Course Climate Smart Agriculture (CCSA)			
Coordinator	TEJ (Jantien Tempert)	**credits**	**22**

Module elements	**EC**	**Name**	**Exam**	**Period**	**Literature**
CCSA01	2	Principles of sustainable climate smart agriculture	Integrated assessment	5 Feb – 17 May ‘24	
CCSA02	4	Plant breeding and selection towards drought resilience	Integrated assessment	5 Feb – 17 May ‘24	
CCSA03	7	Agricultural production in water-scarce areas; soil and water management	Integrated assessment	5 Feb – 17 May ‘24	
CCSA04	4	Project @ Cirkl Business Lab	Poster Presentation (achieved / not achieved)	5 Feb – 17 May ‘24	
CCSA05	1	Integrated Pest Management	Training	5 Feb – 17 May ‘24	
CCSA06	4	Advanced English language training	Portfolio	5 Feb – 17 May ‘24	

Professional task:	Analysing and advising about climate smart agriculture to increase resilience of plant and animal production to climate change and contribute with agriculture activities to mitigation possibilities in the agricultural value chains.
Role:	Advisor, trainer (also possible: entrepreneur and policy maker)
Methods:	Lectures, practical training, project work, lab work
Fields of expertise:	**Learning objectives (The student):**
CCSA01	• Has general knowledge about Climate Smart Agriculture • Is able to assess the situation of different international areas and companies (case studies) on climate change. • Knows how different greenhouse gases influence climate • Can define the different climate risks and impacts • Knows how agricultural activities contribute to climate change and how agriculture can play a role in mitigation • Knows how agricultural production, climate change and food security interact
CCSA02	• Is able to describe crop characteristics and crop growth under different circumstances. • Can explain the effect of abiotic stress factors, like high/low temperatures, deficient water and high salinity, on the plant growth and development • To explain cultivation practices and plant strategies to cope with stress factors • To describe different selection methods to improve crops by plant breeding
CCSA03	• Can describe the soil type and geology of a specific region • Is able to evaluate the soil’s suitability for agricultural use • Can describe the water system in a region (and on farm level) • Can describe the weather circumstances in a region and it’s influences on agricultural production (same for farm level) • Is able to evaluate water management (quality and quantity) in a region (and on farm level) and give suggestions for improvement • Is able to describe the drainage and/or irrigation system

	• Gives improvements for water quality and biodiversity
CCSA04	• To put into practice knowledge learned in CCSA1-CCSA3 • Can explain how his/her project contributes to climate smart agriculture. • Can transfer the knowledge gained in the project to practical situations.
CCSA05	• Explain what IPM is and apply the term to agricultural issues • Knows different ways of isolating fungi from the soil • Knows how to use the soil as a source to rebalance nature • Can set a sustainable mass production line for fungi • Knows the minimum conditions to grow the fungi under lab conditions. • Can explain the difference between selective medium and general medium. • Is able to isolate fungi from infected insect to growing medium without contamination. • can make a fungal purification and grow fungi from one single spore
CCSA06	At the end of this training you are on a Cambridge B2 level. This means that you can produce and receive English in such a way that you can: • participate in meetings in your area of expertise, if you have help understanding some points. • discuss gender issues as they relate to perceptions of rudeness and cultural norms. • talk about your personal finances and give advice to friends and colleagues about their finances. • talk about your personal and professional lifestyle, including a description of your life at work. • explain your education, experience, strengths and weaknesses, and discuss your career path. • talk about mental processes and how you can use them to improve your effectiveness on the job. • talk about what you like to read and make recommendations about good things to read. • use appropriate language in social situations, including praising and expressing sympathy. • discuss leadership qualities and talk about leaders whom you admire. • deal with relatively complex awkward situations that arise in social and business contexts. • discuss common political situations and the behaviour of politicians.
Aeres competencies:	
To present, to research, to endorse sustainable behaviour, to appreciate the global perspective	
Final qualifications:	
• To know the current developments in the agri-food sector • Developing a vision and strategy for an (international) agri-food business • Entrepreneurship and innovation in the international agri-food business. • Effective cooperation and communication in a multi-disciplinary, intercultural environment. • Management and development of own professional and personal attitude and skills	

Involved Teachers:

