Datum: 06.06.2024 Nr.: 8

Inhaltsverzeichnis

Fakultät für Agrarwissenschaften:

Die Veröffentlichung des Modulverzeichnisses zur Prüfungs- und Studienordnung für den konsekutiven Master-Studiengang „Sustainable International Agriculture" (Amtliche Mitteilungen II Nr. 7/2024 S. 6666 ff.) ist fehlerhaft und wird hiermit für ungültig erklärt. Nachfolgend erfolgt die korrekte Veröffentlichung.

Nach Beschlüssen des Fachbereichsrates des Fachbereichs Ökologische Agrarwissenschaften der Universität Kassel vom 12.07.2023 sowie des Fakultätsrats der Fakultät für Agrarwissenschaften der Georg-August-Universität Göttingen vom 06.07.2023 sowie nach Zustimmung des Senats der Universität Kassel vom 06.12.2023 haben das Präsidium der Universität Kassel am 19.02.2024 und das Präsidium der Georg-August-Universität Göttingen am 22.05.2024 die Neufassung des Modulverzeichnisses zur Prüfungs- und Studienordnung für den konsekutiven Master-Studiengang „Sustainable International Agriculture" genehmigt (§ 44 Abs. 1 Satz 2 Nr. 1 Hessisches Hochschulgesetz (HHG) und § 44 Abs. 1 Satz 2 Niedersächsisches Hochschulgesetz (NHG); § 36 Abs. 2 Satz 1 Nr. 5 HHG; § 41 Abs. 2 Satz 2 NHG; § 37 Abs. 5 Satz 1 HHG; §§ 37 Abs. 1 Satz 3 Nr. 5 b), 44 Abs. 1 Satz 3 NHG).

Die Neufassung des Modulverzeichnisses tritt nach deren Bekanntmachung in den Amtlichen Mitteilungen II rückwirkend zum 01.04.2024 in Kraft.

Directory of Modules

zu der Prüfungs- und Studienordnung für den konsekutiven Master-Studiengang "Sustainable International Agriculture" (Amtliche Mitteilungen I 6/2011, zuletzt geaendert durch Amtliche Mitteilungen I Nr. 18/2024 S. 430)

Modules

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Index by areas of study

I. MSc Sustainable International Agriculture (English)

At least 120 C must be succesfully completed within the following regulations.

1. Specialisations

At least 90 C must be succesfully completed within a specialisation.

a. International Agribusiness and Rural Development Economics

aa. Compulsory modules

The following four compulsory modules must be completed:

bb. Elective compulsory modules

From the following modules five mandatory modules (of which at least one module is on learning work methods with code M) must be completed:

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cc. Elective modules

From the following modules (or the so far not chosen mandatory modules of the degree programme) six elective modules must be completed. Language courses at level B1 or B2 of the Common European Framework of Reference for Languages (CEFR) or comparable totaling 6 C may be considered once as electives, provided that the course is not English or the student's native language.

b. International Organic Agriculture

aa. Compulsory modules

The following bridging module (P07) and four compulsory modules comprising 30 C must be successfully completed.

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bb. Elective compulsory modules

From the following modules four mandatory modules (of which at least one module is on learning work methods with Code M and one economics module with Code E) must be completed:

cc. Elective modules

From the following modules six elective modules must be completed. It is also possible to choose the mandatory modules of the degree programme so far not chosen. Language courses at level B1 or B2 of the Common European Framework of Reference for Languages (CEFR) or

comparable totaling 6 C may be considered once as electives, provided that the course is not English or the student's native language.

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c. Tropical Agricultural and Agroecosystems Sciences

aa. Compulsory modules

The following bridging module (P07) and four compulsory modules must be completed.

bb. Elective compulsory modules

From the following modules four mandatory modules (of which at least one module is on learning work methods with Code M) must be completed:

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cc. Elective modules

From the following modules, six electives must be completed. It is also possible to choose the mandatory modules of the degree programme that have not already been chosen. Language courses at level B1 or B2 of the Common European Framework of Reference for Languages (CEFR) or comparable totaling 6 C may be considered once as electives, provided that the course is not English or the student's native language.

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2. Master's thesis and Colloquium

Successful completion of the Master's thesis and of the colloquium for the Master's thesis is worth 30 Credits.

II. Supplementary Modules for Student of the double degree programme with the University of Talca

1. Study programme at the universities of Kassel and Goettingen in the first and second semester

a. Study programme at the universities of Kassel and Göttingen

Students must complete during the first two semesters at the University of Göttingen and Kassel:

aa. Compulsary modules

The following four compulsory modules must be successfully completed:

bb. Mandatory modules

From the following three mandatory modules must be successfully completed:

_____

cc. Elective Modules

From the following modules (or so far not chosen elective modules of the major field of study) three elective modules must be successfully completed:

b. Study programme at the university of Talca

During the last two semesters at the University of Talca, students must complete a range of modules from the following modules program:

aa. Mandatory modules

From the following modules two mandatory modules must be successfully completed:

bb. Elective Modules

From the following modules three electiv modules must be successfully completed:

2. Study programme at the universities of Kassel and Goettingen first and fourth semester

First semester at the Universities of Göttingen and Kassel, two semesters at the University of Talca and the last semester at Göttingen and Kassel.

a. Study programme at the universities of Kassel and Göttingen

Students must complete during the first semester at the Universities of Göttingen and Kassel:

aa. Compulsory Modules

The following three compulsory modules must be successfully completed

bb. Mandatory modules

From the following one mandatory module must be successfully completed

cc. Elective Modules

From the following one elective module must be successfully completed

b. Study programme at the university Talca

During the two semesters at the University of Talca, students must complete a range of modules from the following modules program:

aa. Compulsory Modules

The following compulsory module must be successfully completed:

bb. Mandatory modules

From the following four mandatory modules must be successfully completed:

cc. Elective Modules

From the following modules (or so far not chosen elective modules of the major field of study) five elective modules must be completed:

3. Study programme at the universities of Kassel and Goettingen during the thrid and fourth semester

Students who study as part of the double degree programme with the University of Talca complete the following study programme during the first two semesters at the University of Talca.

a. Study programme at the university Talca

Students who study under the double degree program with the University of Talca must complete during the first two semesters at the University of Talca:

aa. Compulsory Modules

The following one module must be successfully completed:

bb. Mandatory modules

From the following four mandatory modules must be successfully completed:

cc. Elective Modules

From the following modules (or not so far chosen elective modules of the major field of study) five module must be completed:

b. Study programme at the universities of Kassel and Göttingen

During the semester at the University of Kassel and Göttingen, students must complete range of modules from the following modules programme:

aa. Compulsory Modules

The following three compulsory modules must be successfully completed:

bb. Mandatory modules

From the following modules one mandatory module must be successfully completed:

cc. Elective Modules

From the following modules (or so far not chosen elective modules of the major field of study) one elective module must be successfully completed:

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Georg-August-Universität Göttingen **Module M.Agr.0009: Biological Control and Biodiversity**	6 C 6 WLH

Learning outcome, core skills: Gain an understanding of what biological control is and how it can be used effectivelyas part of an IPM system and how biodiversity contributes to control of pest populations and other ecosystem services.	**Workload:** Attendance time: 84 h Self-study time: 96 h

Course: Biological Control and Biodiversity (Lecture, Exercise, Seminar) *Contents*: • Theoretical foundations of biological control • Natural enemy behaviour and biological control success • Biodiversity and ecosystem services in agroecosystems • Practical examples of biological control projects • Plant-herbivore-predator-interactionsPrinciples of population dynamics • Biological weed control	6 WLH
Examination: Written exam (70%; 45 minutes) and presentation (30%; approx. 20 minutes) **Examination prerequisites:** regular attendance at seminar and exercise and presentation of a seminar talk **Examination requirements:** Basic knowledge of the mechanisms of biological control of herbivorous insects; methodological approaches based on case examples; role of biodiversity for ecosystem processes and the population dynamic of herbivorous insects, multitrophic interactions between plants, herbivorous insects and their natural enemies; biodiversity and services of ecosystems.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Michael Georg Rostás
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Additional notes and regulations: Lecture based materials; details provided during lectures.

Georg-August-Universität Göttingen **Module M.Agr.0056: Plant Breeding Methodology and Genetic Resources**	6 C 4 WLH

Learning outcome, core skills: Students learn the integration of classical and molecular approaches to solve present problems in plant breeding. Social aspects have to be considered. Students learn, in own presentations, to draw critical conclusions from recent research papers and to communicate these to other students.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Plant breeding methodology and genetic resources (Lecture) *Contents*: Principles of breeding methodology: Response to selection, breeding methods for clonal, line, hybrid and population cultivars. Marker assisted selection for monogenic and polygenic traits. Use of plant genetic resources: wild species, ex-situ and in-situ conservation, on-farm management. Breeding for marginal environments, demonstrated with examples from temperate and tropical regions.	4 WLH
Examination: Written exam (90 minutes, 80%) and presentation (approx. 20 minutes, 20%) **Examination requirements:** Population Genetics, Application of Markers in Plant Breeding, Concepts of using genetic resources in plant breeding. Good knowledge on: 'Pre-Breeding', categories and methods in Plant Breeding.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) in genetics and plant breeding
Language: German, English	**Person responsible for module:** apl. Prof. Dr. Wolfgang Link
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 25	

Additional notes and regulations: **Literature:** Lecture based material.

Georg-August-Universität Göttingen **Module M.Agr.0086: World Agriculture Markets and Trade**	6 C 6 WLH

Learning outcome, core skills: Theoretical foundations of international trade: Ricardo, Heckscher-Ohlin-Viner; Empirical tests for different trade theories; imperfect competition in international trade; gravity theory; institutions and organisations on world agricultural markets; agricultural trade liberalisation at the multilateral (WTO) and bilateral level; specific policy measures in agricultural trade.	**Workload:** Attendance time: 84 h Self-study time: 96 h

Course: World agricultural markets and trade (Lecture, Exercise) *Contents*: This module deals with the situation in the world agricultural markets and with the intervention of agricultural and trade policy in these markets based on an introduction into basics of the international trade theory. The students are able to discern populistic arguments against free-trade. They can estimate if there are reasons to deviate from the from the postulate of free-trade in matters of agricultural products, e.g. in order to reward the positive external effects of the agriculture, to ensure the food supply, to fend off dumping or to correct distorted world prices for agricultural products.	6 WLH
Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Handelstheoretische Grundlagen: Ricardo, Heckscher-Ohlin-Vanek, Viner; Empirische Tests von Handelstheorien; unvollkommener Wettbewerb auf internationalen Märkten; Grundlagen von Gravitätsgleichungen; Institutionen und Organisationen auf Weltagrarmärkten; Agrarhandelsliberalisierung auf multilateraler (WTO) und bilateraler Ebene; spezielle Politikmaßnahmen im internationalen Agrarhandel	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of agricultural economics
Language: English, German	**Person responsible for module:** Prof. Dr. Bernhard Brümmer
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 90	

Additional notes and regulations: **Literature:** Feenstra, R.C. 2004: Advanced international trade: Theory and evidence. Princeton University Press

Georg-August-Universität Göttingen **Module M.Agr.0106: China Economic Development: From an Agricultural Economy to an Emerging Economy**	6 C 4 WLH

Learning outcome, core skills: The students learn more about the specificities of China's economic transformation as well as the underlying economic concepts.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: China Economic Development: From an agricultural economy to an emerging economy (Lecture, Seminar) *Contents*: The lecture is designed for master students enrolled at the University of Göttingen. The course covers experiences and lessons to be drawn from China's economic transformation, by explaining the root causes for a shift from an agriculturally dominated to an emerging economy.	4 WLH
Examination: Presentation (about 25 minutes, 50%) and homework (max 15 pages, 50%) **Examination requirements:** Presentation and critical discussion of a scientific aspect of China's economic transformation.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Xiaohua Yu
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.Agr.0118: Applied Microeconometrics**	6 C 4 WLH

Learning outcome, core skills: Learn the basic logics behind each econometric model, understand the tests for model specification, and appropriately explain the model outputs in connection to economic theories.	**Workload:** Attendance time: 40 h Self-study time: 140 h

Course: Applied Microeconometrics" (Internship, Lecture, Seminar) *Contents*: This course mainly teaches how to correctly apply basic econometric models to studying specific research questions for master level students in agricultural economics, agribusiness, and related programs at the University of Goettingen. The main software package used in this course will be STATA.	4 WLH
Examination: Written examination (120 minutes, 70%) and term paper (max. 12 pages, 30%) **Examination requirements:** 1. Understand the econometric models taught in the class 2. Use Stata skillfully	6 C

Admission requirements: Ökonometrie I / Econometrics I	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Xiaohua Yu
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.Agr.0148: Policy Analysis of International Agri-environmental Schemes**	6 C 4 WLH

Learning outcome, core skills: Students gain essential knowledge on the analysis of policy instruments in agri-environmental systems and are capable to apply selected methods and criteria for policy analysis.	**Workload:** Attendance time: 40 h Self-study time: 140 h

Course: Policy analysis of international agri-environmental schemes (Seminar) *Contents*: This module is aimed at analyzing public policies in agri-environmental schemes. The module will • Outline the role of agriculture for positive and negative environmental externalities, e.g. biodiversity loss, climate change, multi-functionality of agriculture • Introduce into governance and policy processes of agri-environmental schemes • Give an overview of policy instruments, such as economic incentives and environmental standards and regulation • Present criteria and methodologies to conduct policy analysis Students will subsequently conduct a small policy analysis of their own interest in the field of agri-environmental policy and incentive instruments (national, EU-level or international level), e.g. EU-CAP, PES schemes, carbon markets in agriculture, sustainability standards, environmental financing, or land-use planning.	4 WLH
Examination: Presentation (approx. 25 min; 30%) and term paper (max. 20 pages; 70%) **Examination requirements:** Students write a seminar paper on the analysis of specific agri-environmental policy measures applying selected evaluation criteria and methods. Subsequently, they present and discuss their findings in class.	6 C

Admission requirements: none	**Recommended previous knowledge:** M.Agr.0124: Environmental Economics and Policy
Language: English	**Person responsible for module:** Prof. Dr. Meike Wollni
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 2 - 3
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Agr.0151: Data Analysis with R in Agricultural Economics**	6 C

Learning outcome, core skills: Students learn - the basic functionality of the statistical software package R - how to retrieve, manage and analyze datasets - an independent and autonomous usage of online resources (e.g. packages, support, R-literature) with regard to topics in agricultural economics. The course aims at providing a tool-set for the successful completion of final thesis with quantitative focus.	**Workload:** Attendance time: 55 h Self-study time: 125 h

Course: Data Analysis with R in Agricultural Economics (Block course, Exercise) The course is split into two main components: The first one is mainly concerned with R programming while the second part deals with applied analysis of datasets connected to agricultural economics: **1. Programming in R:** Introduction and basic functionalities, data management, data visualization, coding styles, functions and programming, dynamic report generation and maps **2. Applied Data Analysis:** data sources in agricultural economics and related API packages, application of selected econometric techniques	
Examination: Term Paper (max. 15 pages) **Examination requirements:** Students prove that they are capable of - finding relevant data, manage and manipulate datasets - applying an appropriate econometric or statistical method and create a corresponding code which is comprehensive and reproducible - interpreting data and results through the use of graphical tools. The produced code has to be handed in along with the paper and will also be subject to the evaluation.	6 C

Admission requirements: Econometrics I (*M.WIWI-QMW.004*), Introduction to Econometrics (B.WIWI-VWL.0007) or equivalent	**Recommended previous knowledge:** Basic econometric techniques (OLS)
Language: English	**Person responsible for module:** Prof. Dr. Bernhard Brümmer
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Georg-August-Universität Göttingen **Module M.Agr.0156: Microfinance for the Rural Poor: A Business Class**	6 C

Learning outcome, core skills: Students learn concepts of different microfinance instruments, such as microcredit, microsaving, and microinsurance. Students can critically evaluate the potentials and drawbacks of microfinance tools for the rural poor. Designing their own business model, students learn how to properly • work in groups • brainstorm an idea • pitch and argue for their business idea • write a business plan	**Workload:** Attendance time: 66 h Self-study time: 114 h

Course: Microfinance for the Rural Poor: A Business Class (Block course, Lecture) *Contents*: This module provides students with an overview of microfinance instruments. In groups, the students will be given case studies involving rural poor from different regions, facing different problems. The challenge is to apply a microfinance instrument to the respective case study, making it a business model. Being supported, the groups will need to create their own business idea, pitch and argue for it and write a business plan to prove it is a thought through idea.	
Examination: Presentation (approx. 20 minutes, 40%) and term paper (max. 12 pages, 60%) **Examination requirements:** Good knowledge about microfinance instruments (definition, criticism, and examples), Applying business ideas in among low-income population (difficulties and chances); Proper writing of a business plan/ argumentation of an idea).	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Oliver Mußhoff
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen **Module M.Agr.0174: Plant Health Management in Tropical Crops**	6 C 4 WLH

Learning outcome, core skills: Students are able to recognize pests and diseases of tropical crops as treated in this course. They critically evaluate scientific and non-scientific publications on crop protection in the tropics. Students are able to create a scientific presentation according to the standards of international conferences and use interactive teaching material; students know the scope and limits of their knowledge in the treated field, they know where to find relevant, reliable information. Students learn to consider subject-related issues from a variety of different perspectives and to work effectively in international teams.	**Workload:** Attendance time: 36 h Self-study time: 144 h

Course: Plant Health Management in Tropical Crops (Lecture, Excursion, Seminar) *Contents*: Blended learning module; presentation of the most important pests and diseases of the most important tropical crop plants: symptoms, life cycles and plant health management (eg. in rice, maize, cacao, coffee, bananas). Additional crops may be included according to students´ preferences and practical experience. Introduction to relevant international data banks and networks. Use of scientific videos on selected topics of crop protection in the tropics.	4 WLH
Examination: Written exam (45 min, 40%), Student presentation with discussion (ca. 20 min presentation + ca. 10 min discussion 60%) **Examination requirements:** • Written exam: main groups of causal agents, basic botany of the crop plants treated, basic biology of causal agents (life cycles etc.), recognition of symptoms, knowledge of control strategies. • Presentation: appropriate according to the standard of international conferences: relevant and sound content, clear structure, style, language (written and spoken) and pronunciation, citation and use of sources according to good scientific practice.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basics of plant pathology, including basics of integrated pest management
Language: English	**Person responsible for module:** Prof. Dr. Michael Georg Rostás
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** from 2
Maximum number of students: 30	

Additional notes and regulations:

The module is designed as a blended learning-course with strong emphasis on digital material and student based learning. Contact time is reduced to allow thorough preparation of the presentations.

Georg-August-Universität Göttingen **Module M.Agr.0180: Mineral Nutrition of Crops Under Different Climate and Environmental Conditions**	6 C 4 WLH

Learning outcome, core skills: Students acquire knowledge of characteristic properties and specialities of nutrient cycles of ecosystems of different climate zones and upon different environmental drivers. Participants develop understanding of important processes and interactions between abiotic condition of locations, processes in soils and in particular on their effects on plant nutrient uptake. They know plant adaptation mechanisms. Students also get knowledge of the use of stable isotopes for the study of the above processes.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Mineral nutrition of crops under different climate and environmental conditions (Lecture) *Contents*: Lectures focus on element dynamics in ecosystems starting with element inputs, their internal turnover processes and dynamics and outputs. In the course of the semester they will cover sub-arctic over temperate to tropical zones and key examples. In each zone a key focus will be on adaptation mechanisms that can be found among wild plants and crops. About one third of the module will address stable isotope methods for studying such subjects.	4 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Knowledge of key characters of nutrient cycles in different climate zones with respect to major problems of soil fertility, plant nutrient supply and other environmental impacts, including anthropogenic management. Second important focus on adaptation mechanisms in plants to cope with nutritional constraints. Basic knowledge in stable isotope tracer methods and natural stable isotope abundance methods for the study of above research subjects.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basics in plant physiology, chemistry and soil science
Language: English	**Person responsible for module:** Prof. Dr. Klaus Dittert
Course frequency: each winter semester	**Duration:**
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 36	

Additional notes and regulations: After successful conclusion of M.Agr.0103 students can not complete M.Agr.0180

Georg-August-Universität Göttingen **Module M.Agr.0200: Machine Learning in Food Economics and Agribusiness**	6 C 4 WLH

Learning outcome, core skills: Machine learning is changing the world from different dimensions, and agricultural and food economics is no exception. In contrast to econometrics of causal analysis, machine learning put more emphasis on prediction and pattern recognition. This course will briefly introduce machine learning algorithms for research of agricultural and food economics. It will help master students to master bask techniques in programing for machine learning with Python and their application in food economics and agribusiness analysis.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Machine Learning in Food Economics and Agribusiness (Lecture, Exercise) *Contents*: This course will introduce basic algorithms in machine learning and apply them to research of agribusiness and food economics. Specifically, we will introduce Python language, and how to use Python to realize plotting, feature engineering, linear regression, logit model, support vector machine, k-nearest neighbor, random forest, k-means clustering, neural network and deep learning (ANN, CNN and RNN). **Course Outline** 1. Introduction to Python and its application of machine learning in agricultural economics 2. Data Plotting and visualization 3. Linear regression and feature engineering 4. Logit model and support vector machine 5. k-nearest neighbor and discrimination analysis 6. Classification and random forest 7. Artificial neural network and deep learning (CNN and RNN) 8. Unsupervised learning: k-means clustering, PAM, Principal Component Analysis, and 9. Machine learning with time series data **Programming Requirement**: 1. Python : https://www.python.org/ 2. Anaconda: https://www.anaconda.com/ 3. VScode: https://code.visualstudio.com/ **Text books:** Swamynathan Manohar.2017.Mastering Machine Learning with Python in Six Steps. APress. Matthes E. , 2022. Python Crash Course, 3rd Edition. No Starch Press, L.A. Raschka Sebastian, Yuxi (Hayden) Liu, Vahid Mirjalili.2022. Machine Learning with PyTorch and Scikit-Learn. Packet Press. 2022.	4 WLH

Reference Papers :

Wang H. , X. Yu (2023) "Carbon Dioxide Emission Typology and Policy Implications: Evidence from Machine Learning". Forthcoming in China Economic Review.

Maruejols L., L. Hoeschle, X. Yu (2022) Vietnam between economic growth and ethnic divergence: A LASSO examination of income-mediated energy consumption. Energy Economics.

Graskemper V., X. Yu and Jan-Henning Feil (2022) Values of Farmers-Evidence from Germany, Journal of Rural Studies. Vo. 89:13-24.

