201 - Genetics of Plant Disease
	Climate information services The history of Department of Meteorology and Hydrology Current situation in Myanmar Traditional methods for prediction of climate	AGY 4201- Agrometeorology / Visiting Lecturer from Meteorology and Hydrology
	Policy engagement Agriculture Policy Myanmar Climate Smart Agricultural Strategy (MCSAS) The key targets of CSA 1. Adaptation targets 2. Mitigation targets	AEC 533 Rural Development Policy AEC 633 Rural Development Policy

Unit		Course code and title
	3. Climate –smart village targets Implementation of MCSAS in three steps 1. Short-term steps 2. Medium-term steps 3. Long-term steps	
	Strengthening institutional capacity to adapt to CC	***Case study**
	Extension approach Challenges and perspectives, Demonstration plots, Farmer field School/Participatory approach Farmer to farmer, Observe local situation, Mitigation risks, Reducing steps in value chain, Food security, food safety, market and target research and extension design (not upstream but downstream)	AGY – 5101: Participatory Extension Approach
	Gender and social inclusion Key messages Gender-differentiated impacts of climate change The gender gap in agriculture and its implications on the context of climate change Inclusion of gender and other disadvantaged groups in agriculture development	AEC 533 Rural Development Policy AEC 633 Rural Development Policy

***Case studies are only for postgraduate level.**

At the end of each section, assignment relevant to each topic will be given to the students individually or as a group. In some cases, a video clip related to some particular topics will be shown and group discussion will be followed to assess the understanding of the students and also to get some idea how to apply the idea or technology and tools to benefit Myanmar farmers taking examples and lessons from the global context.

Unit and content will be the same for undergraduate level and postgraduate level. However, master students need to read more widely and to submit more assignments and practice group discussion. They also need to explore case studies.

Field trips to the areas severely affected by climate change will be arranged to see the impact of climate change and how farmers are tackling the problems and also to witness if they do have success stories.

Food and Agriculture Organization of the United Nations
Representation in Myanmar
Seed Division Compound, Department of Agriculture
Insein Road, Gyogon, Yangon
Tel: +95-1-641672
Fax: +95-1-641561
Email: FAO-MM@fao.org

CA3676EN/1/03.19