Module elements	Name	Teacher
CCSA01	Principles of sustainable climate smart agriculture	Mohamad al Hassan, PhD in Plant Science, MSc Botany/Plant Biology
CCSA02	Plant breeding and selection towards drought resilience	Jeroen Vermue, MSc Plant Breeding
CCSA03	Agricultural production in water-scarce areas; soil and water management	Jolien Lelivelt, MSc Aquaculture and Marine Resources Management, MSc Earth and Environment Karin Blok, MSc Soil Science
CCSA04	Project @ Cirkl Business Lab	Zilal Suleiman, MSc Plant Protection, MSc Plant Protection and Integrated Pest Management Michiel Klaassen, PhD Plant Science, Plant Breeding and Genetics Eric de Bruin, PhD Biotechnology
CCSA05	Integrated Pest Management	Zilal Suleiman, MSc Plant Protection, MSc Plant Protection and Integrated Pest Management
CCSA06	Advanced English language training	Lize van de Pol, Master of Arts, English Language and Literature

CCSA04; Link with innovation and research

Our professors, lecturer-researchers and students carry out practice-oriented research together with partners from education, industry and governments. In doing so, Aeres aims to further develop not only the practice of our education, but also the world of work. Now and in the future.

Together with companies and institutions, the research department of Aeres formulates the research questions. The research is socially relevant, so it directly benefits practice. Moreover, it enriches the scientific knowledge domain. The three faculties each have their own focus and research programme.

In Dronten, the focus is on Sustainable Business and entrepreneurship. The research programme deals with sustainable ways of producing food, responsible entrepreneurship and sustainable business developments in the agri-food and horticultural sectors.

The circular economy, the pursuit for short and fair chains, re-use of raw materials and human and animal health are a source of inspiration. To make serious improvements in this, the business community is looking for smart (digital) methods and technologies and circular economic business models. The Biobased & Circular Economy research line conducts research into sustainable entrepreneurship and matching business models. Research questions that fit this line are all part of People, Planet and Profit issues.

This type of research studies the economic aspects of a circular economy in the agro and food sector. These are studies of the circularity of residual waste, circularity of construction and conversion of buildings and farmyards, and the development of related business models. They also include encouraging innovations to improve techniques that reduce pollution from residual waste. Other studies within the research line are more conceptual in nature, looking at aspects applicable to different chains or conducting empirical research on specific aspects within one chain or parts of chains.

Examples of projects that CCSA students contribute to:

Most of these practical assignments are conducted in the CirKl Business Lab (CBL). This is a big greenhouse next to the school, also called the cold greenhouse. In this greenhouse we perform experiments focused on Circular Entrepreneurship, so there is always a relation with Climate Smart Agriculture. Finding out why these experiments might be related to Climate Smart Agriculture is one of your tasks.

We would like to involve as many as possible students and teachers in the research we are doing at the CBL. So, after students experienced what happens at the CBL, students create an informative and good-looking poster about the topic, including the following criteria: share what you did at the CBL, what the relation is with Climate Smart Agriculture and the opportunities for the future, looking at more sustainable agriculture.

1. Vermicompost

To valorise waste streams created in and around our university, we set up a vermicomposting system. In this system, the worms use the waste streams to create high-value compost, the vermicompost.

The first task in this project is managing the worm bins, so to keep the system running. This is done by feeding the worms based on a recipe, watering and measuring the circumstances. Next to that, it

is interesting to set up small research with leaf litter on behalf of the municipality of Dronten. In this you are entirely free and we are open for any other ideas.

2. Urban tower farming

This system consists out of four towers of 2m high in a round shape. Plants can be fitted on/into the tower. Every tower has a misting nozzle installed at the inside. The system was tested for a short period but is not work properly. It is your task to make the system work properly. Once it's working, you can start growing your plants/herbs/lettuce in the system.

3. Microgreens

Microgreens are young, edible plants that are typically grown from seeds and harvested just a few weeks after germination. Microgreens considers as a system between urban farming systems (growing plants inside cities). The focus of this project is to create a comprehensive manual for indoor microgreen cultivation within our facilities (CBL and kitchen) while considering all necessary environmental conditions (such as irrigation, light, ventilation, growing medium.... etc.).

4. Hydroponics system

Hydroponics is a method of growing plants without soil, using nutrient-rich water solutions. In a hydroponic system, plants are grown in containers filled with an inert growing medium, such as perlite or rockwool, or suspended in air using techniques like aeroponics.

This project has two main objectives:

1. To determine the most sustainable materials to use as containers for growing plants in a hydroponic system.
2. To establish a fully automated, smart system for maintaining the hydroponic system, ensuring optimal growth conditions for the plants.

5. Green Walls at school

The school is preparing for “green farming” in the school itself. Some advice has already been given about this by other students. In order to choose the right plants that can grow on the walls of the school building, we want you to do some systematic measurements, like:

- What is the humidity,
- What is the temperature,
- How much (sun)light is there?