Wang H., L. Maruejols, and X.Yu (2021) Predicting energy poverty with combinations of remote-sensing and socioeconomic survey data in India: Evidence from machine learning. Energy Economics. Vol. 102, 105510. https://doi.org/10.1016/j.eneco.2021.105510

Graskemper V., X. Yu and Jan-Henning Feil (2021). Farmer Typology and Implications for Policy Design – an Unsupervised Machine Learning Approach. Land Use Policy. Volume 103, April 2021, 105328.

Examination: Written examination (120 minutes, 70%) and homework assignments (30%) **Examination requirements:** Examination requirements: 1. Understand the machine learning models taught in the class 2. Use python skillfully	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Xiaohua Yu
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.Agr.0201: Dynamic modelling in land use systems**	6 C 4 WLH

Learning outcome, core skills: System dynamics is an interdisciplinary field of study that combines insights from various disciplines, such as sociology, agronomy, economics, ecology and computer science, to understand the behaviour of complex systems over time. The course on system dynamics aims to equip students with a solid understanding of the principles and methods used in this field. The targets of the course include developing an understanding of complex systems, teaching students how to model and simulate these systems, analysing feedback loops, understanding system behaviour, optimizing systems, and developing effective communication skills.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Dynamic modelling in land use systems (Lecture, Exercise) *Contents*: System dynamics is an interdisciplinary field of study that combines insights from various disciplines, such as sociology, agronomy, economics, ecology and computer science, to understand the behaviour of complex systems over time. The course on system dynamics aims to equip students with a solid understanding of the principles and methods used in this field. 1. Understanding complex systems: The primary target of a course on system dynamics is to help students develop an understanding of complex systems. System dynamics is concerned with the study of systems that are made up of interdependent components that interact with one another in complex ways. These systems can be found in a wide range of fields, such as economics, ecology, healthcare, and engineering. A course on system dynamics provides students with the necessary tools and techniques to analyse and model such systems, and to understand the behaviour of these systems over time. 2. Modelling and simulation: Another important target is to teach students how to develop models of complex systems and simulate their behaviour. System dynamics modelling involves constructing a graphical representation of the system, identifying the key components and their interrelationships, and developing equations that describe the behaviour of the system over time. Simulation involves running these equations to generate predictions of how the system will behave under different conditions. A course on system dynamics helps students develop the skills needed to create and run such models and simulations, and to interpret the results. 3. Analysis of feedback loops: Feedback loops are a central concept in system dynamics, and a course on this topic aims to help students understand their role in complex systems. Feedback loops occur when the output of a system is fed back into the system as input, leading to a cycle of cause and effect. System dynamics courses teach students how to identify different types of feedback loops, such as reinforcing and balancing loops, and how they can impact the behaviour of a system. Students also learn how to analyse the dynamics of feedback loops using mathematical and computational tools.	4 WLH

4. Understanding system behaviour: A course on system dynamics also helps students understand the behaviour of complex systems over time. System dynamics models can be used to generate predictions of how a system will behave under different conditions, and to identify key factors that influence the behaviour of the system. Students learn how to use these models to understand the behaviour of systems in various domains, such as business, healthcare, and the environment. They also learn how to interpret the results of these models and to use them to make informed decisions.

5. System optimization: In addition to understanding system behaviour, a course on system dynamics also teaches students how to optimize complex systems. System optimization involves identifying the goals of the system and developing strategies to achieve them while taking into account various constraints and trade-offs. Students learn how to use system dynamics models to optimize systems in various domains, such as supply chain management, energy systems, and transportation.

6. Communication: Finally, a course on system dynamics aims to develop students' communication skills. Students learn how to communicate complex concepts and models to a wide range of audiences, including policymakers, managers, and other stakeholders. Effective communication is critical in system dynamics, as it helps to ensure that the insights generated by models are understood and acted upon by decision-makers.

The targets of the course include developing an understanding of complex systems, teaching students how to model and simulate these systems, analysing feedback loops, understanding system behaviour, optimizing systems, and developing effective communication skills.

Examination: 4 Home assignments (50%), 1 written paper (50%) **Examination prerequisites:** attendance of 80% of the course sessions	6 C

Admission requirements: none	**Recommended previous knowledge:** Regional Economics, Agroecology, Agr. Sociology, div
Language: English, German	**Person responsible for module:** Dr. sc. agr. Holger Bergmann
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: three times	**Recommended semester:**
Maximum number of students: 16	

Georg-August-Universität Göttingen **Module M.FES.321: Ecopedology of the Tropics and Subtropics**	6 C 4 WLH

Learning outcome, core skills: General understanding of the most important aspects of tropical and subtropical soils, their occurrence, genesis, geography, properties and use. Understanding the principles of the international FAO soil profile description and classification.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Ecopedology of the Tropics and Subtropics (Lecture) *Contents*: Part I: General introduction in soils of the tropics and subtropics, their functions, genesis, geography and properties. Objective: general understanding of the most important aspects of tropical soils, their occurrence, genesis, properties and use. The following topics will be discussed: Introduction; Climate, water and vegetation; Weathering and weathering products, clay minerals; Soil organic matter, C and N dynamic; Soil chemical reactions, variable charge; Soil forming processes and development of soils; Water and nutrient cycling of land use systems; Tropical shield areas (example: Amazon basin); Arid shields and platforms (example: West Africa); Tropical mountain areas (example: Andes); Fluvial and coastal areas in the tropics (example: coastal areas in Asia). Part II: Introduction in the description and classification of soils, using in international system (FAO). Objective: understanding the principles of the FAO soil profile description and classification. The course consists of introductory lectures in which the principles of the FAO soil description and classification will be explained. This knowledge will be practiced using examples of soil profiles from different tropical countries. The second part consists of a practical week during which soil profile descriptions and evaluations will be exercised in the field. We will visit three contrasting sites around Göttingen where a site and soil description will be made. The work will be done in small groups. Students discuss their results in a report.	4 WLH
Examination: Term paper (10 pages max.) and written exam (2 hours)	6 C

Examination requirements: Being able to describe, classify and evaluate soils for forestry applications in (sub)tropical regions. Understand most relevant biogeochemical processes and function of (sub)tropical soils. Calculate water and nutrient stocks in soils. Explain differences between soils in different (sub)tropical regions.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Edzo Veldkamp
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**

Maximum number of students:	
not limited	

Georg-August-Universität Göttingen **Module M.FES.734: Agroforestry Design Course**	6 C 4 WLH

Learning outcome, core skills: Acquiring knowledge to design an agroforestry system. The gained knowledge will be applied for own design work in groups, in cooperation with real farms that aim to plant agroforestry systems. This course is for students who aim to implement agroforestry in the field as farmers or as agroforestry consultants.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Agroforestry Design Course (Lecture, Excursion, Seminar) *Contents*: Learn about different agroforestry systems, historic developments, design processes, analysis of local conditions, (social) context, complexity, geography and water management, soil and plants, tree spacing and management, economy and marketing and map design. Two short excursions are included.	4 WLH
Examination: Presentation (approx. 10 minutes) with written outline (max. 5 pages)	6 C

Examination requirements: Agroforestry design as a group work of approx. 3 students. Presentation and report to explain and embed the design in scientifically sound contexts, as learned in the course	

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge on Agroforestry
Language: German	**Person responsible for module:** Franziska Leonie Gaede
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: cf. examination regulations	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.A02M: Epidemiology of international and tropical animal infectious diseases	6 C 4 WLH

Learning outcome, core skills: Based on a scientific and practical up-to-date level, students know to evaluate and develop modern and effective livestock hygiene and husbandry concepts and to integrate them into complex quality management programs. Graduates are trained to be competent in implementing and communicating their knowledge in a multidisciplinary occupational setting that establishes epizootic control programs.	Workload: Attendance time: 84 h Self-study time: 96 h

Course: Epidemiology of international and tropical animal infectious diseases (Lecture, Exercise) *Contents*: Infectious diseases play an enormous role in international animal health control. National health and veterinary authorities, as well as international organizations (WHO, FAO) are very much involved in the surveillance of epidemics and establishment of health and hygiene monitoring programs. These efforts will increase in future, because of a further globalization of international markets, and will require well-educated experts collaborating worldwide in this multidisciplinary field. This module will give a generalized view of current epidemics together with a specialized understanding of infectious diseases and hygienic programs in subtropical and tropical countries. Characteristics of the biology of relevant infectious agents like parasites, fungi and bacteria together with their toxins, viruses, and prions will be presented in detail. Some of these germs included in this unit cause severe zoonotic diseases with a lethal danger for humans. Immunological host-defence mechanisms of wild and domestic farm animals against pathogens will be discussed together with modern strategies of active and passive immunizations. Diagnostic methods presently available and new biotechnological approaches in future assay and vaccine development will be demonstrated. The adaptation of practical health and standardized quality management processes to various animal production systems (ruminants, pigs, poultry) and the corresponding management measurements will be explained. The view will deeply focus on environmental impacts (water, soil, air hygiene), epizootiology and modern tools in epizootiological research. It will include biology and eradication of vectors (insects, ticks) transmitting pathogens of animal and zoonotic diseases, as well as biological and chemical methods for vector control. In the laboratory course, this module will also communicate well-established techniques of microbiological and parasitological diagnostics. Students will be practically trained in classical methods and in modern biochemical, immunological, biotechnological and molecular biological techniques for the detection of infectious agents, toxins and noxious substances. Tissue culture procedures for vaccine or antibody development are also used. Modification of livestock-environment interactions through human management are discussed.	4 WLH
Examination: Oral examination (approx. 90 minutes)	6 C

Examination requirements:
Knowledge of current veterinary epidemic and infectious diseases inclusive emerging diseases. Background of hygiene and eradication programs. Profound knowledge in important infectious agents (parasites, fungi, bacteria, viruses) as well as toxins and prions. Skills in immunologic defense mechanisms of wildlife, zoo and domesticated animals in connection with modern active and passive vaccination strategies and biotechnological vaccine development. Knowledge in modern diagnostic tools as well as in biology and control of biological vectors (ticks, midges).

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) of soil, plant and animal sciences
Language: English	**Person responsible for module:** Prof. Dr. Jens Tetens
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Additional notes and regulations:
Literature:

Lecture based materials.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.A03M: International and tropical food microbiology and hygiene**	6 C 4 WLH

Learning outcome, core skills: Based on a scientific and practical up-to-date level, students know to evaluate and develop modern and effective food hygiene concepts and to integrate them into complex quality management programs. Graduates are competent to implement and to communicate their knowledge in a multidisciplinary occupational area establishing epizootic control programs in food microbiology and hygiene. They are able to understand international experts of public health authorities and collaborate in international and multidisciplinary platforms including control, monitoring, and research.	**Workload:** Attendance time: 84 h Self-study time: 96 h

Course: International and tropical food microbiology and hygiene (Lecture, Exercise) *Contents*: Infectious and toxic pathogens cause most of the food-borne impacts on human health all over the world. Global markets require an international surveillance system together with standardized food hygiene regulations. This module will give a generalized view of currently and internationally relevant food-borne zoonotic diseases, epidemics and food hygiene programs together with a specialized view on the conditions in subtropical and tropical countries. The biology of infectious agents (parasites, fungi, yeasts, bacteria, viruses, prions, together with their toxins) responsible for contaminations and intoxications of human food of animal origin will be discussed in detail. Some of these germs cause severe zoonotic diseases with a lethal potential for humans or certain age groups. Special characteristics of germ resistance in the food matrices meet, milk and eggs as well as in the corresponding products are elucidated along the complete manufacturing processes: from stable to table. Deterioration and spoilage of foodstuffs by microorganisms will be discussed as well. Diagnostic methods presently available for the detection of contaminated or spoiled nourishments and new biotechnological approaches in future assay designs will be analysed. The adaptation of practical hygiene and standardized quality management adjustment factors to various animal production systems (ruminants, pigs, poultry) as well as to the subsequent production processes will be explained together with the corresponding management measurements. This includes food conservation procedures, germ depletion and eradication techniques (cleaning, disinfection, autoclaving, sterilization). Beside negative microbial effects influencing food quality, positive effects especially of bacteria and fungi in food production will also be presented. Biotechnological aspects of genetic engineering of foodstuff supplements or directed genetic germ design will be discussed. In a laboratory course on food microbiology, this module will also communicate well-established techniques of microbiological and parasitological diagnostics in food matrices. Students will be practically trained in classical methods and in modern biochemical, immunological, biotechnological and molecular biological techniques for the detection of food-borne infectious agents, toxins and noxious substances.	4 WLH

Vorlesungsbegleitende Materialien	
Examination: Oral examination (approx. 90 minutes) **Examination requirements:** Knowledge in current food-borne zoonoses, programs in food hygiene and requirements for their implementation in tropical and subtropical countries. Background of the biology of infectious agents, tenacity of special microorganisms and microbial spoilage of foodstuffs, available diagnostic tools for detection of contaminated or spoiled foodstuffs and about new biotechnological diagnostic assays. Skills in practical hygiene norms, normative documents and standardized international quality management systems, foodstuff conservation, germ depletion and inactivation as well as in positive influences of bacteria and fungi on foodstuff production.	6 C

Admission requirements:	Recommended previous knowledge:
none	Basic knowledge (B.Sc. level) of soil, plant and animal sciences
Language: English	**Person responsible for module:** N. N.
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 20	

Additional notes and regulations: **Literature:** Lecture based materials.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.A04: Livestock reproduction physiology**	6 C 4 WLH

Learning outcome, core skills: Acquire in-depth knowledge of the physiology of reproduction of agricultural livestock; Ability to critically consider what has been learned and to independently identify and solve problems of global challenges in the reproduction of farm animals	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Livestock reproduction physiology (Lecture, Excursion, Exercise, Seminar) *Contents*: Anatomical and physiological principles of reproduction in farm animals (endocrinology, growth factors, oogenesis, spermatogenesis, reproductive cycles, reproductive-specific behavior, insemination and fertilization, pregnancy, parturition, lactation and care of offspring); Reproductive Biotechnologies, Assisted Reproductive Technologies (artificial insemination, pregnancy diagnosis, gamete preservation, embryo transfer, in vitro fertilization, sex determination on gametes and fetuses, cloning techniques, creation of transgenes); stem cells; ethics. Hafez B., Hafez, E.S.E. 2000: Reproduction in Farm Animals 7th ed. Lippincott Williams & Wilkins Publishing; Bearden, H.J., Fuquay, J.W., Willard, S.T. 2004: Applied Animal Reproduction, 6th ed. Pearson Prentice Hall Publishing; Squires, E.J. 2003: Applied Animal Endocrinology 1st ed. CABI Publishing; Pineda, M.H., Dooley, M.P. 2003: Mc Donald's Veterinary Endocrinology and Reproduction 5th ed. Blackwell Publishing. Senger P.L. (2003): Pathways to pregnancy and parturition (2nd edition). Current conceptions, Inc.	4 WLH

Examination: Oral examination (approx. 30 minutes) **Examination requirements:** The exam will ask knowledge and transfer questions related to the lecture content (i.e. endocrinology, physiology of reproduction, genetics, animal husbandry, animal nutrition, animal hygiene and reproductive biotechnologies). Emphasis is placed on being able to assess the interaction of the individual disciplines in reproductive management.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of animal sciences
Language: English	**Person responsible for module:** Prof. Dr. Michael Hölker
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students:	

20	

Additional notes and regulations:

After successful conclusion of M.Agr.0069, M.Agr.0070 and B.Agr.0331 students can not complete M.SIA.A04

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.A07: Unconventional livestock and wildlife-management, utilization and conservation**	6 C

Learning outcome, core skills: Based on the historical development of agriculture, particularly the domestication of animals, students know the differences between livestock and wildlife and the importance and potential of unconventional livestock and wildlife for rural development and human livelihoods in different regions of the world. Students obtain an overview over the wide variety of unconventional livestock, their adaptive features, biology and ecology and the various production systems under which they are kept. Students familiarize with the variety of wildlife species, their biology, ecology, and population dynamics and the potential of their exploitation. They know the major international conventions pertaining to wildlife conservation and are familiar with the nature and magnitude of human/wildlife conflicts. They know about costs and benefits associated with human-wildlife-co-existence and understand the dilemma between (inter)national conservation objectives and local household livelihood objectives. Students obtain an overview over different terminal and non-terminal options of wildlife utilisation and management and their respective potential contribution to the above conflicting objectives.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Unconventtional livestock and wildlife-management, utilization and conservation (Block course, Excursion, Seminar) *Contents*: History of domestication of livestock. Unconventional livestock in Asia/Oceania, Africa and Latin America: Biology, management and, production systems. Commercial and subsistence products from little known domesticated animal species – such as insects, snails, reptiles, rodents, up to little-used ungulates. Local and national economic potential and contribution to local livelihoods. Wildlife in Asia, Africa and Latin America: Biology, wildlife demography and modelling of population dynamics, human/wildlife conflicts, international conventions on (agro)-biodiversity and conservation, strategies for wildlife conservation through utilisation, different wildlife utilisation concepts, wildlife-based tourism, terminal wildlife utilisation of different intensity ("Hunting/Trophy hunting", "Game-Ranching", "Game Farming", "Feedlot" with beginning domestication), community-based utilisation cum conservation approaches. Contribution of wildlife utilisation to the livelihood of rural communities. Regulations, possibilities and constraints for wildlife conservation. Diamond, J. 1999: Guns, Germs, and Steel: The Fates of Human Societies. W.W.Norton and Company, New York, 480 p.; Board on Science and Technology for International Development 1991: Microlivestock Little-Known Small Animals with a Promising Economic Future. National Academy Press, Washington D.C., 449; Bonner, R.. 1993: At the Hand of Man - Peril and Hope for Africa's Wildlife. Alfred A. Knopf Inc., New York, 322 p.; Convention on International Trade in Endangered Species of Wild Fauna and Flora 1973/1979 at http://www.cites.org/ (incl. appendices)	WLH

Examination: Written exam (90 minutes, 70%) and oral seminar presentation (ca. 20 minutes, 30%)	6 C
Examination requirements: Domestication / taming; unconventional domesticated animals: Biology, management, husbandry, economic potential. Wildlife: Biology, population dynamics, modelling of population dynamics; human-wildlife conflicts, international conventions on biodiversity and species conservation. Wildlife utilization: Tourism, game ranching, game hunting, trophy hunting.	

Admission requirements: none	Recommended previous knowledge: Basic knowledge (B.Sc. level) of soil, plant and animal sciences
Language: English	Person responsible for module: Prof. Dr. Eva Schlecht
Course frequency: SoSe, jedes 2 Jahr, alternieernd mit dem Modul M.SIA.A08; Witzenhausen	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: not limited	

Additional notes and regulations: **Literature:** Diamond, J. 1999: Guns, Germs, and Steel: The Fates of Human Societies. W.W.Norton and Company, New York, 480 p.; Board on Science and Technology for International Development 1991: Microlivestock Little-Known Small Animals with a Promising Economic Future. National Academy Press, Washington D.C., 449; Bonner, R.. 1993: At the Hand of Man - Peril and Hope for Africa's Wildlife. Alfred A. Knopf Inc., New York, 322 p.; Convention on International Trade in Endangered Species of Wild Fauna and Flora 1973/1979 at http://www.cites.org/ (incl. appendices)

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.A08: Social-ecology in livestock production systems**	6 C 4 WLH

Learning outcome, core skills:	Workload:
Students understand livestock systems as social-ecological systems in which livestock farmers, through their actions, establish, maintain and develop the respective production system. Consequently, these so-called human activity systems are assessed using an actor-oriented approach. Emphasis of this module is on methods that are used to analyse and improve livestock farmers' management. This serves to understand "why livestock farmers do what they do" and "how livestock farmers produce". Students learn how they can make use of the knowledge of livestock farmers to better understand how low external input systems work. Collaborative learning is introduced as methodology to develop human activity systems in a transdisciplinary research approach. They deal with the question of how mutual understanding between livestock farmers and scientists can be achieved despite the different knowledge systems. Students obtain a profound insight into methods for farmer experimentations in which livestock farmers and scientists collaborate, and into using computer models as learning tools for ex-ante assessment of improvement measures in community based approaches. In "what – if" analyses, the change of action rules on the performance of socio-ecological systems is assessed.	Attendance time: 60 h Self-study time: 120 h

Course: Social-ecology in livestock production systems (Block course, Lecture, Seminar) *Contents*: Theoretical background of the social-ecological system view: System theory, 1st and 2nd order cybernetics, complex adaptive systems, human activity systems. Actor-oriented approach to understand and influence low external input systems: Local knowledge and situated practices Methodology for understanding local knowledge: Second order observation and knowledge analysis Collaborative learning: Exchange between knowledge systems, dialogue, action research, livestock farmer experimentation, participatory monitoring and evaluation Modelling of livestock systems as tool for collaborative learning: Bio-economic modelling, multi-agent modelling, role plays. Kaufmann, B.A. 2007: Cybernetic analysis of socio-biological systems: The case of livestock management in resource poor systems. In: Kommunikation und Beratung, Volume 81, Margraf Publishing; McCown, R.L. 2002: Changing systems for supporting farmers' decisions: problems, paradigms and prospects. Agricultural Systems 74: 179-220; Wiener, N. 1948: Cybernetics or control and communication in the animal and the machine. John Wiley, New York.	WLH
Examination: Written exam (90 minutes, 70%) and presentation (ca. 20 minutes, 30%)	6 C

Examination requirements:

Social-ecological systems analysis; systems theory, cybernetic, complex adaptive systems, human activity systems. Local knowledge and situated practices; analysis of local knowledge; cooperative learning; modelling of livestock husbandry systems.

Admission requirements:	**Recommended previous knowledge:**
none	Basic knowledge (B.Sc. level) of soil, plant and animal sciences
Language:	**Person responsible for module:**
English	Prof. Dr. Brigitte Kaufmann
Course frequency:	**Duration:**
SoSe, jedes 2 Jahr, alternierend mit dem Modul M.SIA.A07; Witzenhausen	1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**
twice	
Maximum number of students:	
30	

Additional notes and regulations:

Literature:

Kaufmann, B.A. 2007: Cybernetic analysis of socio-biological systems: The case of livestock management in resource poor systems. In: Kommunikation und Beratung, Volume 81, Margraf Publishing; McCown, R.L. 2002: Changing systems for supporting farmers' decisions: problems, paradigms and prospects. Agricultural Systems 74: 179-220; Wiener, N. 1948: Cybernetics or control and communication in the animal and the machine. John Wiley, New York.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.A10M: Livestock nutrition and feed evaluation under (sub)tropical conditions	6 C 4 WLH

Learning outcome, core skills: Students are able to: • describe the function of the major digestive systems and processes of domestic livestock species and their consequences for ration formulation • understand the different feeding strategies and nutritional requirements of the main livestock species • assess the quality of feedstuffs through theoretical concepts and practical feed quality analyses • calculate rations for the main livestock species • understand abiotic and biotic environmental influences on the physiology of different livestock species • discuss opportunities and limitations of feeding strategies for an optimization of livestock production under specific agro-ecological settings	Workload: Attendance time: 56 h Self-study time: 124 h

Course: Livestock nutrition and feed science *Contents*: The lecture explains and discusses the nutritional physiology of the main livestock species. The adaptation of the different livestock species to climatic conditions and to qualitatively and quantitatively variable fodder supply is analysed. Possibilities to reduce the negative impact of environmental factors on animal production through adapted feeding strategies and ration formulation are evaluated.	2,5 WLH
Course: Laboratory analyses of feedstuffs *Contents*: Students are introduced to the main standard methods of feed quality analyses, such as determination of crude protein, macro-minerals, cell wall constituents and *in vitro* digestibility. They apply these methods onto selected tropical feed samples and write an essay on one method, thereby interpreting the quality of their feed samples which they determined with the selected method.	1,5 WLH
Examination: Oral (approx. 20 minutes; 75%) and protocol (max. 6 pages; 25%) Examination requirements: Knowledge of basic terms relevant to livestock nutrition and physiology, feed science and feed quality analysis; insights into interdependencies between the discussed fields and livestock performance; ability to explain species-specific implications of nutrition physiology on global feed requirements of livestock systems.	6 C

Admission requirements: none	Recommended previous knowledge: Basic knowledge (B.Sc. level) of animal sciences
Language: English	Person responsible for module: Prof. Dr. Eva Schlecht

Course frequency:	Duration:
each winter semester; Witzenhausen	1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**
twice	
Maximum number of students:	
12	

Additional notes and regulations:

Literature:

- *Close, W.H., Menke, K.H. (eds.) 1986: Selected topics in animal nutrition. A manual. Deutsche Stiftung für Internationale Entwicklung (DSE), Feldafing, Germany*
- *Payne, W.J.A., Wilson, R.T. 1999: An Introduction to Animal Husbandry in the Tropics. Blackwell Science Ltd., Oxford, UK*
- *Van Soest, P.J. 1994: Nutritional Ecology of the Ruminant. Cornell University Press, Ithaca, US*
- *Selected up-to-date journal articles*

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.A11: Tropical animal husbandry systems**	6 C 4 WLH

Learning outcome, core skills: Students are able to: understand the impact of the natural and economic environment on the evolution of different types of husbandry systems as well as on their orientation and intensity of production; gain understanding for parameters that have to be considered when aiming at the improvement of livestock husbandry systems within a given framework; individually analyse and present a specific tropical livestock production system.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Tropical animal husbandry systems (Lecture, Seminar) *Contents*: This module provides an extensive overview on the different forms of animal husbandry systems in developing and transformation countries of Africa, Asia and Latin America, ranging from camel nomadism in deserts to beef ranching and intensive dairying in tropical highlands. The system-specific strategies of livestock management are analysed in view of their ecological and economic sustainability. The (potential) interactions of livestock with other components of the farming system are explored, thereby differentiating between market and subsistence oriented systems. The role of additional factors influencing livestock production systems such as cultural, social, economical and political frame conditions are discussed. Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S., Courbois, C. 1999: Livestock to 2020. The next food revolution. FAO Discussion Paper 28, FAO Rome, Italy; Devendra, C., Thomas, D., Jabbar, M.A. and Zerbini, E., 2000: Improvement of Livestock Production in Crop-Animal Systems in Agro-ecological Zones of South Asia. ILRI, Nairobi, Kenya; Falvey, L., Chantalakhana, C. (eds) 1999: Smallholder Dairying in the Tropics. ILRI, Nairobi, Kenya	4 WLH
Examination: Written exam (90 minutes, 75%) and oral seminar presentation (ca. 15 minutes, 25%) **Examination requirements:** abiotic and biotic conditions of animal husbandry in the (sub-)Tropics; characteristics, opportunities/constraints of pastoral, agro-pastoral, silvo-pastoral, aquatic, industrial and urban systems; species-specific management and production (cattle, sheep, goat, camel, yak, pig, poultry).	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) of plant and animal sciences or agricultural economics
Language:	**Person responsible for module:**

English	Prof. Dr. Eva Schlecht
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:

Literature:

Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S., Courbois, C. 1999: Livestock to

2020. The next food revolution. FAO Discussion Paper 28, FAO Rome, Italy; Devendra,

C., Thomas, D., Jabbar, M.A. and Zerbini, E., 2000: Improvement of Livestock

Production in Crop-Animal Systems in Agro-ecological Zones of South Asia. ILRI,

Nairobi, Kenya; Falvey, L., Chantalakhana, C. (eds) 1999: Smallholder Dairying in the

Tropics. ILRI, Nairobi, Kenya

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.A13M: Livestock-based sustainable land use**	6 C 4 WLH

Learning outcome, core skills: To understand the interactions of livestock with the natural resource base and their site- and management specific positive or negative environmental impacts; To get acquainted with and test methodological approaches used in field research on livestock-environment interactions; To learn about simple modelling approaches and the significance of their results.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Livestock-based sustainable land use (Lecture, Exercise) *Contents*: This module highlights the general positive and negative impacts of livestock and livestock management on the natural resources (air, water, soil vegetation), specifically under (sub)tropical conditions, at the plot to the watershed scale. It discusses options for sustainable livestock-based land use, thereby building upon the beneficial impacts of animals on soils and plants. Management options for reducing negative environmental effects of livestock (gaseous emissions, nutrient excretion) are highlighted, and possibilities for consolidating the interests of livestock keepers with international conventions are discussed. The students are introduced, in lectures, own reading and practical field tests to up-to-date quantitative and qualitative methods that are used in studies on animal-environment interactions. Simple modelling approaches that depict animal-environment interactions at the plot level up to the watershed scale are presented and tested by the participants. Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M., de Haan, C. 2006: Livestock's long shadow. Fao, Rome, Italy; Specific scientific articles, distributed in the course.	4 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Influences of animal husbandry / the individual animal on its environment: soil fertility and soil erosion, pasture vegetation, nutrient transfers, greenhouse gas emissions; livestock keeping versus nature conservation; methods for assessing quality and quantity of pasture vegetation; methods to determine the animal's behavior at pasture and its feed intake.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) of soil, plant and animal sciences
Language: English	**Person responsible for module:** Prof. Dr. Eva Schlecht
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]

Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: not limited	

Additional notes and regulations:

Literature:

Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M., de Haan, C. 2006: Livestock's long shadow. Fao, Rome, Italy; Specific scientific articles, distributed in the course.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.A14: Organic livestock farming under temperate conditions**	6 C 4 WLH

Learning outcome, core skills: Animal nutrition and animal health: Students have a basic understanding of farm animal nutrition and health management; they understand the challenges emerging in organic livestock systems related to both animal nutrition and animal health and know how to assess, quantify, evaluate and approach these challenges. Animal welfare: Students have a basic understanding of animal welfare, familiarise with different organic husbandry systems, practical problems and scientific concepts including how to assess animal welfare both at farm and system level. Sustainable forage production systems: Students are able to assess the relationships between sward management and structural (yield, botanical composition) and functional (nutrient efficiency) sward characteristics.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Animal nutrition and animal health (Lecture) *Contents*: Principles and regulations of organic livestock farming in Europe; Nutrition in organic cattle, pigs and poultry; Animal health and production diseases; Production diseases in organic cattle, pigs and poultry; Health management in organic livestock farms	1,33 WLH
Course: Animal Welfare (Lecture) *Contents*: Principles of animal welfare in relation to organic farming; scientific methods of welfare assessment.	1,33 WLH
Course: Sustainable forage production systems (Lecture) *Contents*: • Design and management of a sustainable forage production • Management of forage quality and biodiversity on grassland • Minimizing nutrient losses towards water and atmosphere	1,33 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Knowledge of basic terms relevant to organic livestock systems; insights into aspects of feeding, healthcare, welfare, forage production and forage quality assessment; linkages and interdependencies between the discussed fields.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) of animal and forage sciences.
Language: English	**Person responsible for module:** Dr. Margret Krieger

Course frequency:	**Duration:**
each summer semester; Witzenhausen	1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**
twice	
Maximum number of students:	
35	

Additional notes and regulations:

Literature:

Appleby, M.C., Hughes, B.O. (eds) 1997: Animal welfare. CAB International, Wallingford; Vaarst, M. et al. (eds.) 2004: Animal health and welfare in organic Agriculture. CAB International, Wallingford; Hopkins, A. 2000: Grass, its production and utilization. Blackwell Science, Oxford, UK;   Cherney J.H. 1998: Grass for dairy cattle CABI Publishing, Exon, UK; Frame, J. 1992: Improved Grassland Management. Farming Press Books, Ipswich, UK; Marshall, A. & Collins, R. (eds.) 2018: Improving grassland and pasture management in temperate agriculture. Burleigh Dodds Science Publishing Limited, Cambridge, UK.

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.A15M: Scientific writing in natural sciences	

Learning outcome, core skills:	**Workload:**
In the course of their study programme, when compiling their MSc thesis and for their further (academic) career, students have to deliver a variety of scientific texts. Therefore, this module aims at presenting and discussing the main principles of such texts. It provides training in how to write different types of essays, abstracts, grant winning proposals and complex texts (chapters) in preparation and writing of the master thesis research. At successful completion of this module, participants will be able to:	Attendance time: 56 h Self-study time: 124 h

- differentiate the structure and format of various types of scientific texts;
- search scientific literature, set up and manage an electronic literature database and compile reference lists;
- write term papers, grant proposals, conference abstracts, and final thesis (chapters);
- compile scientific tables and figures and be able to decide which type of data is best expressed in which format;
- apply the rules of good scientific practice;
- give and receive constructive feedback on scientific texts.

Course: Scientific writing in natural sciences

Contents:

To provide participants with theoretical basics and practice these, the module will offer a mixture of lecture and exercises. Within the course a variety of facets and techniques of scientific writing will be imparted that graduate SIA students should be able to master. Consequently, participants are introduced to scientific literature search and analysis, good scientific practice and how to avoid plagiarism. Additionally, guidelines for creating concise tables and figures are presented. To be prepared for their master thesis work, students will be taught how to write different scientific text documents such as grant proposals and conference abstracts. By reviewing and discussing a scientific article and peer-reviewing an abstract of a fellow student by using an online tool, module participants will train how to give and receive constructive feedback. Finally, students will choose a topic for their term paper (see below) to further apply the newly acquired knowledge.

| **Examination: 3 short written assignments (approx. 4 pages, 50%) are to be handed in during the semester and one major text (term paper, approx. 6 pages 50%) is to be submitted at the end of the semester.** | 6 C |

Admission requirements:	**Recommended previous knowledge:**
none	Basic knowledge of Word (Microsoft or Open Office) and Adobe Acrobat.

Language:	**Person responsible for module:**
English	Prof. Dr. Eva Schlecht

Course frequency:	**Duration:**
each winter semester	1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**
twice	1 - 3
Maximum number of students:	
30	

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.A16: Livestock Breeding Programs - Planning Procedures, Organization of Breeding Programs and International Case Studies**	6 C 4 WLH

Learning outcome, core skills: Students will gain knowledge on breeding planning concepts and cycles as well as on definition of breeding goals. They know the gene flow method as basis for calculating genetic gain in breeding goal traits. Based on recommended literature and invited lectures by external breeding experts, students will be able to analyze European breeding strategies for practicability and applicability in developing countries of sub-/ tropical regions. They will elaborate and present the application of breeding methods (pure-/crossbreeding) by selected case studies, and thereby gain an understanding of differences of the suitability of breeding methods for different livestock species. By active studying, skills to use planning approaches for pure- and crossbreeding programs in a production system context are acquired. International case studies (livestock species) will be selected based on students' preferences. Complementary literature will be provided to prepare for the lectures; it will be discussed during the lectures and in invited contributions of external breeding experts. The recommended literature should be read before the lecture to be used as a basis for joint discussions during lecture. Specific aspects will be deepened by the lectures and invited speakers, and questions of students are answered during lectures. The contents presented in the lectures will be complemented by selected topics that will be treated by the students in student seminars. In that way, every student has the possibility to study in more detail on one specific content/topic of the course. Independent acquiring of knowledge is learned. The aim of the student seminars is to sharpen the critical view and the attention for problems; to learn how to deal with literature and how to judge differing or contradictory statements; to develop/strengthen the ability of independent, profound, critical analysis and synthesis of literature, as well as the ability of presenting and discussing results of scientific research.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Livestock Breeding Programs - Planning Procedures, Organization of Breeding Programs and International Case Studies (Lecture, Seminar) *Contents*: 1. Definition of breeding goals; 2. Purebreeding: Design of livestock breeding programs, gene flow method, estimation of genetic gain; 3. Crossbreeding: Parameter estimation, prediction of performance in crossbred animals 4. International case studies on organization and process of purebreeding in cattle, sheep and goats; herdbook breeding, nucleus breeding 5. International case studies on organization and process of crossbreeding: Presentation of species-specific breeding methods in crossbreeding – e.g.	4 WLH

      commercial crosses in pigs, stratified crossbreeding in sheep with vertical and
      horizontal integration

6. Structure and efficiency of pure-/crossbreeding programs for different livestock
     species and feasibility under marginal conditions

Literature will be provided to prepare for the lectures and the students' seminars.

Examination: Written exam (90 minutes, 70%) and oral seminar presentation (approx. 20 minutes, 30%) **Examination requirements:** Knowledge of concepts for breeding planning and organization; knowledge of conventional and village (pure-/cross-)breeding schemes; insights into livestock breeding programs in Europe; ability to explain the problems associated with the implementation of breeding programs under marginal conditions	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of animal breeding (BSc level) Basic knowledge of tropical animal agriculture (M.SIA.A11 or M.SIA.A08)
Language: English	**Person responsible for module:** PD Dr. Regina Rößler
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 4
Maximum number of students: 15	

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.A17: Digitalisation in Livestock Systems	

Learning outcome, core skills:	**Workload:**
Following a successful completion of this module, students are expected to:	Attendance time: 56 h
	Self-study time: 124 h

- Have an overview of the current trends in digital technology for agricultural development with particular emphasis on livestock husbandry.

- Be familiar with key terminologies including Precision Agriculture (PA), Precision Livestock Farming (PLF), Precision Pasture Management (PPM), and Digital Livestock Farming (DLF). They should be able to give relevant examples of a range of technologies currently applied to facilitate individual animal management systems.

- Identify the opportunities and challenges of PLF for organic agriculture

- Be able to critically assess the benefits of digitalisation vis-à-vis the socioeconomic realities of agricultural transformation, especially in low- and middle-income countries

- Develop scientific presentation and reporting skills

Course: Digitalisation in Livestock Systems (Lecture, Excursion, Seminar)	4 WLH

Contents:

Course content:

Lectures (16 h), Seminars (plus excursion) 44 h

Digitalisation is revolutionising the agricultural sector at an unprecedented pace requiring the building of human resource capacity to conveniently cope with the emerging norms of farming and livestock husbandry practices. In this module, students will be given a broader overview of the changes that have taken place in agricultural development. The concept of digital transformation which is enforcing the adoption of automation, high-tech sensors, cloud computing, decision making algorithms, and the Internet of Things will be introduced, and terminologies such as PA and PLF will be explained. Focusing on PLF, students will be helped to self-study a range of digital tools currently in use for either individual or group intensive and extensive management systems. These may include but not limited to the following:

- Use of radio frequency identification (RFID) leveraged in other technologies for monitoring feed intake, weight gain etc.

- Behavioural monitoring using on-animal motion and pressure sensors

- Thermal and biochemical sensors for monitoring disease state

- Autonomous animal location management (virtual fencing)

- Pasture management using geographical information system (GIS)

The students must have a fair understanding of what these tools/systems are, their mode of operation, associated costs, and the pros and cons of usage.

As part of the learning process, students will be provided with journal article(s) relevant to the trends in application of digitalisation in PLF. Each student would be required to carefully study/review the article provided, and prepare a 25-page (max.) PowerPoint presentation to be presented in a weekly seminar session. Non-presenting students are also required to attend the weekly seminars and learn from their colleagues. de Queiroz DM, Valente DSM, Pinto FAC, Borém A, Schueller JK, eds. 2022: *Digital Agriculture*. Springer	
Examination: Student presentation with discussion (ca. 25 min presentation + ca. 10 min discussion 70%) and written report (30%) **Examination requirements:** transitions in agricultural development; digital transformation and sustainability; role/trends of digital tools, e.g., sensors in livestock husbandry. Written report and PowerPoint presentation according to international conference standards: concise, sound content, clear structure, and very well communicated (orally in case of ppt).	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Sowah Addo
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 25	

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.E02: Agricultural price theory	

| **Learning outcome, core skills:** | **Workload:** |
| Significance of prices from individual and societal viewpoint, agricultural price structure, role of technical change, vertical and spatial price formation, price formation in quota markets, futures and forward contracts. | Attendance time: 56 h
 Self-study time: 124 h |

Course: Agricultural price theory (Lecture)	4 WLH
Contents: This module is designed to provide students with an introduction to the theory and measurement of price formation on agricultural markets. Students will learn about price formation and price linkages over space and time, and how prices on markets in different locations and/or for products of different levels of processing are linked with one another. They will also learn about special examples of price determination that are unique (land markets) or especially common (markets influenced by quota schemes) in agriculture. A final focus will be placed on future markets and their possible use as a risk management tool in agriculture and agribusiness. Vorlesungsbegleitende Materialien	
Examination: Written examination (90 minutes) **Examination requirements:** Knowledge of impact of prices from an individual and macroeconomic point of view, of agricultural price structure as well as the importance of the technical progress, vertical and spatial price formation, price formation in the farm land market and the quoted market, as well as of commodities future markets	6 C

Admission requirements: none	**Recommended previous knowledge:** Background in agricultural markets and policy recommended
Language: English	**Person responsible for module:** Prof. Dr. Bernhard Brümmer
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 60	

| **Additional notes and regulations:**
 Literature:

 A script and a variety of supplemental reading will be provided. |

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.E05M: Marketing research**	6 C 4 WLH

Learning outcome, core skills: Students · are able to describe how marketing research relates to the marketing concept · are able to outline the steps in the marketing research process and show how the steps are interrelated · know the factors to consider in defining the marketing problem or opportunity · are able to develop a research design · are able to state the specific advantages of the most important methods of data collection · know fundamentals of sampling theory · acquire personal skills for oral and written presentations in teamwork.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Marketing researches (Lecture, Seminar) *Contents*: • Steps and management of marketing research • Development of research design • Methods of data collection • Oral and written presentation of market research topic Aaker, D.A., Kumar, V., Leone, R.P., Day, G.S. (2013): Marketing research. 11th ed., Hoboken: Wiley; Nunan, D., Birks, D.F., Malhotra, N.K. (2020): Marketing research, 6th ed., Harlow: Pearson Education	4 WLH

Examination: Oral examination (30 minutes) 60%, oral and written presentation (20min + 5 p.) 40%	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge on marketing
Language: English	**Person responsible for module:** Prof. Dr. Katrin Zander
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 40	
Additional notes and regulations:	

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.E06: International organic food markets and marketing	

Learning outcome, core skills: Students • are able to describe international markets for organic food • know about international organic regulations • are able to outline the steps for developing a marketing strategy • know how to develop a marketing concept on international markets • acquire personal skills for oral and written presentations in teamwork.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: International markets and marketing for organic products (Lecture, Seminar) *Contents*: • Analysis of international markets for organic products • Organic regulations • Basics of food marketing for exporters • Oral and written presentation of marketing topic Vahlen, Munich. Armstrong, G, Kotler, K., Opresnik, M.O. 2016: Marketing: An Introduction, 13th ed., Pearson, Harlow, UK. Hollensen, S., Opresnik, M.O. 2015: Marketing: A Relationship Perspective.	4 WLH
Examination: Presentation (ca. 20 minutes) with written outline (max. 5 pages) (40%) and oral exam (approx. 30 minutes) (60%) **Examination requirements:** Knowledge of tasks and approaches in market research as well as knowledge of data survey methods, prognosis methods and analysis methods.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge on marketing
Language: English	**Person responsible for module:** Prof. Dr. Katrin Zander
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 35	

Additional notes and regulations:

Armstrong, G, Kotler, K., Opresnik, M.O. 2016: Marketing: An Introduction, 13th ed., Pearson, Harlow, UK.

Hollensen, S., Opresnik, M.O. 2015: Marketing: A Relationship Perspective.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.E11: Socioeconomics of rural development and food security**	6 C 4 WLH

Learning outcome, core skills: Students learn concepts of development and problem-oriented thinking in a development and food security policy context. The identification of interdisciplinary linkages is trained. Building on case-study analyses, course participants can pinpoint appropriate economic and social policies and assess their impacts. These qualifications can also be transferred to unfamiliar situations.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Socioeconomics of rural development and food security (Lecture) *Contents*: This module provides students with an overview of socioeconomic aspects of hunger, malnutrition, and poverty in developing countries. Apart from more conceptual issues and development theories, policy strategies for sustainable rural development and poverty alleviation are discussed and analyzed. Special emphasis is put on problems in the small farm sector. Empirical examples are used to illustrate the main topics.	4 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Concepts and measurement of hunger, malnutrition, and poverty; classification and evaluation of rural development policies	6 C

Admission requirements: none	Recommended previous knowledge: Prior knowledge of microeconomics at the BSc level is useful
Language: English	**Person responsible for module:** Prof. Dr. Liesbeth Colen
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** until 1
Maximum number of students: 120	

Additional notes and regulations: **Literature:** Text books, research articles and lecture notes.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.E12M: Quantitative research methods in rural development economics	6 C 4 WLH

Learning outcome, core skills: Students are familiar with empirical, quantitative methods in rural development economics. They understand the basic elements of research-study design, data collection, and data analysis. Thus, they are able to initiate, develop, and implement their own research projects.	Workload: Attendance time: 56 h Self-study time: 124 h

Course: Quantitative research methods in rural development economics (Lecture) *Contents*: This module teaches the design of quantitative research in rural development economics, starting from formulating research questions and developing a research proposal to undertaking analysis. It trains methodological skills for the analysis of micro data in rural development economics. In particular, farm and household level data are used. Apart from statistical and econometric techniques, approaches of primary data collection are covered (questionnaire development, sampling design, and implementation of household surveys). Aspects of using secondary data are also covered. The statistical and econometric methods are used for concrete examples in the computer lab.	4 WLH
Examination: Written exam (90 Minutes) (85%) and homework assignment (max. 15 pages) (15%) Examination requirements: Types of research designs; use and interpretation of descriptive statistics and standard econometric methods; hypothesis testing; data management; sampling design.	6 C

Admission requirements: Familiarity with the contents of the module "Socioeconomics of Rural Development and Food Security" is assumed.	Recommended previous knowledge: none
Language: English	Person responsible for module: Prof. Dr. Doris Läpple
Course frequency: each summer semester; Göttingen	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 40	

Additional notes and regulations: Literature: Text books, research articles and lecture notes.