We would like this data to be systematically collected over a longer period for the spots we have defined the plants to grow. After collecting this data, we want you to advise us about the type of plants we can grow here, or the measures to get the right circumstances to let the plants of our choice grow. Some advice about the right soil and nutrients for the plants is also very much appreciated.

6. Oyster mushroom project:

Setting up a small-scale mushroom farm at Aeres Innovation Centre with the goal of producing *Pleurotus* mushrooms sustainably and profitably in a mobile container. Coffee ground from the school will be used as a substrate for growing these mushrooms and after harvesting the mushrooms will go to the school canteen and the remains will be converted to vermicompost in the CirKl Business Lab.

7. Salt water aquaponics

This project turns the problem 'brackish ground water' into the opportunity to grow salt-tolerant vegetables (New Zealand Spinach), together with shrimp. The system is not yet fully operational, the shrimp are not in the system yet (but that can change during the time on which students are working on the project). The plants now lack nutrients. This project focusses on monitoring the nutrients (e.g. EC) in the water and identifying what the plants need for optimal growth (if we change nutrient x, this happens, etc). Next to that, it is important that we can get a continuous supply of plants out of the system to use in the restaurant of Aeres. Thus, a plan must be made to harvest the same amount of vegetables each week, together with planting the next seedlings in the system.

8. Omega-garden system

This system was already used at another location. Right now, the physical components are available in the CirKl Business Lab but has some malfunctioning components. Your task is to make the system work again and then start growing lettuce and/or herbs in the system. The Omega-garden is a 1m diameter rotating cylinder with grow light in the middle of the cylinder. Underneath the cylinder it has a water reservoir with nutrients in it. The plants are constantly influenced by the gravity, caused by the rotation of the plants.

9. Optimization of Energy Efficient Production Systems using Duckweed as a model crop.

The cost of energy is a major concern for crop growers in the Netherlands. Recently the cost price of natural gas has increased dramatically, making conventional crop production systems unprofitable. Therefore, the sector is interested in novel energy efficient systems using existing or new crops. In this assignment you will grow duckweed (an aquatic protein crop) in research greenhouses and test physical parameters on the development and yield of duckweed. Parameters may include temperature, humidity and light type and intensity. The research will be carried out in the CBL (circle business lab) at the campus of Aeres UAS in Dronten.

10. Batch digester

With a digester, it is possible to produce methane gas from organic matter. This organic matter could be roadside grass, residual feed from the farm or something similar. The digester is working and should be run. You can measure the amount of produced gass. The work that comes with this batch digester is 1) arrange the input of the digester, 2) to fill the system and 3) monitor the producting. One batch is functional for about 30 days. After the 30 days you can empty, refill and start monitoring the system again.

11. Tiny greenhouse trials

In the CirKl Business Lab are three (3) little greenhouses. Every greenhouse can be set to have its own climate. One of these greenhouses will be ready in a short period of time to start with experimenting. Inside the greenhouse is a carrier with LED lights which can be adjusted for the right light recipe. Make this your own and start experimenting with a wide range of crops/plants.

12. Heat innovation

Heat Innovation is a little pilot warmth/heat storage unit. We are trying to make it part of the heating system of one of the little greenhouses in the CirKl Business Lab. This isn't ready yet. You can help with creating a working heating storage and trying to make the system function automatically by creating the right setpoints.

13. Production of mealworms on organic waste streams from juice-companies.

A company nearby Dronten is producing mealworms for human consumption and is looking for new plant-based waste streams for influencing the colour and the taste of the mealworms. Feeding experiments have to be performed with different waste-streams from a smoothie/juice producing company to investigate if there is an effect on both parameters.

The course ‘Climate Smart Agriculture’ is aimed at students who are motivated to contribute to the adaptation of agriculture to climate change. Climate-smart agriculture emphasizes adaptive strategies to cope with changing climatic conditions liking rising temperatures, changing precipitation patterns, and a higher frequency and intensity of extreme weather events. This includes for example selecting crops that are more resilient to heat, drought, or floods, and adopting farming practices that can adapt to variable and unpredictable weather patterns. Climate-smart agriculture aims to enhance the resilience of agricultural systems to these changes.

During the course, students will work out case studies, in which soil and water management and plant adaptation are integrated. Next to that, hands-on projects in our circular business laboratory or green house are included. This implies that Aeres UAS is a strong advocate in ‘learning-by-doing’.