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.E13M: Microeconomic theory and quantitative methods of agricultural production	

Learning outcome, core skills: Students are familiar with microeconomic approaches and can apply them to analyze issues related to agriculture and rural development. Students are also familiar with quantitative methods used for the analysis and planning of farms and enterprises in the agricultural sector.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Microeconomic theory of agricultural production (Lecture) *Contents*: Consumer theory, producer theory, markets, monopoly situations, risk and uncertainty, economics of technical change, farm household models, institutional innovations in the small farm sector.	2 WLH
Course: Quantitative methods in agricultural business economics (Lecture) *Contents*: Budgeting, accounting, annual balance sheets, linear programming, finance, investment analysis	2 WLH
Examination: Written examination (120 minutes) **Examination requirements:** Consumer theory; producer theory; risk; technological progress; farm household models; institutional innovations; budgeting and accounting; linear programming; finance; investment analysis	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Oliver Mußhoff Vanessa Bonke
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 40	

Additional notes and regulations: Literature: Text books, research articles and lecture notes. After successful conclusion of M.Agr.0060 students can not complete M.SIA.E13M. This module is designed for students with relatively little economics during their previous BSc studies.

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.E14: Evaluation of rural development projects and policies	

Learning outcome, core skills:	Workload:
Students understand the standard methods in the economic analysis and evaluation of development projects and policies. They are able to design and perform cost-benefit analyses as well as project evaluations independently.	Attendance time: 40 h Self-study time: 140 h

Course: Evaluation of rural development projects and policies (Lecture)	4 WLH
Contents: This module teaches standard methods in the economic analysis and evaluation of development projects and policies. It covers the economic and financial assessment of rural development projects (in particular cost-benefit analysis), as well as experimental and quasi-experimental impact evaluation methods. These methods are illustrated with examples and students learn to apply these methods in different exercises.	

Examination: Written exam (90 minutes, 70%) and homework assignments (max. 10 pages, 30%)	6 C
Examination requirements: Cost-benefit analysis; impact evaluation	

Admission requirements: none	Recommended previous knowledge: Knowledge of the content of the module "Socioeconomics of Rural Development and Food Security" and "Econometrics I" is required.
Language: English	**Person responsible for module:** Ph.D. Bethelhem Legesse Debela
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 45	

Additional notes and regulations: **Literature:** Text books, research articles and lecture notes.

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E17M: Management and management accounting**	6 C 4 WLH

Learning outcome, core skills: The main aim of the module is to acquaint students with the theory and practice of management and management accounting/control, and the role of environmental, social and governance issues therein. More specifically, the aims of the module are: • To provide students with insights into different theoretical perspectives; an understanding of the implicit assumptions held by each perspective as well as the implications of these perspectives for management practice and research; • To provide students with the conceptual and practical skills necessary to effectively understand and critically analyse management/corporate practice; • To provide students with practical experience in and knowledge about "managing and accounting for sustainability"; • To enable students to understand why traditional accounting and accountability do not serve managers and other corporate stakeholders well in the light of increasing demands for social accountability, transparency and social responsibility	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Management and management accounting (Lecture, Seminar) *Contents*: • The fundamentals of management practice, the roles and functions undertaken by managers; • The development and evolution of management theory; • A critical reflection on the wider responsibilities of management (incl. moral decision-making, managing for sustainability); • An introduction to the traditional accounting and accountability theory and practice; key management accounting and control systems and concepts; performance measurement and management; • The developments in new accounting and accountability tools and their role (and limitations) in supporting managerial decision making and increasing transparency on environmental, social and sustainability performance. Lussier, R.N. 2006: Management fundamentals – Concepts, Applications, Skill Development, Thomson, London, UK; Robbins, S.P., Coulter, M. 2007: Management, 9th edition, Pearson, Upper Saddle River; Drury, C. 2005: Management Accounting for Business, Thomson, London, UK; Atkinson, A.A., Kaplan, R.S., Young, S.M. 2004: Management Accounting, 4th Edition, Upper Saddle River.	4 WLH
Examination: Presentation (ca. 15 minutes, 50%) and written examination (90 minutes, 50%) **Examination requirements:** Students should demonstrate a sound understanding of the management / management accounting concepts and frameworks (written exam). Students are also expected to apply the knowledge acquired in class to a case study company and to present and discuss their findings with others (workshops incl. role play and group work).	6 C

Admission requirements:	Recommended previous knowledge:
none	none
Language:	**Person responsible for module:**
English	Prof. Bettina König
Course frequency:	**Duration:**
each winter semester; Witzenhausen	1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**
twice	
Maximum number of students:	
35	

Additional notes and regulations:
Literature:
Lectures and short lectures combined with facilitated group discussion; seminars include case study-based group work and exercises

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.E18: Organization of food supply chains**	6 C 4 WLH

Learning outcome, core skills: Students are introduced into various issues of the organizational design of food supply chains and agribusiness firms. Students learn to write a seminar paper and they are also able to independently acquire additional knowledge by advanced literature search. The preparation and presentation of selected topics as well as the contribution to oral discussions during seminar sessions will be examined. The comprehensive overview of various organizational theories enables the students to identify and classify complex organizational problems in food supply chains and develop solutions.	**Workload:** Attendance time: 68 h Self-study time: 112 h

Course: Organization of food supply chains (Seminar) *Contents*: The module introduces into basic concepts of organizational design in food supply chains and the agribusiness sector. The students write a paper based on the combination of a selected organizational theory and a practical example. The students present their papers and discuss the various organizational issues with high importance for the food and agribusiness sector. Key aspects of the lecture are: - Stakeholder management for farms and agribusiness firms - Efficient organizational design of food supply chains: Contracts, open markets, vertical integration - Competitive strategy and the organizational design of food supply chains - Certification schemes from an organizational perspective - Cooperatives and the organization of food supply chains - Transparency of food supply chains The seminar makes use of various organizational theories and provides students with insights into the practical implications of these theories. Vorlesungsbegleitende Materialien	4 WLH
Examination: Homework (max. 15 pages, 65%) and 2 presentations (about 45 min, 20% and about 15 min, 15%) **Examination requirements:** Ability to write a paper based on the combination of a selected organizational theory and a practical example, to present the paper, serve as a discussant of the paper of another group and discuss the various organizational issues with high importance for the food and agribusiness sector. 1. Presentation: ca. 45 minutes presenting the contents of the own homework; 2. Presentation: ca. 15 minutes discussing the homework of another group of participants.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge food supply chains and agribusiness management
Language: English	**Person responsible for module:** Dr. Christian Schaper

Course frequency:	Duration:
each summer semester; Göttingen	1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**
twice	
Maximum number of students:	
21	

Additional notes and regulations:
Students are not allowed to take the module M.Agr.0053 if they have passed M.SIA.E18.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.E19: Market integration and price transmission I**	6 C 4 WLH

Learning outcome, core skills: Students gain insight into the functioning of the price mechanisms on agricultural markets and into the determinants of market integration. They learn to apply econometric analysis methods to the study of horizontal and vertical price transmission processes (time series methods, cointegration, including non-linear cointegration and non-linear error correction models).	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Market integration and price transmission I (Lecture) *Contents*: Theory and empirical analysis of agricultural market integration A list of seminal papers (Gardner, Goodwin and Fackler, Barrett and others) will be provided to students Lecture notes and presentations are made available on StudIP	4 WLH
Examination: Written examination (90 minutes) **Examination requirements:** Students are able to explain the economic theory of price transmission and market integration (e.g. how can we explain the prevalence of asymmetric price transmission on agricultural markets), and are able to apply the most important methods of empirical price transmission analysis (in particular the econometric estimation of error correction models).	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of econometrics
Language: English	**Person responsible for module:** Prof. Dr. Stephan von Cramon-Taubadel
Course frequency: Every second summer semester (Start: 2021)	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** from 2
Maximum number of students: 40	

Additional notes and regulations: **Literature:** A list of seminar papers (Garnder, Ravallion, Goodwin, Fackler, Barrett) will be circulated to students, together with a list of recent applications.

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.E21: Rural sociology	

Learning outcome, core skills:	Workload:
One of the primary objectives of this course is to introduce students to the principles of sociology in general and key concepts of rural sociology in particular. In addition, we want to provide the analytical tools for understanding the processes inherent to these concepts. Beyond that, the course aims at enhancing students' ability to identify different research perspectives and to critically discuss and analyse research strategies and methods.	Attendance time: 56 h Self-study time: 124 h

Course: Rural Sociology (Lecture, Seminar)	4 WLH
Contents: As an introduction to rural sociology, this course is designed to give an overview of the sociological concepts of "demographic change", "social structural developments and social problems in rural areas" (deprivation, rural poverty): Lectures outline each of these issues and position them within the context of sociology. We will use seminars to debate key questions raised during lectures and to discuss selected issues based on academic publications.	

Examination: Homework (max. 20 pages, 50%) and presentation (approx. 30 minutes, 50%) **Examination requirements:** Presentation of and critical discussion on concepts and methods in the field of rural- and agricultural sociology.	6 C

Admission requirements: none	Recommended previous knowledge: none
Language: English	**Person responsible for module:** Prof. Dr. Claudia Neu
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 25	

Additional notes and regulations:
Literature:
Adequate literature is presented in the lecture; text book chapters supply basic knowledge and are complemented by scientific publications.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.E24: Topics in rural development economics I**	6 C 4 WLH

Learning outcome, core skills: The objective of this course is to acquaint Master students with the reading and understanding of scientific journal articles on relevant topics of rural development economics. Student should learn how to develop a scientific research question, choose appropriate research methods and strucutre a scientific article.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Topics in Rural Development Economics I (Lecture) *Contents*: This course will provide Master Students with an overview of relevant topics in rural development economics, which will also enable them to develop own research questions and study approaches in this field. The module is structured as a reading course, building on selected articles from relevant international journals. Students are required to read announced articles before the classroom sessions, in order to enable a critical debate in class. The articles selected for the course are clustered around key topics relevant to rural development economics, such as listed below. Tentative Topics 1. The food system transformation and smallholder farmers 2. Rural livelihood strategies and income diversification 3. Adoption and impact of modern agricultural technology 4. Economics of nutrition and health 5. Gender and intra-household resource allocation Master students will have to write a summary of a selected journal article. Furthermore, the course should enable them to develop own research questions and study approaches in the field of rural development economics.	4 WLH
Examination: Presentation (approx. 10 minutes, 40%) and homework (max. 4 pages, 60%) **Examination requirements:** Constructive participation in the discussion during the lectures, which requires the reading of the articles indicated. In both the written and the oral assignments, students are supposed to demonstrate that they are able to identify the most relevant aspects of the articles and to critically evaluate the research questions, the methods and the results of the studies.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Meike Wollni
Course frequency:	**Duration:**

each summer semester; Göttingen	1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:
Literature:

Selected articles from academic journals and book chapters

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.E31: Strategic management**	6 C 4 WLH

Learning outcome, core skills: • The contents and framework of strategic management; • An introduction to organisational & business strategies; • The importance of values and purpose in defining organisation's strategic goals; • The management of stakeholder relations; • Performance management and strategic control; • The management of strategic change;	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Strategic management (Lecture, Seminar) *Contents*: • Concepts and frameworks used in strategic management; • The importance of values and purpose in defining an organisation's strategic goals; • The analysis of the complex environment of agrifood organisations and how it shapes the strategic behaviour of members of the value chain and an organisation's competitive environment; • A critical review of strategic frameworks (e.g. Porter's five forces, life cycle analysis); • The analysis of the internal environment (value creating activities, capabilities and resources); • An introduction to organisational and business strategies; • The management of stakeholder relations; • The relationship between organisation and strategy; • The management of strategic change and the role of strategic leadership.	4 WLH
Examination: Oral presentation (approx. 20 minutes, 50%) and written examination (60 minutes, 50%) **Examination requirements:** Students should demonstrate a sound understanding of the strategic management concepts and frameworks. Further requirements include: development of a research design to contribute to the development of a scenario analysis; collection and analysis of data in groups.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Bettina König
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students:	

not limited	

Additional notes and regulations:

Lectures and short lectures combined with facilitated group discussion; seminars include research based learning elements such as case studies and research activities involving students (e.g. scenario analysis).

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.E33: Responsible and sustainable food business in global contexts**	6 C 4 WLH

Learning outcome, core skills: The aims of the module are: • To deepen the students' understanding of the role of food business in society and the social responsibility and accountability issues that arise in a global business setting; • To familiarise students with the concepts and frameworks used in responsible and sustainable food business, the development of business principles for responsible food businesses, to meet stakeholders' interests; To provide students with the knowledge and confidence to critically reflect corporate practice; • To raise awareness for different perspectives which provide contrasting and competing ways of making sense of responsible food business practices.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Responsible and sustainable food business in global contexts (Lecture, Seminar) *Contents*: This module explores issues related to responsible and sustainable food business in global contexts. Individual themes include: • The process of globalisation and its impact on the agrifood sector; • Corporate social responsibility, governance and accountability; • The role of transparency of products and markets in the context of an increasingly globalised world; • The scope, nature and types of international operations (and their managerial implications); • The management of global supply chains in the agrifood sector; • The management and reporting of environmental and social information in complex organisational settings (such as multinational food businesses); • The contrasting perspectives in social responsibility and accountability of business across borders.	4 WLH
Examination: Written report (in the form of a learning journal; 60%) and oral presentation (40%)	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Bettina König
Course frequency: each winter semester; Witzenhausen/Kassel	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**

Maximum number of students: 35	

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E34: Economic Valuation of Ecosystem Services**	6 C 4 WLH

Learning outcome, core skills: Students get introduced to the essential concepts and methods of interdisciplinary Ecosystem Services (ES) research. Special emphasis will be put on the integrated and systematic assessment of ES, including their dependencies of and impacts on biodiversity, climate change and development. Students will familiarize themselves with common methods of economic valuation of ES and learn about different examples of practical implementation in developing countries. Within the scope of a presentation and a term paper, students will review and evaluate selected scientific literature, process the findings in an environmental-economic analysis and compile results and derived policy recommendations for better maintenance, sustainable use and integration of ES into development planning.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Economic Valuation of Ecosystem Services in Developing Countries (Seminar) *Contents*: • Integrated and interdisciplinary analysis of ES • Dynamic linkages between ES, biodiversity, climate change and development • Methods and applications of economic valuation of ES • Implementation examples from developing countries • Integration of ES in development planning (entry points to the policy cycle) • Practical application in a case study (literature work, monetary quantification)	4 WLH
Examination: Term paper (max. 20 pages, 70%) and oral presentation (approx. 30 minutes, 30%) **Examination requirements:** For a given case study students will develop appropriate analytical strategies and implement them with the help of identified scientific literature. Methodological knowledge provided during the lectures will be essential for the case work. Most relevant results will be summarized in a presentation. The compilation of the term paper requires basic techniques of scientific literature research.	6 C

Admission requirements: none	**Recommended previous knowledge:** M.Agr.0079 Environmental Economics and Policy or similar skills
Language: English	**Person responsible for module:** Prof. Dr. Meike Wollni
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students:	

30	

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.E36: Institutions and the food system**	6 C 4 WLH

Learning outcome, core skills: Students: will become familiar with the role of institutions and governance in the food system from a social-ecological systems perspective; will be familiar with public choice and political science approaches to the analysis of constitutions and policies and their change; will be familiar with theories of decentral and central institutional change in the traditions of economics, political science and sociology; will apply this conceptual knowledge concerning the role, performance and change of institutions and governance of a variety of aspects of food systems in different countries in and outside Europe; will review global drivers of change of food and agricultural production systems	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Institutions and the food system (Lecture, Excursion, Seminar) *Contents*: Institutions are core elements structuring economic exchange in the food system. The course starts out with a discussion of what institutions are and what roles a stratified, multi-disciplinary concept of institutions has in food and agricultural systems and their change. Approaches will cover the study of institutions in classical and new institutional economics, in evolutionary economics, in economic sociology and in political sciences. Subsequently, discussions will be organized along public choice and constructivist approaches to understanding centrally driven institutional change on the one hand and economic and constructivist approaches to understanding decentral institutional change on the other. Discussions of the role of institutions for performance of the food and agricultural sectors and their change will be illustrated through ample recourse to examples drawn from studies of the food and agricultural production systems in and outside of Europe. That way, principal drivers of the change of food systems will be reviewed. In this regard, as far as possible examples will be drawn from one particular cultural, national or regional context. Ending the module, potentials and limits of researching the role of institutions in the food and agricultural sectors will be evaluated and corresponding research designs will discussed. Literature and seminar papers will be circulated to students at the beginning of term	4 WLH

Examination: oral exam 20 min. (60%) and term paper (1500 words) (40%) **Examination requirements:** Understanding of the role of institutions and governance in the food system from a social-ecological systems perspective; knowledge of public choice and political science approaches to the analysis of constitutions and policies and their change; knowledge of theories of decentral and central institutional change in the traditions of economics, political science and sociology; application of conceptual knowledge concerning the role, performance and change of institutions and governance to a variety of aspects of food systems in different countries in and outside Europe Knowledge of global drivers of change of food and agricultural production systems	6 C

Admission requirements:	**Recommended previous knowledge:**

none	Background in agricultural and environmental policy and economics
Language: English	**Person responsible for module:** Prof. Dr. Andreas Thiel
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:

Further examination prerequisites:

Participation in the excursion/ thematic day and its preparation/ evaluation

Literature:

Literature and seminar papers will be circulated to students at the beginning of term

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	6 WLH
Module M.SIA.E37: Agricultural policy analysis	

Learning outcome, core skills:	**Workload:**
• Students get an overview on EU institutions and the history of the EU's common agricultural policy (CAP) • Students learn different theories and methods for the analysis of agricultural policies • Students learn how to analyse different policy measures and instruments and evaluate them	Attendance time: 56 h Self-study time: 124 h

Course: Agricultural policy analysis (Lecture)	6 WLH
Contents:	

1. Introduction into Economic Policy and Economic Theory

Definition of agricultural policy, Analytical framework of economic analysis, Objectives, measures, institutions, The coordination process, a model for the economic process

2. Market Failure

Public Goods & externalities, Market power & monopolistic behavior, State intervention due to Instability of markets, State intervention & government failure, principal-agent theory

3. The European Union – A short introduction

History of the EU, the importance of the agricultural sector in the EU, institutions and political structure of the EU, decision-process in the EU,

4. The EU's common agricultural policy: Description and Analysis

The history and analysis of the Common Agricultural Policy (CAP) of the EU

5. Introduction into Environmental policy

Objectives, measures and analysis and interaction with agricultural policy

Literatur:

B. Hill (2013): Understanding the Common Agricultural Policy, Earthscan

A. Cunha & A. Swinbank (2011): An Inside View of the CAP Reform Process, Oxford University Press

A. Oskam, G. Meester & H. Silvis (2011): EU policy for agriculture, food and rural areas, Wageningen, University Press

Swinnen, Johan F.M. (2008): The Perfect Storm – the political Economicy oft he Fischler Reforms oft he Common Agricultural Policy, Centre for European Policy Studies, Brussels

Krugman, P.R., M. Obstfeld & M.J. Melitz (2011), International Economics (9.Ed.), Pearson

B. Hill (2013): Understanding the Common Agricultural Policy, Earthscan

A. Cunha & A. Swinbank (2011): An Inside View of the CAP Reform Process, Oxford University Press A. Oskam, G. Meester & H. Silvis (2011): EU policy for agriculture, food and rural areas, Wageningen, University Press Selected readings and lecture notes / slides provided by the lecturer on StudIP	
Examination: Written examination (90 minutes) **Examination requirements:** • Fundamental knowledge of EU institutions and the EU's common agricultural Policy (CAP) • Knowledge of different theories and methods to analyze agricultural policies • Analysis of different measures and instruments of the EU's common agricultural policy (CAP)	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic micro- and macroeconomics
Language: English	**Person responsible for module:** Prof. Dr. Stephan von Cramon-Taubadel
Course frequency: Every second summer semester (Start: 2020)	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** from 2
Maximum number of students: 50	

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.E38: Scientific working in Agricultural Economics	6 C 4 WLH

Learning outcome, core skills: Students have a deep understanding of the following aspects of scientific writing and good academic practice and are prepared to apply them appropriately • Scientific writing and structuring • Literature search • Good academic practice, citation and avoidance of plagiarism • Use of citation software • Structuring and preparation of primary and secondary datasets • Result illustration • Presentation of academic content	**Workload:** Attendance time: 48 h Self-study time: 132 h

Course: Scientific writing in Agricultural Economics (Lecture, Exercise) *Contents*: 1) **Research process and paper structure**: An introduction is given on structuring seminar-papers and master-theses, literature search in various literature databases, formulating valid objectives, research questions and hypotheses. Thereby, the basic principles of describing the research gap based on previous findings and correct citing are covered. Students practice structuring and writing during different practical assignments like creating a commented outline , a reference list or writing an introduction and conclusion for a seminar-paper or a thesis. 2) **Literature review, citation and plagiarism:** An introduction is given on the rules of "good academic practice" according to the standards of the German Research Association (DFG). In addition to detailed explanations about the appropriate use of references and correct citing, the topic of plagiarism and intellectual property rights is addressed in detail including concrete examples. Furthermore, software applications such as Citavi are introduced. 3) **Data and methods:** An introduction is given on (i) how to structure, process and present primary and secondary data, and (ii) how to choose and present a method in accordance to the respective research question. Formal requirements and good scientific practice for the illustration in written text, tables and figures are presented. Special emphasis will be given to the interpretation of results (hypothesis testing). Students practice data and results illustration during different practical assignments like structuring datasets, creating a methods & data chapter, preparing tables and figures and embed them into a results chapter. 4) **Presentation:** An introduction is given on the design and structure of scientific presentations. In detail, common practices for presenting scientific contents are explained and the typical corporate design of the Georg-August-University is introduced. As an assignment students prepare a presentation about scientific contents.	4 WLH
Examination: 2 Written assignments (max. 800 words each), 1 data sheet and 1 presentation-file (max. 6 slides)	6 C

Examination requirements:

Students have to prepare two written assignments, one data sheet and one presentation file (se above) and upload the documents. The required assignments accompany the content of the lecture and include the following topics:

- Sections of scientific manuscripts (Introduction; Methods&Data, Results)
- data documentation (e.g. descriptive tables)
- presentation slides.

Admission requirements: Enrolled in SIA study-program with focus on International Agribusiness and Rural Development Economics	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Hartmut Ernst Reinhard Uehleke
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 30	

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.E39: Critical and Collective Perspectives on the Global Food System**	6 C 4 WLH

Learning outcome, core skills: Students: will be aware of development tendencies of the global food system; will be able to critically analyse the global food system informed by political ecology; will be introduced to collective action theory and "Commoning" approaches in the Global Food System;will be familiar with different conceptions of society-nature relationships; will be acquainted with methods of political ecology will be acquainted with transition and transformation studies; will be acquainted with food regime studies; will be able to critically evaluate and apply the corresponding approaches	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Critical and Collective Perspectives on the Global Food System (Lecture, Seminar) *Contents*: The course introduces students to critical approaches and studies of the global food system. It introduces the concepts, theories and methods of political ecology, food regime theory collective action theory and transitions studies and discusses these in relation to empirical studies worldwide.	4 WLH
Examination: Presentation (approx. 45 minutes, 40%) and term paper (max. 15 pages, 60%) **Examination prerequisites:** Submission of protocols (literature-related questions) in regard to 80% of assigned readings (max 8 articles) **Examination requirements:** Students will need to demonstrate: Understanding of political ecology, collective action and commoning perspectives, transition approaches and critical perspectives; understanding of a food systems approach; ability to apply political ecology approaches to the food system and its change; knowledge of global drivers of food and agricultural production systems; academic presentations, discussion and writing skills. Details on Examination: Presentation 20 min. + 25 minutes guided discussion (student-led seminar) (40%) and term paper (15 pages, 3000 words) (60%)	6 C

Admission requirements: none	**Recommended previous knowledge:** Background in agricultural and environmental policy and economics
Language: English	**Person responsible for module:** Prof. Dr. Andreas Thiel
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**

Maximum number of students:	
not limited	

Additional notes and regulations:
Literature:
Literature will be circulated to students at the beginning of term and throughout

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.E40: Agriculture, Environment and Development	6 C 4 WLH

Learning outcome, core skills: This module treats the economic and political causes of environmental problems in the context of agriculture and development. Global challenges such as climate change, sustainable development and poverty are in the focus. Selected basic concepts of environmental and resource economics are addressed, followed by a deepened analysis of important aspects such as management of common pool resources, pollution control and climate protection in international agri-environmental contexts.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Agriculture, Environment and Development (Lecture, Exercise, Seminar) *Contents*: The module consists of a combination of lectures and tutorials during the first semester term. Theoretical concepts from lectures will be deepened and complemented by examples from scientific research and practical applications. During the second semester term students present an analysis of a scientific case study from selected topics in the seminar. This enables students to deepen the contents learned in an independent and targeted manner and to apply concepts in the evaluation of a case study. Contents: • Basic concepts (market failure, natural resources, natural capital) • Efficiency and sustainability: Concepts, criteria and application • Economics of common pool resources in developing countries • Economics of land use in developing countries • Economics of water use in developing countries • Poverty, development and environment • Agriculture and climate change • Global initiatives and international agreements on sustainable development and climate protection	4 WLH
Examination: Written exam (60 minutes, 70%) and presentation (approx. 20 minutes, 30%) **Examination prerequisites:** Regular attendance in seminar **Examination requirements:** Knowledge of selected basic concepts of environmental and resource economics. Understanding of important concepts such as economic efficiency and sustainability. Knowledge of important relationships between agriculture, resource use, sustainability and climate change in development contexts. Discussion of current courses of action.	6 C

Admission requirements: none	Recommended previous knowledge: none
Language:	**Person responsible for module:**

English	Prof. Dr. Meike Wollni
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 40	

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.E41: EU Policies and Organic Agriculture	6 C 4 WLH

Learning outcome, core skills: The students deal with selected key issues of European agricultural policy that are relevant to organic farming. They work on these policies in a project-oriented way and apply concepts and methods of knowledge integration, policy process analysis and policy evaluation. This enables them to transfer the knowledge that they have acquired in their agricultural policy and governance courses to concrete issues and to link them to particular political and international contexts. At the same time, the aim of the course is to make students from Europe and beyond familiar with the relevance of these dimensions for their future professional life and to understand European organic agricultural policy through discussions from the perspectives of different the regional contexts represented by students of the course.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: EU Policies and Organic Agriculture *Contents*: Organic farming is influenced both by the EU Organic Farming Regulation (Regulation (EC) No 834/2007) and by the policy measures of the EU Common Agricultural Policy. Working on selected key issues of EU agricultural policy during the course, students analyse specific policy processes and evaluate policy measures. To start with, the lecturers introduce the role of the EU for organic farming, highlight selected key issues of and they re-fresh the different conceptual and methodological issues of analysing them. Students then work on these key issues from different lenses in topic-related small groups which are supervised by the lecturers. Each group first develops the project concept (definition of a research question, methodological approach). These project concepts are presented by the different groups and discussed in the plenary before the small group projects are implemented. At the end of the semester, all groups present and reflect their project results. Finally, the project results are discussed from both the European and the international perspective. Parallel to working on these key issues, students learn about methods of knowledge integration (e.g. system analysis, multi-criteria analysis), policy evaluation and policy process analysis and they are able to apply these methods. Literature und publications will be provided for the course. Vedung, E., 1997. Public policy and program evaluation. Transaction Publishers, New Brunswick, London. Scholz, R.W., Tietje, O., 2002. Embedded case study methods: Integrating quantitative and qualitative knowledge. Sage Publications, Thousand Oaks. Weible, Christopher M. (2018): Theories of the Policy Process. 4th ed. Milton: Routledge.	4 WLH

Examination: presentation (approx. 30min, 50%), written exam (60min, 50%) **Examination prerequisites:** submission of protocols (literature-related questions, max. 1 page) in regard to 80% of assigned readings (max 8 articles) **Examination requirements:**	6 C

The course presupposes attendance of one of the following modules: „Institutions and the food system" or "Critical and collective perspectives on the global food system"

Admission requirements:	Recommended previous knowledge:
none	Background in agricultural and environmental policy and economics
Language:	**Person responsible for module:**
English	Prof. Dr. Andreas Thiel
	Dr. Matthias Stolze
Course frequency:	**Duration:**
each summer semester	1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**
twice	
Maximum number of students:	
25	

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E42: Agriculture, Nutrition and Sustainable food systems**	6 C 4 WLH

Learning outcome, core skills: Students learn how food systems and food policies are shaping what we eat, how we produce our food, and how this links to sustainable development in a global context. The course covers food systems in both developing and developed countries. Students learn to engage in a critical debate on the role of food policies and other drivers in shaping what we consume, how this links to food production and sustainable development, including health, environment and the economy. Students learn to analyze these themes by engaging in basic data analysis, case studies and the critical analysis and exposition of arguments.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Agriculture, Nutrition and Sustainable food systems (Lecture) *Contents*: This module introduces students to apply systems thinking to the global challenges of food security, nutrition, health and sustainability. It introduces the relevant concepts, analyses the drivers and food policies that may transform food systems using an interdisciplinary approach. Every lecture is accompanied by a more practical session in which basic analysis of data (using Stata) or comparative and critical analysis are applied to the specific themes or policies covered in the lecture. Course material consists of presentations and lecture notes. A list of scientific reports, research articles and relevant data will be provided to students. *Course frequency:* each winter semester	4 WLH
Examination: Written examination (60 minutes, 50%) and paper (max. 15 pages, 50%) **Examination requirements:** Students are able to explain the concepts related to food systems, to analyse food policies, and to generate and interpret relevant statistics related to nutrition, food policies and global sustainability. In a written assignment, students provide critical analysis of a specific food system and/or food policy intervention.	6 C

Admission requirements: none	**Recommended previous knowledge:** Prior knowledge of microeocnomics at BSc level is useful. Prior experience with Stata or SPSS may be helpful but is not a requirement.
Language: English	**Person responsible for module:** Prof. Dr. Liesbeth Colen
Course frequency: each summer semester	**Duration:** 1 semester[s]

Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 45	

Georg-August-Universität Göttingen	6 C
Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.E45: Introduction to choice experiments in food economics**	6 C 4 WLH

Learning outcome, core skills:	Workload:
Learning outcome, core skills: • Students experience the entire process of (choice) experimental practice in the field of social sciences, including its possibilities, limitations and interpretation of results • Students learn how to identify and narrow down a research question into a testable hypothesis. Students learn how to test such a hypothesis by identifying control and treatment groups, the importance of power calculations, sampling design and analysis of data. • Students improve their general understanding of the scientific practice, correct interpretation of scientific results and their contribution to (public) decision making. • Students train their teamworking skills, through brainstorming exercises, discussions, self-organization and distribution of tasks of the team.	**Workload:** Attendance time: 55 h Self-study time: 125 h

Course: Introduction to choice experiments in food economics (Block course, Exercise)	4 WLH
Course: Introduction to choice experiments in food economics (Block course, Exercise) *Contents*: This module consists of two blocks. • The first block concerns the introduction to choice experimental practice and the set-up of a small online experiment addressing a specific research question in the field of agricultural, food or nutrition economics. • The second block concerns the analysis of the obtained data and interpretation of results. Students will work in groups of 4-5 students to identify and narrow down a research question in the field of agriculture, food or nutrition economics, learn how to translate a research question into a testable hypothesis, design the choice experiment, perform power calculations, and effectively launch the online survey. In the second part, the results of the survey will be analysed and each group will present the results, limitations and lessons learned.	4 WLH

Examination: Term Paper (max. 10 pages, 70%) and presentation (approx. 20 minutes, 30%)	6 C
Examination: Term Paper (max. 10 pages, 70%) and presentation (approx. 20 minutes, 30%) **Examination requirements:** Short paper describing the set-up and execution of the experiment (70%), and presentation presenting the approach, results and limitations/lessons learned (30%)	6 C

Admission requirements:	Recommended previous knowledge:
Admission requirements: Econometrics I (M.WIWI-QMW.004), M.SIA.E12M: Quantitative research methods in rural development economics	**Recommended previous knowledge:** Basic statistics/econometrics Students proof that they are capable of

Or a similar introduction to statistics or econometrics	• Identifying research question and developing a testable hypothesis • Collaborate in groups to brainstorm, guide the discussion towards a practically implementable outcome, and implement the experiment • Analyse, interpret and discuss experimental results
Language: German, English	**Person responsible for module:** Prof. Dr. Liesbeth Colen
Course frequency: each summer semester; Göttingen	**Duration:**
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.I02: Management of (sub-)tropical landuse systems**	6 C

Learning outcome, core skills:	Workload:
Enable students to understand the functioning and bio-physical limitations of (subtropical agro-pastoral land use systems, to argue for the need of interdisciplinary approaches to overcome these and to apply current research methods in land use systems analysis.	Attendance time: 28 h Self-study time: 152 h

Course: **Management of (sub-)tropical landuse systems** (Block course, Lecture) *Contents*: Witzenhausen: Plant-animal interactions, diet selection and nutritional wisdom, impact of grazing on pastures; statistical approaches to measure and cope with short-distance variability in crop growth; measurement techniques for nutrient fluxes in different agro-ecosystems. Prague: Land-use management: farm and family income in different farming systems, soil conservation technologies for smallholder farming systems, conservation tillage systems, potential use of waste-stream products to enhance soil productivity in tropical peri-urban and rural areas, crop diversity in tropical agricultural systems. Altieri, M. 1995: Agroecology, Westview Press, USA; Martius, C. 2002: Managing Organic Matter in Tropical Soils: Scope and Limitations. Kluwer Academic Publishers; Van Soest, P. 1994: Nutritional ecology of the ruminant. Cornell University Press, London, UK; Provenza, F.D. 1995: Post-ingestive feedback as an elementary determinant of food preference and intake in ruminants. Journal of Range Management, 48: 2-17.	
Examination: Written examination (90 minutes) **Examination requirements:** Knowledge about: the ability of animals to select feed; animal-plant interactions; effects of grazing on grasslands and pastures; statistical methods and measurements material flows in various agroecosystems; landuse management; incomes in different operating systems; soil conservation measures for smallholders and soil conservation systems; potential use of waste products to increase productivity and the significance of agrobiodiversity.	6 C

Admission requirements: none	Recommended previous knowledge: Knowledge in plant, soil and animal sciences
Language: English	Person responsible for module: Prof. Dr. Andreas Bürkert
Course frequency: WiSe 13/14, einmal in 2 Jahren, alternierend mit Modul I07; Witzenhausen	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:

Maximum number of students: 25	

Additional notes and regulations:
Literature:
Altieri, M. 1995: Agroecology, Westview Press, USA; Martius, C. 2002: Managing Organic Matter in Tropical Soils: Scope and Limitations. Kluwer Academic Publishers; Van Soest, P. 1994: Nutritional ecology of the ruminant. Cornell University Press, London, UK; Provenza, F.D. 1995: Post-ingestive feedback as an elementary determinant of food preference and intake in ruminants. Journal of Range Management, 48: 2-17.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.I03: Food quality and organic food processing	6 C 4 WLH

Learning outcome, core skills: Students will be able to define food quality and quality systems in agriculture and food industry discuss principles of organic food production (agriculture, processing) according to EEC 2092/91) discuss and evaluate food processing techniques and quality assessment methods	Workload: Attendance time: 56 h Self-study time: 124 h

Course: Food quality and organic food processing (Lecture) *Contents*: European and international legislation for organically produced agricultural commodities (focussing : Annex II, Annex VI EEC 2092/91; contracting, quality standards, product handling) Quality standard setting and the Organic Guarantee System Certification systems for organic and conventional products (overview, principles, concept, certification) Accreditation and accreditation agencies Process and product orientated food quality concepts and assessments; "holistic" quality definitions Processing techniques for organic food processing (different product groups) Quality assessment methods for small and medium-size enterprises Florkowski et al. 2000: Integrated View of Fruit and Vegetable Quality, Technomic; Welti-Chanes et al. 2001: International Congress on Engineering and Food, Volume I and II, Technomic; Luning et al. 2002: Food quality management, Wageningen Pers; Lawless et al. 1999: Sensory evaluation of Food, Kluwer; Kent et al.1994: Technology of cereals, Pergamon; Bidlack et al. 2000: Phytochemicals as bioactive agents, Technomic; Linden et al. 1994: New ingredients in food processing, CRC; Souci et al. 2000: Nutrition Tables, Medpharm	4 WLH
Examination: Presentation (ca. 20 minutes, 50%) and project work (max. 20 pages, 50%) Examination requirements: Knowledge about the quality of food in terms of concepts and criteria with focus on organic production. Insides in processing and management of organic food according the guidelines, standards and practices. Basic knowledge in the concepts of HACCP and QACCP.	6 C

Admission requirements: none	Recommended previous knowledge: Basic knowlegde in chemistry

Language:	**Person responsible for module:**
English	Dr. Nicolaas Busscher
Course frequency:	**Duration:**
each summer semester; Witzenhausen	1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**
twice	
Maximum number of students:	
40	

Additional notes and regulations:
Literature:
Florkowski et al. 2000: Integrated View of Fruit and Vegetable Quality, Technomic; Welti-Chanes et al. 2001: International Congress on Engineering and Food, Volume I and II, Technomic; Luning et al. 2002: Food quality management, Wageningen Pers; Lawless et al. 1999: Sensory evaluation of Food, Kluwer; Kent et al.1994: Technology of cereals, Pergamon; Bidlack et al. 2000: Phytochemicals as bioactive agents, Technomic; Linden et al. 1994: New ingredients in food processing, CRC; Souci et al. 2000: Nutrition Tables, Medpharm

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.I06M: Exercise on the quality of tropical and subtropical products**	6 C 4 WLH

Learning outcome, core skills: Students are able (i) to analyze and discuss experimental data considering economics and consumer expectations, (ii) to work with scientific primary literature, (iii) to elaborate written presentations in teamwork, (iv) to exchange their opinions about sensorial evaluation.	**Workload:** Attendance time: 40 h Self-study time: 140 h

Course: Exercise on the quality of tropical and subtropical products (Block course, Exercise) *Contents*: Exercises on quality properties of wheat, rice, potatoes, fruits and vegetables: Starch and protein quality of baking wheat; dough and baking properties of wheat, sensors of baking goods, rheological properties of rice flour and other starch containing products, cooking and frying properties of potatoes; consumer acceptance of potatoes; Marketing properties of fruits and vegetables; texture, ripeness, inner quality properties of fruit and vegetable and their extracted juices (e.g. sugar/acid ratio, ethanol in fruit juice), sensors of fruit and vegetable juices.	4 WLH
Examination: Project work (max. 40 pages) **Examination prerequisites:** Participation in all introductory meetings and at all experimental laboratory work **Examination requirements:** Knowledge about quality parameter of wheat, rice and starch containing products, potatoes, fruits and vegetables. Knowledge about starch and protein quality of baking wheat, sensoric properties of bread and bakery products, rheological properties of rice flour and other starch containing products, consumer acceptance of potatoes, marketing of fruits and vegetables, texture analysis, intrinsic quality parameter of fruits and vegetables and sensoric proerties of fruits and vegetables.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge on food chemistry, statistics, scientific writing.
Language: English	**Person responsible for module:** Prof. Dr. Susanne Neugart
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.I07: International land use systems research - an interdisciplinary study tour**	6 C 8,5 WLH
Learning outcome, core skills: To gain multi- and interdisciplinary insights into (international) approaches towards opportunities and challenges of agro-silvo-pastoral production systems, sustainable resource use and agricultural development interventions. To familiarize participants with theoretical and practical questions of field research in an international contexts	**Workload:** Attendance time: 119 h Self-study time: 61 h

Course: International land use systems research - an interdisciplinary study tour (Lecture, Excursion, Seminar) *Contents*: Through the combination of one semester of preparatory impulse lectures and student seminars and the 12-14 day excursion to a (sub)tropical country, this module provides participants with interdisciplinary insights into the bio-physical and socio-economic components of agro-silvo-pastoral systems in the global context. The small- to large-size farm enterprises, processing plants and marketing organisations to be visited during the excursion exemplify the opportunities and challenges of agricultural activities in their specific context, whereby particular attention is paid to aspects of sustainability and environmental safety. The excursion targets regions where the two universities conduct research programmes, and also includes visits to partner universities and (inter)national research institutions. This will allow the MSc students to gain a first impression on how field research is organized and carried out in (sub)tropical countries. Up-to-date research approaches are presented to the participants, and questions targeting the sustainable use of natural resources as well as questions of development cooperation are discussed in an international and interdisciplinary context.	8,5 WLH
Examination: Oral exam (ca. 20 minutes, 50%) and oral seminar presentation (ca. 20 minutes) with written outline (max. 4 pages) (50%) **Examination prerequisites:** Day protocol of the excursion (max 2 pages) **Examination requirements:** The module and excursion contents are reviewed in an oral exam whereby two examiners are putting forward questions to the below topics (10 minutes each): A) Aspects of soil, plant, crop and forestry sciences pertaining to the regions and enterprises/farms visited during the excursion. B) Aspects of animal husbandry and socio-economic issues pertaining to the regions and enterprises/farms visited during the excursion.	6 C

Admission requirements: none	**Recommended previous knowledge:** Study focus on international agriculture and development policy

Language: English	**Person responsible for module:** Prof. Dr. Eva Schlecht
Course frequency: Winter semester, every second year, alternating with Module I02; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 25	

Additional notes and regulations: **Literature:** Specific general and scientific articles dealing with the excursion country, distributed in the course.

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	5 WLH
Module M.SIA.I10M: Applied statistical modelling	

Learning outcome, core skills:	Workload:
Students have a detailed understanding of the concepts of statistical modelling, regression analyses and analyses of variance. They are familiar with the basic concepts of 'linear models', 'generalized linear models' and 'non-parametric estimation procedures', which now belong to the standard methods in applied statistics. Students are able to practically apply these methods and carry out statistical analyses in soil, plant and animal sciences using the statistical software R. They are able to apply the acquired skills in the analysis of their own MSc (and PhD) datasets.	Attendance time: 60 h Self-study time: 120 h

Course: Applied Statistical Modelling (Lecture, Exercise)	5 WLH
Contents: **Statistical analyses in animal science, soil science and plant sciences** (Lecture, computer practical) • Review of statistical concepts (boxplots, QQ plots, distributions, classical tests, • General aspects of hypotheses formulation and testing • Correlations, analyses of count and proportion data • Basic concepts of experimental design • Standard experimental field designs • Introduction to the software R • Regression (multiple linear, non-linear and logistic) • Statistical modelling, model types and model simplifications • Transformations • Analyses of variance, post-hoc tests • Non-parametric test procedures • Analysis of covariance • Particularities of unbalanced designs • Formulation of statistical models and basic programming in R • Linear mixed models	

Examination: Written examination (120 minutes) Examination requirements:	6 C
One written exam with two parts. Knowledge of basic statistical terms and approaches, linear and generalized linear models and non-parametric estimation procedures. Ability to apply the methods and models to real data by using the software package R.	

Admission requirements:	Recommended previous knowledge:
none	Basic knowledge (B.Sc. level) of applied statistics
Language:	**Person responsible for module:**
English	Prof. Dr. Bernard Ludwig
Course frequency:	**Duration:**
each summer semester; Witzenhausen	1 semester[s]

Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 25	

Additional notes and regulations:

Admission requirements:

Registration

Literature:

Lecture notes

Crawley, M.J. 2012. The R Book, Wiley

Dobson A. & Barnett A. (2008) An Introduction to Generalized Linear Models, Chapman & Hall.

Field, A., Miles, J., Field, Z. 2012. Discovering Statistics using R, SAGE

Mrode R. A. (2005) Linear Models for the Prediction of Animal Breeding Values, CABI Publishing.

Searle S. R. (1982) Matrix Algebra Useful for Statistics, Wiley Series in Probability and Statistics.

Welham, S.J., Gezan, S.A., Clark, S.J., Mead, A. 2014. Statistical Methods in Biology. Design and Analysis of Experiments and Regression, CRC Press, Boca Raton.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.I11M: Free Project	6 C

Learning outcome, core skills: Students are able to plan and carry out a scientific project. This includes critical evaluation of publications and the ability to apply acquired knowledge to problems in the field or in economic or social sciences. Students are also able to present results and discuss them on the basis of their knowledge.	Workload: Attendance time: 0 h Self-study time: 180 h

Course: Free project *Contents*: A topic for a project is chosen in agreement with the instructor. The aim of the project is to gain profound scientific knowledge on the chosen topic. This can include experimental work. The result of the project can be a written thesis, an oral presentation and/ or an electronically stored result.	
Examination: Project work (max. 15 pages or 4000 words) **Examination requirements:** In agreement with the instructor. Generally project work (max. 15 pages or 4000 words).	6 C

Admission requirements: Written agreement with instructor on topic, form and time frame for the project.	Recommended previous knowledge: none
Language: English	Person responsible for module: Prof. Dr. Stephan von Cramon-Taubadel
Course frequency: each semester; Göttingen oder Witzenhausen	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: not limited	

Additional notes and regulations: Literature: Scientific publications on the topic agreed upon with the instructor.

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.I12: Sustainable international agriculture: basic principles and approaches	

Learning outcome, core skills:	**Workload:**
Students	Attendance time:
• are able to describe the main bio-physical and socio-economic drivers shaping agricultural production systems and land and resource use strategies; • have knowledge of relevant ecological, economic and social indicators • can describe and apply integrated approaches of indicator use for the evaluation of a system's sustainability	56 h Self-study time: 124 h

Course: Sustainable International Agriculture: basic principles and approaches (Lecture) *Contents*: 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 module 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.	4 WLH

Examination: Written examination (90 minutes) **Examination requirements:** • general definitions and indicators for sustainable development; strong and weak sustainability; the substitution-paradigm and its limits; carrying capacity and critical natural capital; economic growth models; economic approaches for the quantification of sustainable development; SNA / green accounting; cost-benefit analysis. • dimensions of social sustainability; utilization of communal resources; McDonaldisation of agriculture; agriculture and social justice. • multi-functionality and farm-management; realization of sustainability concepts in the farm enterprise; agro-ecological systems and sustainable farm management; indicators for enterprise sustainability; controlling of sustainability; profitability of organic farming; collective forms of farming. • sustainability of livestock husbandry; environmental effects of animal keeping and their avoidance: a) GHG emissions and environmental pollution from animal holdings; b) overgrazing.	6 C

- concepts of sustainability; agroforestry systems; shifting cultivation; effects on soil fertility and sustainability.
- role of soils in ecosystems; soil types; soil functions and soil threats/degradation; physical, chemical and biological soil quality indicators; soil organic matter; soil as a carbon sink or source and greenhouse gas emissions; soil conservation; soil compaction.

Admission requirements:	Recommended previous knowledge:
none	none
Language:	**Person responsible for module:**
English	Prof. Dr. Eva Schlecht
Course frequency:	**Duration:**
each winter semester; Witzenhausen	1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**
twice	
Maximum number of students:	
not limited	

Additional notes and regulations:
Literature:

Lecture notes and reading materials distributed during the module;
Bell, S. & Morse, S., 2003. Measuring sustainability: learning by doing; Earthscan, London, UK. Bell, S. & Morse, S., 2008. Sustainability indicators: measuring the immeasurable? Earthscan, London, UK.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.I14M: GIS and remote sensing in agriculture	6 C 4 WLH
Learning outcome, core skills: GIS: A broad overview of basic GIS functions and related background knowledge should enable students to explore GIS-Software for relevant commands and prepare functional strategies for spatial data management and analysis. Lecture and exercise examples have predominantly agricultural reference. Remote Sensing The lecture will introduce physical principles (reflectance, transmittance, and absorption), sensor techniques (passive and active sensors, satellites, field spectrometer) and methods of analysis (calibration, validation) in remote sensing applications. This technical framework is presented using agricultural examples, as e.g. the generation of maps for crop yield and protein, assessment of species composition in mixed vegetation (e.g. grassland), like legume content for a calculation of residual nitrogen and crop rotation effects.	**Workload:** Attendance time: 56 h Self-study time: 124 h
Course: Remote sensing in agriculture (Lecture) *Contents*: The lecture will introduce physical principles (reflectance, transmittance, and absorption), sensor techniques (passive and active sensors, satellites, field spectrometer) and methods of analysis (calibration, validation) in remote sensing applications. This technical framework is presented using agricultural examples, as e.g. the generation of maps for crop yield and protein, assessment of species composition in mixed vegetation (e.g. grassland), like legume content for a calculation of residual nitrogen and crop rotation effects.	2 WLH
Course: GIS (Lecture) *Contents*: The course gives an introduction to Geographical Information Systems (GIS). Starting from geodetical background information, a wide range of different GIS- methods and - functions are presented using agricultural examples (e.g. data import, georeferencing, aggregation, (re)classification, interpolation, overlays and image analysis). The students have the opportunity to carry out exercises on the computer themselves for some important GIS-procedures. A special focus is given on data capturing using maps and field data survey with GPS as well as the spatial analysis of site conditions. Finally a particular view on GIS in organic farm management and Precision Farming is given.	2 WLH
Examination: Oral examination (approx. 30 minutes) **Examination requirements:**	6 C

Knowledge about basic GIS functions and the preparations of functional strategies for spatial data management. Knowledge of physical principles, methods of analysis and sensor techniques.

Admission requirements:	**Recommended previous knowledge:**
none	none
Language:	**Person responsible for module:**
English	Dr. Jayan Wijesingha
Course frequency:	**Duration:**
each winter semester; Witzenhausen	1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**
twice	
Maximum number of students:	
20	

Additional notes and regulations:

Literature:

Principles of Geographical Information Systems
by Peter A. Burrough and Rachael A. McDonnell (2015)

Introduction to Remote Sensing
by James B. Campbell **a**ndRandolph H. Wynne (2011)

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.I17: Sustainable diets**	6 C 6 WLH

Georg-August-Universität Göttingen

Universität Kassel/Witzenhausen

Module M.SIA.I17: Sustainable diets

Learning outcome, core skills: Students are able to describe the interactions of diets, sustainability and human nutrition/health. Students are able to assess the impacts of a dish/meal (as unit) on sustainability and nutrition parameters.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Sustainable diets (Lecture, Excursion) *Contents*: • Culture and cultural patterns of diets • Interactions of food quality and lifestyle on sustainability and human health • Healthy diets within sustainable food systems • Model diets such as Med. Diet and New Nordic Diet • Optimization of a dish/meal according sustainability and nutrition impacts • Role of organic food systems	6 WLH
Examination: Presentation (ca. 15 minutes, 50%) with written outline (max. 15 pages, 50%) **Examination requirements:** Knowledge of lifestyles and interaction with food quality (in selected countries). Knowledge of methods for the collection of environmental and nutritional parameters. Knowledge of legal requirements for the labelling of foodstuffs as well as guidelines for the processing of sustainable food products.	6 C

Admission requirements: none	Recommended previous knowledge: Basic knowledge on nutrition, statistics and environmental issues.
Language: English	Person responsible for module: Liliana Stefanovic
Course frequency: each winter semester; Witzenhausen	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 40	

Additional notes and regulations: **Literature:** Will be provides via the system2teach platform.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.I19M: Participatory research methods for sustainability**	6 C 4 WLH

Learning outcome, core skills: This course will look at the importance of place-based, participatory and transdisciplinary research methods in sustainability science. Students will learn different participatory methods to capture the knowledge and aspirations of the different agents that operate in agricultural landscapes and will be able to integrate this knowledge in practical outcomes for sustainable land management. After successfully completing this module students should: • comprehend the fundaments of participatory research • be familiar with the different types of participatory research methods • be able to design and implement participatory processes This module contributes to the following skills: • performance of transdisciplinary processes • integration of knowledge and aspirations of different agents towards sustainable land management • data collection and analysis using participatory methods • group work techniques (organization of working schedule, team work) • presentation skills and communication of main research results	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Participatory research methods for sustainability (Lecture, Seminar) *Contents*: The course is structured in three parts. An introductory part focuses on research principles of sustainability science, paying particular attention to the role of transdisciplinary and ethics in the participation processes. A second part showcases a broad suite of different participatory research methods (e.g. photo-voice, participatory mapping, storytelling) for sustainable landscapes management and land-use conflict resolution. The full research process is addressed, from participatory process design, the approaching and involvement of participants and the organisation and facilitation of participatory activities, to the analysis, integration and presentation of the outcomes. In the third part of the course, students have the opportunity to choose and design a protocol for a participatory study, applied to a specific geographical location and a specific problem, and share the insights of the process with the class. The first part will be outlined in lectures, the second part will take the form of seminars and the third part will consist of group work with a final presentation to the class where the different experiences will be critically discussed.	4 WLH

Examination: Presentation (approx. 30 minutes, 50%) and Term paper (max. 20 pages, 50%) **Examination requirements:** Presentation and critical analysis of a participatory research approach applied to a land-use topic of the students' choice.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Tobias Plieninger
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 25	

Additional notes and regulations: **Literature:** Bergmann, M. et al. (2012). Methods for Transdisciplinary Research: A Primer for Practice. Campus Verlag. Course materials to be provided.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.I20: Agriculture and ecosystem services	6 C 4 WLH

Learning outcome, core skills: This course will introduce students into the concepts of ecosystem services and human well-being, with a particular focus on their relevance for agriculture and other land uses. It will foster the ability of students to assume an interdisciplinary research perspective (including ecological, socio-cultural, and economic approaches) and to critically discuss and analyse the concept of ecosystem services in its multiple scientific, political and practical meanings.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Agriculture and ecosystem services (Lecture, Exercise, Seminar) *Contents*: Global environmental assessments (e.g., the Intergovernmental Platform on Biodiversity and Ecosystem Services, IPBES) have highlighted that human well-being is critically dependent on ecosystem services – the benefits that nature provides to people. Depending on the particular land-use system and its social-ecological context, agriculture can either degrade or enhance such ecosystem services. This course gives an overview on the rising field of ecosystem services science. Focus will be on: • techniques for decision support, • practical applications of the approach in agriculture and other land-use sectors, and • linkages to other sustainability issues (e.g., biodiversity, climate change, water security, poverty). These topics will be outlined in lectures and deepened in seminars and field exercises, where key issues will be explored and critically discussed.	4 WLH
Examination: Presentation (approx. 30 minutes, 50%) and term paper (max. 20 pages, 50%) **Examination requirements:** Presentation and critical analysis of a case study that takes a particular ecosystem services problem in a land-use setting and geographic location of the participants' choice into focus.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Prof. Dr. Tobias Plieninger
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students:	

25	

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.I21M: From conceptualisation to communication: key steps in empirical research**	6 C 4 WLH

Learning outcome, core skills: This course will enable students to develop and execute their own empirical (MSc) research project, to elaborate empirical real-world data in a meaningful way and to communicate major insights in a professional manner. The approaches and methods taught are applicable to a wide range of research topics. After successful completion of this module, students can: • Formulate research questions and hypotheses; • Write a grant application for acquisition of funding for their research project; • Design an e-questionnaire for interview-based data acquisition; • Recover interview data in a tabulation program and elaborate meaningful results; • Pinpoint research highlights in a prize-winning poster.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: From conceptualisation to communication: key steps in empirical research (Lecture, Exercise) *Contents*: This module prepares <u>students with a natural sciences focus</u> for international agricultural research in the framework of their M.Sc. thesis, the prerequisites of which include the ability to identify a research topic, formulate research questions and working hypotheses, elaborate a data collection matrix, analyse the collected data and communicate the obtained results in an effective manner. Therefore this module emphasises the practice of skills concerning the conceptualisation of a research project, data acquisition and analysis, and presentation skills. It is organised in four major sections: **Part I: Conceptualisation of a research project** – 15% of time In a participatory process, students will brainstorm on research topics, learn to formulate research questions and working hypotheses, and familiarize with the full conceptualisation of an MSc study proposal, for submission to, e.g., PROMOS or *fiat panis* grants. **Part II: Elaboration of a structured e-questionnaire using freeware** – 20% of time Students are introduced to the CS PRO freeware for the setup of e-questionnaires; they then individually conceptualise and computerise their own questionnaire of 20-30 differently scaled questions and test its functionality. **Part III: Descriptive and creative analysis of data using tabulation software** – 50% of time Participants receive real-world interview-based data from finalised or ongoing research projects of the principal instructor's group. In groups of 2 to 3 persons, they elaborate the information contained in the database, thereby answering to a series of simple as well as more complex research questions that guide this analytical step.	4 WLH

Part IV: Preparation and presentation of a research poster – 15% of time

Being provided with guidelines and templates, each group of students designs a research poster to present their most relevant results (see part III), thereby using PowerPoint or corresponding freeware. Posters are printed on A0 paper and are presented in short oral communications of 3-5 minutes, just as at a conference. Each poster is evaluated by the non-involved participants (standardized evaluation sheet, covered) and the three best posters receive a poster price.

Examination: Written exam (90 minutes; weight: 50%) and presentation (ca. 20 minutes; weight: 50%) **Examination requirements:** Knowledge of the steps, do's and don'ts of research project conceptualisation, grant application, interview/questionnaire design, data elaboration and poster presentation. Part of the examination is an assessment of data evluation.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of Excel and PowerPoint or corresponding freeware
Language: English	**Person responsible for module:** Prof. Dr. Eva Schlecht
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 25	

Additional notes and regulations:

Literature:

- Lecture notes
- Schoonmaker-Freudenberger, K. 2008: Rapid rural appraisal (RRA) and participatory rural appraisal (PRA):
  a manual for CRS field workers and partners. (online resource; www.crs.org).
- de Hoyos, M., Barnes, S.A. 2012. Analysing interview data. Warwick Institute for Employment Research (online resource).

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.I23: Sustainable agricultural practices in Mediterranean regions	6 C 2 WLH

Learning outcome, core skills: To gain interdisciplinary insights into (international) approaches towards opportunities and challenges of sustainable agricultural systems under limited water conditions, sustainable resource use, and agricultural development interventions. Students will get to know socio-cultural contexts on the ground about the impacts of agricultural intensification and their repercussions on local well-being (e.g., immigrated population welfare, labor issues, and environmental degradation) and sustainable agricultural alternatives. To familiarize participants with theoretical and practical questions of field research in an international contexts. Learn and put into practice research methods of data collection and analysis.	**Workload:** Attendance time: 96 h Self-study time: 84 h

Course: Sustainable agricultural practices in Mediterranean regions *Contents*: Sustainable agricultural practices in the context of Mediterranean water-scarce regions: an interdisciplinary field trip (Lecture, Excursion, Seminar) Through the combination of preparatory lectures and student seminars and the 10 days excursion to a Mediterranean country, this module provides participants with interdisciplinary insights into the ecological, socio-cultural and economic components of sustainable agricultural systems and practices within the Mediterranean context. The different agricultural systems, from small- to large size farms, enterprises, local associations and non-governmental organisations to be visited during the excursion will exemplify the opportunities and challenges of agricultural activities in their specific context. In addition, particular attention will be paid to aspects of sustainability, water management, social and local well-being, and environmental safety. The participation of different universities and international research institutions will allow the MSc students to gain a first impression on how field research is organized and carried out in the Mediterranean countries. In addition, the participation of local associations and non-governmental institutions will provide another view of the social, and economic contexts, as well as, conflicts of the specific visited region/country. Specific general and scientific articles dealing with the excursion country, distributed in the course	2 WLH
Examination: Presentation (approx. 20 minutes; 35%) written outline to the excursion resport (max. 4 pages; 30%), and oral examination (35%) **Examination requirements:** Presentation and critical analysis of a case study that will be covered during the excursion, focusing on interdisciplinary aspects from the ecological (agricultural	6 C

oriented) dimension to the socio-cultural and human well-being contexts, developed
during the preparatory seminars.

Admission requirements:	Recommended previous knowledge:
none	none
Language:	**Person responsible for module:**
English	Dr. Sören Köpke
Course frequency:	**Duration:**
each winter semester	2 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**
twice	
Maximum number of students:	
25	

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.I24: Modelling climate impacts on agroecosystems	6 C 4 WLH

Learning outcome, core skills: The students have an overview of models used to capture climate change impacts on different agroecosystems and the effects of climate adaptation measures. The module teaches climate change impacts on various agroecosystems, adaptation measures and how these aspects can be captured by different types of statistical and process-based agricultural models. With this knowledge, the students are able understand and develop agricultural models to assess climate impacts, risks and resilience. In the last section, adaptation measures to climate change are modeled, discussed and evaluated using various methods and indicators.	Workload: Attendance time: 60 h Self-study time: 120 h

Course: Modelling climate impacts on agroecosystems (Lecture, Exercise, Seminar) *Contents*: The course gives an overview of climate change impacts across different agroecosystems, a solid understanding of climate and agricultural models and the projected climate impacts on the agricultural production, resilience and adaptation. In addition, short term climate and weather risks are discussed in the course. The lecture is in parallel with an exercise, where the students rebuild and develop own models in the statistic software R.	4 WLH
Examination: Oral examination (approx. 30 minutes, 50%) and written report (max. 7 pages, 50%) **Examination requirements:** Students write a written report which includes an data exercise in R and understand the content taught in the lecture.	6 C

Admission requirements: none	Recommended previous knowledge: First experience with the statistic software R is valuable.
Language: German, English	Person responsible for module: Prof. Dr. Christoph Gornott
Course frequency: each summer semester1	Duration:
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 20	

Additional notes and regulations: **Literature:** Shukla, Gleixner, Yalew, Schauberger, Sietz, Gornott, 2021: Dynamic vulnerability of smallholder agricultural systems in the face of climate change for Ethiopia, Environmental Research Letters.Laudien,

Schauberger, Makowski, Gornott, 2020: Robustly forecasting maize yields in Tanzania based on climatic predictors, Nature Scientific Reports.

Iizumi, T., Hirata, R., Matsuda, R. (2019) Adaptation to Climate Change in Agriculture, Springer, ISBN 978-981-13-9235-1

Bryant, C.R., Sarr, M.A., Délusca K. (2020) Agricultural Adaptation to Climate Change, Springer, ISBN 978-3-319-31392-4

Torquebiau, E. (2016) Climate Change and Agriculture Worldwide, Springer, ISBN 978-94-017-7462-8

Castro, P., Azul, A.M., Leal Filho, W., Azeiteiro, U.M. (2019) Climate Change-Resilient Agriculture and Agroforestry, Springer, ISBN 978-3-319-75004-0

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.I25: Engineering software in agriculture and livestock farming	6 C 4 WLH

Learning outcome, core skills: The participants will have gained computer programming skills in image processing, signal processing, machine learning in agriculture and livestock farming. They will also learn about the related software and application in the context.	Workload: Attendance time: 60 h Self-study time: 120 h

Course: Engineering software in agriculture and livestock farming (Exercise, Seminar) *Contents*: • Introduction to engineering solutions in agriculture and livestock farming • Advanced Machine vision for agricultural context • Advanced computer programming in MATLAB®software • Image and signal processing algorithms in MATLAB® • Machine learning algorithms • Training, validation and test set selection in machine learning models	4 WLH

Examination: Report (field work) 30% (max. 8 pages), practical exam 70% (software application) Examination prerequisites: attendance is compulsory Examination requirements: • Understanding of computer programming in MATLAB • Knowledge of image processing in agriculture and livestock farming • Ability of data analysis and classification • Ability to work and use optical sensors in agriculture and livestock farming	6 C

Admission requirements: none	Recommended previous knowledge: Basic knowledge of MATLAB, scientific research and data collecting
Language: English	Person responsible for module: Dr. Abozar Nasirahmadi
Course frequency: each summer semesterWitzenhausen	Duration:
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 20	

Additional notes and regulations: Papajorgji P. J. und P. Pardalos 2006: Software Engineering Techniques Applied to Agricultural System. Springer.

Gonzalez R. C., Woods R. E. and S. L. Eddins 2003: Digital Image Processing Using Matlab. Prentice-Hall, Inc., USA

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.I27: Postharvest Technology	

Learning outcome, core skills:	Workload:
Students are able to understand Postharvest operations and can evaluate them in respect to loss reduction and quality aspects. They can select proper criteria for quality assurance and can decide fitting instrumentation for control purposes.	Attendance time: 60 h Self-study time: 120 h

Course: Postharvest Technology (Lecture)	4 WLH
Contents: Basics of processing and storage of agricultural products (drying, cooling) Selection of machinery and process technology Quality assessment and respective instruments	
Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Students are able to critically select process technology, chose instrumentation for process control and quality assessment, and they are able to interpret the measurements	6 C

Admission requirements:	Recommended previous knowledge:
Fundamentals of Physics	Basic course in agricultural engineering
Language: English	**Person responsible for module:** Prof. Dr. Oliver Hensel
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 20	

Additional notes and regulations:
Literature:
-      Hand-outs in lectures and exercises
Wild, Y. and R. Scharnow, Container Handbook, Vol. 3, German Insurance Association – GDV, Berlin, 2003

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.I28M: Unoccupied aerial vehicle (UAV) applications in agriculture**	6 C 4 WLH

Learning outcome, core skills: The students will learn about the unoccupied aerial vehicle (UAV) based remote sensing data acquisition and use in the agricultural context. They will understand the logic of using UAVs for agricultural applications and challenges and the essential theoretical background of available airborne technology, including international legislation and regulations for UAVs. They will learn to prepare a flight plan with all the prerequisites and to execute a safe flight mission. They will get experience in collecting UAV remote sensing data and the corresponding validation in-situ data on the field. Students will develop the ability to process the collected remote sensing data using open-source software to prepare maps and interpret them. They will obtain basic modelling skills to calibrate/validate models and estimate crop parameters with collected in-situ data and UAV remote sensing data	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Unoccupied aerial vehicle (UAV) applications in agriculture (Exercise) *Contents*: • Basic principles of vegetation remote sensing with a focus on different sensors and their characteristics. • Overview of the UAV application for agriculture, including opportunities and challenges. * Understanding of essential components of UAVs and international rules and regulations for UAVs. • Design an agricultural application with UAVs (Problem identification, data to be collected, selection of UAV and sensor, designing flying plans) • Field-level experience in UAV flying, mission planning, remote sensing and crop in-situ data (e.g., LAI, plant height), and ground control point data collection. • Introduction to structure from motion (SfM) technology for processing UAV images. • Processing of UAV remote sensing data using Open-Drone-Map (ODM) to develop image ortho-mosaics. • Visualisation of developed image products in Quantum GIS (QGIS) and their interpretation. • Basic principles of regression models and introduction to R. • Calibration and validation of crop in-situ data models using UAV remote sensing data, generation of estimated crop parameter maps, and interpretation of outputs.	4 WLH
Examination: Oral exam (approx. 30 min) 70 %; Presentation (approx. 15 min + 2 side handout) 30 % (45 minutes) **Examination prerequisites:** Basic understanding of remote sensing for vegetation analysis, opportunities and limitations of UAV for agriculture, and how to design UAV data collection for agriculture applications.	6 C

Admission requirements:	**Recommended previous knowledge:**

none	Participation in the I14M SIA module and programming with R would be advantageous.
Language: English	**Person responsible for module:** Jayan Wijesingha
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Additional notes and regulations:

Literature:

- Unmanned Aerial Vehicle: Applications in Agriculture and Environment, edited by Ram Avtar, and Teiji Watanabe, Springer International Publishing AG, 2019. ProQuest Ebook Central, https://ebookcentral.proquest.com/lib/unikassel/detail.action?docID=5979944.
- E-agriculture in action: Drones for agriculture. Thailand, Food & Agriculture Org., 2018.; UAV Remote Sensing for Plant Traits and Stress. N.p., Frontiers Media SA, 2022.
- UAS-Remote Sensing Methods for Mapping, Monitoring and Modeling Crops. N.p., MDPI AG, 2021.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.I29M: Research Methods and Data Science in the Life Sciences	6 C 4 WLH

Learning outcome, core skills: Students have an understanding of the methods of quantitative and qualitative data collection in the life sciences and the different sampling techniques and experimental designs. They are able to apply standard data analysis techniques. They understand the usefulness and limitations of selected multivariate approaches for regressions and pattern recognitions in the data science and learn the concepts of different machine learning approaches. They are able to apply the acquired skills in the analysis of their own MSc (and PhD) datasets.	Workload: Attendance time: 56 h Self-study time: 124 h

Course: Research Methods and Data Science in the Life Sciences (Internship, Lecture) *Contents*: Research methods and standard analyses in the life sciences • Introduction to methods of quantitative and qualitative data collection in the life sciences • introduction to sampling techniques and standard statistical techniques (regressions and analyses of variance) Data science in the life sciences • Application of multivariate approaches: principal component analysis (PCA) and regression (PCR), cluster analyses, factor analyses • Introduction to machine learning: perceptron, artificial neural networks, regression trees, rule-based models and support vector machine classification and regression	4 WLH
Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Profound knowledge of existing research methods and standard analyses in the life sciences. Solid understanding of the concepts, usefulness and limitations of multivariate and machine learning approaches for data analyses in the life sciences.	6 C

Admission requirements: none	Recommended previous knowledge: Basic Knowledge (B.Sc. level) of Soil and Plant Sciences
Language: English	Person responsible for module: Prof. Dr. Bernard Ludwig
Course frequency: each winter semester; Witzenhausen	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:

Maximum number of students:	
20	

Additional notes and regulations:

Literature:

Everitt, B., Hothorn, T. P. 2011. An Introduction to Applied Multivariate Analysis with R. Springer, New York

Jones, E., Harden, S., Crawley, M.J. 2023. The R Book. 3rded. Wiley

Holmes, D., Moody, P., Dine, D., Trueman, L. 2017. Research Methods for the Biosciences. Oxford University Press

Touchon, J.C. 2021. Applied Statistics With R: A Practical Guide for the Life Sciences. Oxford University Press

Wehrens, R. 2020. Chemometrics with R. 2nd ed. Springer

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.I30: Organic Agriculture in Europe	

Learning outcome, core skills:	**Workload:**
Students understand the situation of organic agriculture in different European countries.	Attendance time: 50 h
Students are able to discuss and judge standards of organic agriculture.	Self-study time: 130 h

Course: Organic Agriculture in Europe (Seminar) *Contents*: Online seminar: Comparison of standards of organic agriculture (IFOAM, EU, within EU). Situation of organic production, processing and markets in different European countries. Organic agriculture in European Universities: current research projects, teaching activities. Necessary measures on all levels in the coming future to transform agriculture production in different countries to organic agriculture.	
Examination: Work report (max. 15 p.) 80% or presentation (approx. 25 min) 40% and work report (max. 10 p.) 40%; oral test (approx. 15 min) 20% **Examination requirements:** Students have to analyze the situation of organic agriculture in different European countries and to compare the situation and development under defined criteria.	6 C

Admission requirements:	**Recommended previous knowledge:**
none	none
Language:	**Person responsible for module:**
English	Prof. Dr. Gunter Backes M.Sc. Holger Mittelstraß
Course frequency:	**Duration:**
each winter semester; Witzenhausen	1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**
twice	
Maximum number of students:	
not limited	

Additional notes and regulations:
The international module is offered online by ENOAT (European network of organic agriculture teachers) for students of all participating European universities.

Literature:

FIBL and IFOAM (ed.) 2022: The world of organic agriculture. Frick/Switzerland

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.P01: Ecology and agroecosystems	

Learning outcome, core skills:	Workload:
Students are able to define site-specific conditions of sustainability, identify key constraints to the productivity and sustainable use of agro-ecosystems, assess the scope of human (management) interventions, determine the causes of productivity decline and chose approaches to strengthen sustainability	Attendance time: 56 h Self-study time: 124 h

Course: Ecology and agroecosystems (Lecture, Seminar)	4 WLH
Contents: Case-study based analysis and discussion of ecological framework conditions (limitations) in different arid and sub-humid agro-ecosystems of tropical and temperate zones with a particular focus on marginal soils and/or difficult infrastructural conditions where effective nutrient cycling, integration of cropping and animal husbandry systems as well as the use of biodiversity for income generation at the farm level is of particular importance. The potential/role of organic agriculture will be discussed and a more general discussion of the potential of organic agriculture to strengthen the resilience of agro-ecosystems will be presented.	

Examination: Written Exam (90 min., 70%) and presentation (25 min., 30%) Examination requirements:	6 C
Students should be able to explain the function and biophysical limits of (sub)tropical agro-pastoral land use systems, to justify the need to establish interdisciplinary approaches and to describe current research methods in land use systems analysis.	

Admission requirements:	Recommended previous knowledge:
none	Basic knowledge in plant, soil and animal science, willingness to analyse agro-ecosystems quantitatively
Language: English	**Person responsible for module:** Prof. Dr. Andreas Bürkert
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 25	

Additional notes and regulations:
Literature:
Altieri, M. 1987: Agroecology: the scientific basis of alternative agriculture. Westview Press, Boulder, Colorado, USA; Gliessman, S.R. 1998: Agroecology: ecological processes in sustainable agriculture. Ann Arbor Press, Michigan, USA.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.P05: Organic cropping systems under temperate and (sub)tropical conditions	6 C 4 WLH

Learning outcome, core skills: Students are able to describe the principles and functions of agro-ecosystems, understand nutrient cycles and options for their improvement as an important basis of organic farming, evaluate systems of land use with a particular focus on organic modes of production and their role in agro-ecosystems, assess the role of livestock for nutrient cycling and with respect to the conservation of plant and animal biodiversity in (sub-)tropical settings.	Workload: Attendance time: 56 h Self-study time: 124 h

Course: Organic cropping systems under temperate and (sub)tropical conditions (Lecture, Excursion, Seminar) *Contents*: Visits of organic farms; case studies of livestock-oriented organic farming under different environmental conditions and constraints; development, evaluation and comparison of land use management systems under diverse natural, economic and socio-cultural conditions; nutrient cycling in plant-animal systems; site-specific contributions of legumes to N supply; P availability, P recycling and use of rock phosphates; modes of P supply in farming systems; EC, Australian, Japanese and North American regulations for organic farming – problems and opportunities.	4 WLH
Examination: Oral exam (ca. 15 minutes, 75%) and presentation (ca. 15 minutes, 25%) **Examination requirements:** Knowledge of organic plant cultivation systems, management of nutrient cycle systems, targeted use of legumes for site-specific N supply and knowledge of the basics of P availability, P recycling and the use of raw phosphates. Knowledge about the possibilities of P-supply in different cultivation systems, about the differences and problems with the ecostandards in EU, Japan, Australia and USA as well as knowledge about the contribution of livestock to the sustainability of organic farming systems.	6 C

Admission requirements: none	Recommended previous knowledge: Basic knowledge in plant, soil and animal sciences
Language: English	Person responsible for module: Prof. Dr. Andreas Bürkert
Course frequency: each winter semester; Witzenhausen	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: not limited	

Additional notes and regulations:

Literature:

Altieri, M. 1987: Agroecology: the scientific basis of alternative agriculture. Westview Press, Boulder, Colorado, USA; Willer, H. et al. 2008: The World of Organic Agriculture - Statistics and Emerging Trends 2008, IFOAM, Bonn, Germany.

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.P06: Soil and water	

Learning outcome, core skills:	**Workload:**
Students understand soil - water - plant relations and basic soil physical, soil hydrological and soil (micro)biological processes. They are able to critically evaluate soil and water problems and limits of soils as a natural resource and judge soil management options for sustainable land use.	Attendance time: 60 h Self-study time: 120 h

Course: Soil and water (Lecture, Exercise)	4 WLH
Contents: Fundamental physical and hydrological processes; Soil water storage and transport; Physicochemical properties, Soil water in relation to mechanical processes (e.g. workability, deformation, soil strength); Soil – Water - Plant Relations (root water uptake, root growth, transpiration, soil-plant-atmosphere continuum); Field water cycle and management effects (e.g. mulching, tillage, irrigation); Irrigation principles and practices; Soil degradation and conservation (e.g. soil salinisation, compaction, acidification, contamination); Edaphon and its functions; Mycorrhiza; Rhizobia; Methods in soil biology; Indicators of soil fertility; Turnover of the soil microbial biomass; Habitat protection and ecotoxicology; Soil biology and fertility of tropical soils.	
Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Students show that they understand soil - water - plant relations and basic soil physical, soil hydrological and soil (micro)biological processes. They are able to critically evaluate soil and water problems and limits of soils as a natural resource and judge soil management options for sustainable land use.	6 C

Admission requirements: none	**Recommended previous knowledge:** Fundamentals of soil science; Module Soil and Plant Science or equivalent.
Language: English	**Person responsible for module:** Prof. Dr. Tobias Weber
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:
Literature:
N.C. Brady & R. R. Weil, 2008. The Nature and Properties of Soils. 14th ed., Pearson International Press; Hillel, D. (1998): Environmental Soil Physics. Academic Press; Jury, W. & Horton, R. (2004): Soil Physics.

Wiley & Sons; Lal, R. & Shukla, M.K. (2004): Principles of Soil Physics, Marcel Dekker Inc.; Ehlers, W. & Goss, M. (2003): Water Dynamics in Plant Production, CABI Publishing; Kirkham, M. B. (2005): Principles of Soil and Plant Water Relations, Elsevier; Coyne, M. S. (1999). Soil microbiology: an exploratory approach, Thomson Press; Paul, E.A., Clark, F.E. (1996). Soil microbiology and biochemistry, 2nd ed., New York Academic Press.

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.P07: Soil and plant science	

Learning outcome, core skills:	Workload:
Bridging module for students lacking basic knowledge in some agronomy disciplines. With the help of lectures and reading materials students will be enabled to fill in gaps and get updated on state-of-the art knowledge with a special focus on questions pertinent to organic agriculture. Students, having taken this module, will be able to follow advanced courses in the above fields.	Attendance time: 60 h Self-study time: 120 h

Course: Soil and plant science (Lecture, Seminar)	4 WLH
Contents: Influence of soil formationprocesses on physical properties (texture, soil water, pore space), chemical properties (buffering, exchange capacity, nutrients), and biological properties (organic matter, edaphon), soil formation and classification. Nutrient availability and and nutrient mobilization under conventional and organic agricultural conditions. Major and minor nutrients and food quality.Plant breeding goals for different agricultural systems. Plant morphology, genetics and breeding: principles of plant domestication and use, characterization and evaluation, use of genetic resources in plant breeding, genetic basis for plant breeding Genetics of host-parasite interactions, epidemiology and plant defence. Insect physiology and ecology. Spezifische allgemeine und wissenschaftliche Artikel, die sich mit dem Zielland der Exkursion befassen werden über eine E-Learning Plattform zur Verfügung gestellt	
Examination: Written exam (120 minutes) or oral exam (ca. 20 minutes) Examination requirements: Fundamentals of soil science: Physical properties (texture, soil water, pore space), chemical properties (buffering, exchange capacity, nutrients), biological properties (organic matter, edaphon), soil formation and classification. Plant nutrition: Role of major and minor elements in plants, nutrient availability and nutrient mobilisation, plant nutrients and food quality Plant breeding and genetics: plant morphology, genetics and breeding: principles of plant domestication and use, characterization and evaluation, use of genetic resources in plant breeding, genetic basis for plant breeding. Plant protection: principles of plant pathology and entomology, genetics of plant diseases, epidemiology, plant defence mechanisms; insect physiology and ecology	6 C

Admission requirements:	Recommended previous knowledge:
none	none
Language:	**Person responsible for module:**
English	Dr. Helmut Saucke
Course frequency:	**Duration:**

each winter semester; Witzenhausen	1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:

Literature:

Brady, N.C. 1990: The nature and properties of soils. 10th edition, Prentice Hall; Marschner, H. 1995: Mineral Nutrition of Higher Plants, Academic Press, New York; Sanchez, P. 1976: Properties and Management of Soils of the Tropics, Wiley, New York; van Wyk, B.E. 2005: Food Plants of the World. Briza Publication, Pretoria; Rehm, S., Espig, G. 1991: The Cultivated Plants of the Tropics and Subtropics. Verlag Josef Margraf, Weikersheim, Germany; Agrios, G.N. 2005: Plant Pathology, 5th edition, Academic Press, New York; Pedigo, L.P. 2002: Entomology and Pest Management, 4th edition, Macmillan Pub Co.

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.P10: Tropical agro-ecosystem functions	

Learning outcome, core skills:	**Workload:**
Knowledge of the processes of soil degradation as well as of the measures for their control or prevention in selected land use systems of the tropics and subtropics; knowledge of ecological system functions and their synthesis in agronomic concepts for the adaptation to unfavourable climatic and pedological conditions in the tropics and subtropics.	Attendance time: 56 h Self-study time: 124 h

Course: Tropical agro-ecosystem functions (Lecture, Seminar)	4 WLH
Contents: Introduction to and overview of agronomy-based land use systems in the tropics and subtropics taking into account ecological points of view. Analysis of the sustainability of plant production under special consideration of the physical, chemical and biological soil quality as well as the efficient water use in the seasonal tropics.	
Examination: Presentation (ca. 30 minutes, 50%) and term paper (max. 10 pages, 50%) **Examination requirements:** Knowledge about the processes of soil degradation and the measures taken to control or prevent in selected land use systems in the tropics and subtropics; knowledge of ecosystem functions and their synthesis in agronomic concepts to adapt to unfavorable climatic and pedological conditions in the tropics and subtropics.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) of soil and plant sciences
Language: English	**Person responsible for module:** Dr. Ronald Franz Kühne
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

Additional notes and regulations:
Literature:
Lecture notes and handouts, selected chapters from textbooks; copies of PowerPoint presentations

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.P13: Agrobiodiversity and plant genetic resources in the tropics**	6 C 4 WLH

Learning outcome, core skills: Students are able to understand the role of agrobiodiversity in tropical agro-ecosystems, to present approaches of functional biodiversity analysis and to discuss the needs and strategies of on-farm (in situ) and off-farm conservation of plant genetic resources.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Agrobiodiversity and plant genetic resources in the tropics (Lecture, Seminar) *Contents*: Case-study based analysis of the role of biodiversity for selected crops in different agro-ecosystems from the arid to the humid climate zones; importance of biodiversity for the stability / sustainability of smallholder (subsistence) versus commodity-oriented commercial agriculture in the Tropics, assessment and utilization of diversity, principles and practices in conservation of genetic resources, role of homegardens and indigenous wild fruit trees for in situ conservation of biodiversity, causes and consequences of genetic erosion, approaches of germplasm collection.	4 WLH
Examination: Oral exam (about 15 minutes, 60%) and presentation (about 20 minutes, 40%) **Examination requirements:** Students should be able to understand the role of agrobiodiversity in tropical agroecosystems, to present basic approaches to functionally analyse biodiversity and to discuss the need of and strategies for *in* and *ex situ* conservation of genetic resources.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge in plant and soil sciences
Language: English	**Person responsible for module:** Prof. Dr. Gunter Backes
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations: **Literature:** Altieri, M. 1987: Agroecology: the scientific basis of alternative agriculture. Westview Press, Boulder, Colorado, USA; Eyzaguirre, P.B., Linares, O.F. 2004: Home gardens and agrobiodiversity. Smithsonia

Books, Washington, USA; Wood, D., Lenne, J.M. 1999: Agrobiodiversity: Characterization, utilization and management. CABI Publishing, Wallingford, UK.

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.P15M: Methods and advances in plant protection	

Learning outcome, core skills:	**Workload:**
Students are able to critically evaluate published results and apply this knowledge to actual problems in the field. They are also able to deal with problems in the field: Identification and measurements, design of experimental and analytical approaches to problems.	Attendance time: 60 h Self-study time: 120 h

Course: Methods and advances in plant protection (Lecture, Excursion, Exercise)	4 WLH
Contents: Advanced course in plant pathology and entomology. Methodology and evaluation methods in plant protection. Case studies of specific plant protection issues in organic farming in the form of lectures, seminars and practical courses.	

Examination: Written exam (120 minutes) or oral exam (ca. 20 minutes) (70%) and work reports (max. 3 pages) or seminar speech (ca. 10 minutes) (30%) **Examination requirements:** Advanced knowledge in plant protection (Entomology and Pathology) Methodology and evaluation methods in plant protection based on case studies.	6 C

Admission requirements:	**Recommended previous knowledge:**
Introductory course in plant protection (entomology and pathology, at least 6 ECTS or equivalent) or bridging module M.SIA.P07 Soil and Plant Science	none
Language: English	**Person responsible for module:** Prof. Dr. Maria Renate Finckh
Course frequency: each winter semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:
Literature:
Agrios, G.N. 2005: Plant Pathology, 5th edition Academic Press, New York; Pedigo, L.P. 2002: Entomology and Pest Management, 4th edition, Macmillen Pub Co.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.P16M: Crop Modelling for Risk Management	6 C 4 WLH

Learning outcome, core skills:	Workload:
• Gain knowledge of the features of different crop modelling concepts and model families and learn to use the Agricultural Production Systems SIMulator (APSIM) • Understand the basic principles of production ecology and agro-ecosystems modelling • Apply crop modelling to typical agronomic questions related to risk management strategies	Attendance time: 56 h Self-study time: 124 h

Course: Crop modelling for risk management (Lecture, Seminar) *Contents*: Using the Agricultural Production Systems sIMulator (APSIM) students will be introduced to the concepts (potential, water-limited and nitrogen-limited production) and application options of agro-ecosystem modelling. In the first part of the lecture students will learn along guided exercises to set up different simulations (single season cropping, rotation, intercropping, climate change effects etc.). In the second part selected case studies are presented, which address typical agronomy questions (fertilizer management, closing yield gap, identifying suitable crop rotations).	4 WLH
Examination: Presentation (about 20 min, 50%) and written report (max. 20 pages,50%) **Examination requirements:** Good understanding of the model APSIM and its underlying theory (process) descriptions and of input- and output variables and technical model features for simulating genotype x environment x management interactions in potential, water-limited and nitrogen-limited production situations; Understanding of model evaluation methods.	6 C

Admission requirements: none	Recommended previous knowledge: Basics in agronomy, soil science & plant nutrition
Language: English	Person responsible for module: Prof. Dr. Reimund Paul Rötter Dr. Gennady Bracho Mujica
Course frequency: each summer semester; Göttingen	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 16	

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.P19M: Experimental techniques in tropical agronomy	

| **Learning outcome, core skills:** | **Workload:** |
| Knowledge of the botanical, ecological and agronomic facts of the introduced crop plants and multiplication techniques, scientifically correct interpretation and discussion of results from a greenhouse experiment, limitations and potentials of the interpretation of measuring procedures for the description of physiological state variables in tropical crop plants. | Attendance time: 60 h Self-study time: 120 h |

Course: Experimental Techniques in Tropical Agronomy (Lecture, Exercise, Seminar)	4 WLH
Contents: Principles and practice of vegetative and generative propagation techniques in the greenhouse of the division. Introduction to statistical experimental design and analysis of greenhouse experiments. Theory and practice of eco-physiological measurement methods for the water balance and status, as well as gas exchange / photosynthesis rates in tropical crop plants. Infrastructure like lab benches, cabins, climate chambers and plantarray lysimeters can be used and might be involved in the experiments done by the students in working groups.	
Literatur Kopien von Powerpoint-Präsentationen, ausgewählte Kapitel von Lehrbüchern.	

Examination: Presentation (ca. 30 minutes, 50%) and protocol (max. 20 pages, 50%)	6 C
Examination requirements: Knowledge of botanical, ecological and agronomic facts of the presented crop plants; scientifically correct planning, implementation, evaluation, description and discussion of the results of a greenhouse experiment; limits and possibilities of interpretation of measurement methods for describing the physiological state variables of tropical crop plants.	

Admission requirements: M.SIA.P12	**Recommended previous knowledge:** Basic knowledge (B.Sc. level) of plant sciences
Language: English	**Person responsible for module:** Dr. Ronald Franz Kühne
Course frequency: each summer semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 15	

| **Additional notes and regulations:** |

Literature:

Copies of PowerPoint presentations, selected chapters from textbooks

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.P20: Plant nematology	

Learning outcome, core skills:	**Workload:**
Students will gain advanced insight in plant nematology, nematode interactions with other plant pathogens, and management strategies; hands-on training will be provided on nematode sampling, processing, identification and disease evaluation	Attendance time: 60 h
Students having taken this module will be able to detect nematode damage and identify plant-parasitic nematodes to genus.	Self-study time: 120 h

Course: Plant Nematology (Lecture, Exercise, Seminar)	4 WLH
Contents:	
Introduction: History (first records, evolution, phylogeny), General function of nematodes (nutrient cycling, beneficial nematodes, parasites of plants and animals), Biology (anatomy, classification, life cycle, reproduction, feeding behaviour, parasitism strategies), Ecology (spread, population dynamics, distribution in soil, survival strategies, worldwide occurrence, interaction with other pathogens), Symptoms (aboveground/ belowground), Plant-Nematode Interactions (feeding sites, plant defence mechanisms, nematode survival), Economic importance (quantitative/qualitative yield losses, main damaging genera, most vulnerable crops)	
Methodology: Sampling procedures (sampling depth, number of cores per sample, total sample volume), Sample processing for (a) cysts from soil (Fenwick can, centrifugal/ flotation, elutriation), for (b) mobile stages from soil (Baermann funnel, sieving, flotation, elutriation), for (c) mobile stages from plant material (Baermann funnel, direct preparation, mistifier), Staining of nematodes (in roots, egg masses), Scoring root damage (gall index)	
Nematode identification: fishing of nematodes, fixation, mounting, permanent slides, identification keys, preparation of vulval cones (cyst nematodes) and perineums (root-knot nematodes)	
Management: Threshold levels, Quarantine, Crop rotation (hosts, non-host-plants, trap crops, antagonistic crops, fallow), Resistance/tolerance (classical breeding, molecular approaches), Organic amendments (compost, green manure), Biological Control (antagonistic microorganisms, suppressive soils), Physical control (heat, steam, flooding, radiation), Chemical control (nematicides, fumigants)	

Examination: Referat (ca. 15 Minuten, Gewichtung: 10%), Protokoll (max. 15 Seiten, Gewichtung: 40%), Klausur (120 Minuten, Gewichtung 50%) **Examination requirements:** General and special biology of nemtodes, especially plant parasitic nematodes. Metnodologies in nematology and identification, general management of nematodes.	6 C

Admission requirements:	**Recommended previous knowledge:**
Basic knowledge (B.Sc. level) of soil, plant and animal sciences, alternatively course P07	Grundkenntnisse (B.Sc.Niveau) in Boden-, Pflanzen- und Tierwissenschaften

Language: English	**Person responsible for module:** Prof. Dr. Maria Renate Finckh
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Additional notes and regulations:

Literature:

Perry, N.R., Moens, M. 2013: Plant Nematology, CAB International. Sikora, R.A., Coyne, A., Hallmann, J,, Timper, P. 2018: Plant parasitic nematodes in subtropical and tropical agriculture, 3nd edition. Ciancio, A., Mukerji, K.G. 2008: Integrated Management and Biocontrol of Vegetable and Grain Crops Nematodes, Springer-Verlag. Perry, R.N., Moens, M., Starr, J.L. 2009: Root-Knot Nematodes, CAB International. Agrios, G.N. 2005: Plant Pathology, 5th edition. Berg, R.H., Taylor, C.G. 2009: Cell Biology of Plant Nematode Parasitism. Springer-Verlag. Ferraz, L.C.C.B., Brown, D.J.F. 2002: An Introduction to Nemtaodes: Plant Nematology, Pensoft. Weischer, B., Brown, D.J.F. 2000: An Introduction to Nematodes: General Nematology, Pensoft, Shurtleff, M.C., Averre III, C.W. 2000: Diagnosing plant diseases caused by nematodes, APS Press

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.P21: Energetic use of agricultural crops and Field forage production**	6 C 4 WLH

Learning outcome, core skills: Based on the data presented, students are able to identify and evaluate potentials and limits of energy production from renewable plant resources. Furthermore, students are able to classify and to assess the importance of field forage production for organic cropping systems.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Energetic use of agricultural crops and Field forage production (Lecture, Excursion) *Contents*: Management of agricultural crops for energetic use. Energy scenario and potentials, emission of greenhouse gases, sources of energy from biomass and waste material, selecting and processing biomass as a fuel. Biogas, fermentation process and plant technology. Gasification,pyrolysis, combustion. Benefits and restrictions with the replacement of fossil fuel-based materials through biomass-based products. The importance of field forage production (ffp) for organic cropping systems; basics of ffp – plant species; integration of ffp in crop rotation systems; environmental impact of ffp, quality aspects; nutrient-dynamics. Environmental evaluation by lifecycle assessment analysis.	4 WLH

Examination: Oral examination (approx. 30 minutes) **Examination requirements:** Basic and theme specific deepened knowledge on the use of agricultural biomass for energetic purposes and for forage production.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowlege in soil and plant sciences, physics and chemistry.
Language: English	**Person responsible for module:** Prof. Dr. Michael Wachendorf
Course frequency: every 4th semester; Start WiSe 2017/2018; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 20	

Additional notes and regulations: **Literature:**

Guide to Biogas - From production to use. 2012. Fachagentur Nachwachsende Rohstoffe e. V. (FNR)

Kaltschmitt, M. Energy from Organic Materials (Biomass). Springer, New York, NY. https://doi.org/10.1007/978-1-4939-7813-7.

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen **Module M.SIA.P22: Management of tropical plant production systems**	6 C 4 WLH

Learning outcome, core skills: Knowledge of botanical, ecological and agronomic facts of presented crops and cropping systems. The students should be able to classify crops and cropping systems in relation to site conditions and undertake system-orientated evaluation of sustainable production.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Management of tropical plant production systems (Lecture) *Contents*: Presentation of the most important crops with respect to: botany, morphology, origin, climatic and ecological requirements, crop production, harvest procedure, significance in local farming systems, utilisation as food, feed, raw materials and as bioenergy source. Discussion of specific cropping systems in the tropics and subtropics and specific management systems for the sustainable improvement of productivity. **Literatur** Rehm, S., Espig, G. 1991: The Cultivated Plants of the Tropics and Subtropics. Verlag Josef Margraf. Weikersheim, Germany; lecture notes	4 WLH
Examination: Presentation (ca. 30 Minuten, 50%) und written report (max. 15 pages, 50%) **Examination requirements:** Knowledge of botanical, ecological and agronomic facts of the presented crops and cropping systems. Knowledge of the assignment of crops and cropping systems to different site conditions, as well as system-oriented evaluation of sustainable production at selected sites.	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge on plant production (BSc-level)
Language: English	**Person responsible for module:** Prof. Dr. Reimund Paul Rötter
Course frequency: each winter semester; Göttingen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 35	

Additional notes and regulations: **Literatur:** Literatur, u.a.: Rehm, S., Espig, G. 1991: The Cultivated Plants of the Tropics and Subtropics. Verlag Josef Margraf. Weikersheim, Germany; lecture notes

Slides, selected articles and other materials will be provided

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	
Module M.SIA.P27M: Nutrient dynamics, experimental design and statistical modelling - bilingual	

Learning outcome, core skills:	Workload:
• Anwendung der statistischen Software R für eine Untersuchung und Beschreibung ökologischer Prozesse in Ackerböden. • Verständnis der Nährstoffdynamik in Böden und der Versuchsdesigns, um die Aussagekraft von Feld- und Laborversuchen zur Untersuchung der C-, N- und P-Dynamik kritisch zu beurteilen.	Attendance time: 60 h Self-study time: 120 h

Course: Nutrient dynamics: long-term experiments and modelling - bilingual	
(Lecture, Exercise) *Contents*: • Vertiefung der Kenntnisse bezüglich der C-, N- und P-Dynamik (Formen, Transformationen und Verfügbarkeit) in Ackerböden • Versuchsdesigns in landwirtschaftlichen Experimenten: vollständig randomisierte Anlage, randomisierte vollständige Blockanlage, lateinisches Quadrat, Spaltanlage und balancierte unvollständige Blockanlage • Statistische Modellierung: gemischte Varianz- und Regressionsanalysen und lineare gemischte Modelle • Modellierung der Umsatzdynamik der organischen Bodensubstanz mit dem SoilR-Paket in R • Anwendung der statistischen Software R für eine Beschreibung der C- und N-Dynamik Crawley, M.J. 2012: The R book. 2nd edition, Wiley 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 Welham, S.J., Gezan, S.A., Clark, S.J., Mead, A. 2014. Statistical Methods in Biology. Design and Analysis of Experiments and Regression, CRC Press, Boca Raton	
Examination: Oral examination (approx. 25 minutes)	6 C

Admission requirements: none	Recommended previous knowledge: none
Language: English	**Person responsible for module:** Prof. Dr. Bernd Ludwig
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**

Maximum number of students:	
not limited	

Georg-August-Universität Göttingen Universität Kassel/Witzenhausen Module M.SIA.P28: Digitilization in agriculture	6 C 4 WLH

Learning outcome, core skills: The participants will have gained a holistic understanding of precision agriculture, digitalization in agriculture, image processing and machine learning, data classification and pattern recognising and prediction methodologies around agricultural and animal farming stuffs.	**Workload:** Attendance time: 60 h Self-study time: 120 h

Course: Digitalization in agriculture (Exercise, Seminar) *Contents*: • Introduction to sensor solutions, digital technologies in agricultural science • Application and principle of optical and infrared technology for monitoring of agricultural and animal products • Machine vision and image processing in agricultural context • Basic techniques and functions of matrices in MATLAB® • Computer programming in MATLAB® • Machine learning algorithms • Pattern recognition and object detections algorithms • Development of data classification and pattern forecasting models in agricultural and livestock farming datasets	4 WLH
Examination: Report (field work) 50% (max. 8 pages), practical exam 50% (software application) **Examination prerequisites:** Regular participation **Examination requirements:** • Fundamental understanding of digitalization concepts and approaches in smart farming • Knowledge of technology application for crop, animal and food monitoring • Knowledge and basic ability to program MATLAB software in the context of agricultural science application • Ability to work and use optical sensors in crop monitoring	6 C

Admission requirements: none	**Recommended previous knowledge:** Basic knowledge of scientific research and data collecting
Language: English	**Person responsible for module:** Dr. Abozar Nasirahmadi
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students:	

20	

Additional notes and regulations:

- Gonzalez R.C., Woods R.E. and S.L. Eddins 2010: Digital Image Processing using MATLAB. New Delhi: Tata McGraw Hill Education;
- Stafford S. (ed.) 2019: Precision agriculture for sustainability. Cambridge, UK: Burleigh Dodds Science Publishing

Georg-August-Universität Göttingen	6 C
Universität Kassel/Witzenhausen	4 WLH
Module M.SIA.P29: Impact of climate extremes on plant production systems around the globe	

Learning outcome, core skills:	**Workload:**
Students will:	Attendance time:
	56 h
• Gain a deeper understanding of shifts in climate variability and weather extremes and its relevance in important agricultural regions	Self-study time:
• Get a global perspective on how ongoing climate change is projected to amplify the occurrence of climate extremes	124 h
• Learn about major impacts of climate extremes on important plant production systems around the globe	
• Get familiarized with widely used tools for quantifying impacts of climate extremes on plant production systems (i.e. experiments, eco-physiological & statistical and systems modelling).	
• Learn about current progress in experimentation aimed at getting a deeper understanding of responses of major crops to different types of climate extremes.	

Course: Impact of climate extremes on plant production systems around the globe (Lecture, Seminar)	4 WLH
Contents:	
• Weather/climate and plant production. Climate variables determining growth and development of plants, and operational and strategic management.	
• Natural and anthropogenic weather and climate variability. Temporal and spatial scales. Statistical methods for detecting extremes.	
• What makes an event or series of events extreme? Theory on climate extreme events. Major climate extremes and their damage potential, likely shifts under future climate: illustrated by in-depth cases studies from major plant production systems.	
• Data sources, data types and scales required for quantitative analysis of potential impacts (e.g. yield loss) and adaptation options/management of risk and opportunities for major plant production systems. Available experimental and modelling data on indicators and thresholds for major plant production systems.	
• Introduction to state of the art analysis (statistical and systems modelling) techniques for quantifying impacts, adaptations and risk management strategies at different scales/ levels of organization - from plant/field via farm to landscape/ regional level.	

Examination: Written exam (30 minutes, 50%) and written report (10 pages max. 50%)	6 C
Examination requirements:	
written report on a specific case, i.e. combination of agro-climatic extreme x cropping systems (10 pages max. 50%)	
Basic knowledge of agronomy, agro-meteorology and soil science	

Admission requirements:	Recommended previous knowledge:
none	none
Language:	**Person responsible for module:**
English	Prof. Dr. Reimund Paul Rötter
Course frequency:	**Duration:**
each winter semester	1 semester[s]
Number of repeat examinations permitted:	**Recommended semester:**
twice	
Maximum number of students:	
24	

Georg-August-Universität Göttingen **Universität Kassel/Witzenhausen** **Module M.SIA.P31: Biochar for Environmental Management**	6 C 4 WLH

Learning outcome, core skills: The students obtain basic knowledge in the areas of the production of biochar and activated carbon from residual biomass, as well as their use in agricultural and environmental applications. They develop a deeper understanding of pyrolytic processes and procedures, as well as different technological conversion processes for the production of biochar and activated carbon from biomass. They understand relationships between biomass composition, characteristics of biochar and activated carbons, and their potential applications. The students develop the ability to evaluate thermo-chemical conversion processes of biomasses, as well as to identify relevant influencing parameters on the quality and possible applications of biochars and activated carbons. The students have basic knowledge regarding the advantages and limitations of a material and energetic utilization of residual biomasses for the production of biochar and activated carbon, as well as their use in the agricultural and environmental sector for a sustainable environmental and resource management	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Biochar for Environmental Management (Lecture, Practical course, Seminar) *Contents*: Lecture 20h, Work experience 20h, Seminar 20h Theoretical basics of thermo-chemical conversion (pyrolysis) of biomasses to produce biochar, with a focus on the use of (agricultural) residual biomasses for sustainable resource use, as well as the production of biogenic activated carbons for the substitution of fossil activated carbons in environmental applications. Fundamentals of possible treatment processes of grass and herbaceous residual biomasses for pyrolytic utilization. Possible uses of biochar and activated carbon in agricultural and environmental applications. Material and energetic balances of thermo-chemical processes. Requirements for purity and quality of biochar and activated carbon for different fields of application. Production of biochar and activated carbon from residual biomass (incl. treatment) on laboratory scale using different processes. Laboratory work for basic analytical characterization of the produced biochar and activated carbon and evaluation of their performance for environmental management.	4 WLH

Examination: Oral exam (approx. 30 minutes; 60 %) and presentation (approx. 20 minutes; 40 %) **Examination requirements:** Presentation and critical analysis of a potential utilization case of biochar and biogenic activated carbon in relevant environmental applications. Knowledge in biochar and activated carbon production, handling of residual biomass, biomass pre-treatment,	6 C

characterization of biochar and activated carbon, insights into different conversion technologies, interactions between biomass characteristics and biochar/activated carbon quality.	

Admission requirements: M.Sc.SIA Students Only	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr.-Ing. Korbinian Kaetzl
Course frequency: each summer semester; Witzenhausen	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: 12	

Additional notes and regulations:

Location:

The practical part of the module will take place at our research site in Neu-Eichenberg.

Literature:

Johannes Lehmann and Joseph Stephen (Eds.): Biochar for Environmental Management: Science, Technology and Implementation. Routledge, 2015.

Jay Shankar Singh and Chhatarpal Singh (Eds.): Biochar Applications in Agriculture and Environment Management. Springer, 2020.

Harry Marsh and Francisco Rodríguez Reinoso (Eds.) Activated Carbon. Elsevier Science, 2006.

Balwant Singh, Marta Camps-Arbestain, and Johannes Lehmann (Eds.) Biochar: A Guide to Analytical Methods. Csiro Publishing, 2017.

Peter Quicker and Kathrin Weber (Eds.): Biokohle: Herstellung, Eigenschaften und Verwendung von Biomassekarbonisaten. Springer Vieweg, 2016

Georg-August-Universität Göttingen **Module M.WIWI-QMW.0004: Econometrics I**	6 C 6 WLH

Learning outcome, core skills: This lecture provides a detailed introduction and discussion to the theory of several topics of econometrics. In a practical course the students will apply the methods discussed to real economic data and problems using the statistical software packages Eviews and R.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Econometrics I (Lecture) *Contents*: Multiple linear regression model: Estimation, Inference and Asymptotics. Maximum likelihood modeling. Generalized least squares. Stochastic regressors. Intrumental variable estimators. Generalized method of moments, likelihood based inference. Dynamic models, weak exogeneity, cointegration, stochastic integration.	2 WLH
Course: Econometrics I (Exercise) *Contents*: The practical deepens the understanding of the lecture topics by applying the methods from the lecture to economic problems and data, and reviewing and intensify theoretical concepts.	2 WLH
Course: Econometrics I (Tutorial) *Contents*: The tutorials are small classes with max. 20 students, which give room for applying the concepts to specific problem sets and discussing questions, that students might encounter regarding the concepts addressed in the lecture and practical. A part of the tutorial are hands-on computer exercises using the software R. This enables students to conduct regression analysis in practice and prepares them for others (applied) courses.	2 WLH
Examination: Written examination (90 minutes)	6 C

Examination requirements: Linear regression models, generalized linear regression models. OLS, GLS, EGLS estimation. Multiplikative heteroskedasticity, autocorrelation. LM specification testing, Durbin Watson test. Convergence in probability, convergence in distribution. Asymptotics (consistency, asymptotic normality) of OLS estimators. IV estimation, GMM estimation.	

Admission requirements: none	**Recommended previous knowledge:** Required: Mathematics (linear algebra), statistics. Desirable: Introduction to Econometrics (or comparable lecture).
Language: English	**Person responsible for module:** Prof. Dr. Helmut Herwartz
Course frequency: each semester	**Duration:** 1 semester[s]

Number of repeat examinations permitted:	Recommended semester:
twice	1 - 2
Maximum number of students:	
not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0008: Development Economics I: Macro Issues in Economic Development**	6 C 4 WLH

Learning outcome, core skills: Expose students to macroeconomic issues in economic development, including how economic growth, trade, inequality, aid, capital flows, and population issues affect economic development. They understand historical roots of underdevelopment and acquire knowledge of current economic models and empirical approaches in these topic areas.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Development Economics I (Lecture) *Contents*: Overview of macroeconomic issues and approaches to analyzing problems of developing countries. Topics include measurement of development, historical evolution of income differences, growth theory, and linkages between globalization, aid, debt, population, the environment, and inequality and economic development.	2 WLH
Course: Development Economics I (Exercise) *Contents*: The exercise session is used to deepen understanding of concepts used in the lecture, discuss relevant literature, and apply concepts and methods developed in the lecture.	2 WLH
Examination: Written Exam **Examination prerequisites:** Submission of 6 exercise sheets (of sufficient quality). The exercises deepen the understanding of concepts and empirical methods taught in the lecture and apply it to specific cases.	6 C

Examination requirements: The students demonstrate a good understanding of key theories and models of economic development. They are able to critically present these theories and models, are able to interpret empirical results that relate to these models, and are able to crucially draw relevant policy conclusions coming out of these models and empirical assessments.	

Admission requirements: None	**Recommended previous knowledge:** Knowledge of macroeconomics and econometrics at BA level is highly desirable.
Language: English	**Person responsible for module:** Prof. Dr. Andreas Fuchs
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students:	

not limited	

Georg-August-Universität Göttingen **Module M.WIWI-VWL.0096: Essentials of Global Health**	6 C 3 WLH

Learning outcome, core skills: The goal of this course is to provide students with a comprehensive understanding of global health. By the end of the course, students will be able to: • explain main concepts of global health • describe linkages between health and economic development • describe determinants of health • describe different components of health systems • demonstrate familiarity with the concept of burden of disease and risk factors and how health status is measured • describe key measures to address the burden of disease in cost-effective ways • read, discuss and present recent scientific literature in the global health field • write a clear and concise policy brief tailored to a specific audience	**Workload:** Attendance time: 42 h Self-study time: 138 h

Course: Essentials of Global Health (Seminar) *Contents*: The course will introduce students to the main concepts of the public health field and critical links between global health and economic development. Students will get an overview of the determinants of health and learn how health status is measured. The course will be global in coverage, but with a focus on low- and middle-income countries and on the health of the poor. The course will cover: • Global health concepts • Linkages between health and development • Global burden of disease, measurement and global trends • Determinants of health and social network effects • Health disparities • Health systems • Global health efforts • Health behaviour in developing countries	2 WLH
Course: Essentials of Global Health (Exercise) *Contents*: Practical exercises related to the topics discussed in the seminar give students the opportunity to deepen and enhance their understanding of the seminar's content.	1 WLH
Examination: Portfolio* (max. 15 pages) **Examination requirements:** In their portfolio, students should demonstrate their familiarity with key concepts and topics discussed in the lecture as well as an ability to critically discuss these topics by completing various assignments related to particular seminar contents. In addition, students will be expected to have read the background literature mentioned in the course.	3 C
Examination: Oral Presentation (approx. 60 minutes)	3 C

Examination requirements:

Students will present current research articles in global health and demonstrate an understanding of the main concepts of global health and their linkages with economic development. Students will be further required to demonstrate skills to critically discuss scientific articles.

Admission requirements: none	**Recommended previous knowledge:** Basics in microeconomics and macroeconomics, understanding of econometrics, ability to read scientific articles
Language: English	**Person responsible for module:** Prof. Dr. Sebastian Vollmer
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3 - 4
Maximum number of students: 18	

Additional notes and regulations:

* A portfolio is a collection of the following assignments related to particular seminar contents: summaries of a text, response papers, reading reports and comments on presentations (max. 15 pages).

Georg-August-Universität Göttingen **Module M.iPAB.0002: Breeding schemes and programs in plant and animal breeding**	6 C 4 WLH

Learning outcome, core skills: Students will learn the basic elements and structures of breeding programs in plant and animal breeding. They understand the relationship between biological characteristics of the crop or livestock species and the specific design of the breeding program. The students know the four breeding categories and design possibilities of breeding programs for self-pollination, cross-pollination and vegetative and clonally propagated crops. They learn breeding programs for major crops and livestock species.	**Workload:** Attendance time: 56 h Self-study time: 124 h

Course: Breeding schemes and programs in plant and animal breeding (Lecture, Excursion) *Contents*: Design of breeding programs. Basic elements of breeding programs: Breeding objectives and breeding planning, performance testing, selection and mate selection, use of biotechnologies, transfer of breeding progress in the production level, monitoring of the breeding progress. Breeding program structures in the most important crop species: cereals, corn, rape, sugar beet, specialty crops. Breeding program structures in the main livestock species: dairy cattle, pigs, poultry, beef cattle, small ruminants. Breeding program structures in forest genetics.	4 WLH
Examination: Written exam (45 minutes, 50%) and Presentation (about 20 minutes) with written outline (max. 10 pages) (50%) **Examination requirements:** Profound knowledge of basic breeding program structures and elements of breeding programs and their concrete implementation to various crops and livestock. Elaboration of the breeding planning for a livestock or crop species.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Birgit Jutta Zumbach
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** Master: 1
Maximum number of students: 30	

Additional notes and regulations: Mandatory excursions to practical plant breeding and animal breeding programs.