

Modulhandbuch

Course Book

M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)

Studienbeginn ab WS 2025/2026

Beginning of studies from WS 2025/2026



RHEINISCHE
FRIEDRICH-WILHELMS-
UNIVERSITÄT BONN



AGRAR-, ERNÄHRUNGS- UND
INGENIEURWISSENSCHAFTLICHE
FAKULTÄT

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Abkürzungen/Abbreviations:

Häufigkeit/Course cycle

SS=Sommersemester/Summer semester

WS=Wintersemester/Winter semester

Verwendbarkeit des Moduls/Study program allocation

P/C=Pflichtmodul/Compulsory

WP/E=Wahlpflichtmodul/Elective

fWP/O=freies Wahlpflichtmodul/Optional

PM=Projektmodul/Project module

Lehr- und Lernformen/Teaching and learning methods

V/L=Vorlesung/Lecture

Ü/T=Übung/Tutorial

S=Seminar

P=Praktikum/Practical training

E=Exkursion/Excursion

prÜ/pT=praktische Übung/ Practical course

PS=Projektseminar/Project seminar

T/sT=Tutorium/Student tutorial

K/C=Kolloquium/Colloquium

AG/SG=Arbeitsgemeinschaft/Study group

B-Arb/BT=Bachelorarbeit/Bachelorthesis

M-Arb/MT=Masterarbeit/Masterthesis

Mit Asterisk (*) gekennzeichnet: Lehrveranstaltungen, für die gemäß § 13 Abs. 6 der POO als Voraussetzung für die Teilnahme an Modulprüfungen die verpflichtende Teilnahme festgelegt ist. Die Pflicht zur Teilnahme besteht dann zusätzlich zu etwaigen sonstigen aufgeführten Studienleistungen.

Marked with an asterisk (*): Courses for which, in accordance with § 13 Paragraph 6 of the POO, compulsory attendance is specified as a prerequisite for taking module examinations. The compulsory attendance then exists in addition to any other listed academic achievements.

Compulsory modules of the first semester (ARTS-A)

24 ECTS-CP must be completed.

Module Title: Ecological Conditions and Climate Change							
Module ID/Code: ARTS-A01 [780750010]							
1. Content and intended learning outcomes							
Learning content:	<p>Students acquire the know-how about and a quantitative understanding of the structure and use of resources (soil, water, plant, animal, genes, ecosystem) for agricultural production within their changing biophysical environment, including the effects of agriculture on and the contributions to desertification and climate change. The interdisciplinary lecture is structured into three components aimed at acquiring knowledge, interpreting trends and explaining possible implications:</p> <ol style="list-style-type: none"> 1. Interdisciplinary lecture on ecological conditions for agricultural production, including geodynamics, climate systems, soil and water resources and ecosystem services (- Ecology of the earth, landscape formation, biodiversity; - Climate, agroecological zones, definitions and descriptions; - Soil formation in relation to landscape and climatic factors; - Water resources, management and use in relation to climatic zones; - Land use systems in major climatic zones.); 2. Lecture and case study examples of observations, trends and processes of climate change and their implications and trade-offs for crop and animal production systems (- Trends and scenarios of future climate and its impact on agriculture; - Sources and sinks of greenhouse gases; - Political frameworks to combat climate change; - Strategies to reduce emissions from agriculture (mitigation); - Strategies to cope with climate change phenomena (adaptation); - Scenarios of future climate and its impact on agriculture - Trade-offs of major mitigation / adaptation scenarios); 3. Seminar presentation on a selected climate change-related issue 						
Learning outcomes							
After a successful completion of the course, the students...							
<ul style="list-style-type: none"> - understand and recognize ecological processes and interactions for agricultural production. - are able to classify, interpret, compare and critically assess climate observations and trends. - can summarize and explain observations using a case study example from their home country. 							
2. Prerequisites							
obligatory							
recommended							
Maximum number of students	25 students						
3. Study program allocation							
Study program						Compulsory/ Elective	Semester
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						C	1.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L (blocked)	afternoon block	Ecological principles	English	25	1,5	20,0	30,0
T (blocked)	afternoon block	Observation in climate change	English	25	1,5	20,0	30,0
S (blocked)	afternoon block	Case study presentation	English	25	1,0	20,0	60,0
5. Course cycle			6. Workload [h]		7. Duration		8. Credits (ECTS)
WS			180		1		6,0

Module Title: Ecological Conditions and Climate Change				
Module ID/Code: ARTS-A01 [780750010]				
9. Requirements for the rewarding of credits (ECTS)				
Types of Assessment	Prerequisites for admission to the Assessment	Graded yes/no	Language (exam)	Weighting factor
Written exam [780750019]		graded	English	75%
Report (presentation) [780750018]		graded	English	25%
Academic Achievements				
10. Module coordination				
Module coordinator				
Dr. Janina Dierks				
Teaching person				
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/				
Institute/ Department				
Agrar-, Forst- und Ernährungswissenschaften				
11. Further information				

Module Title: Food Security and Sustainable Food Systems							
Module ID/Code: APO-260 [780763260]							
1. Content and intended learning outcomes							
Learning content:	Students will learn to look at agriculture and nutrition through a food systems lens and understand synergies and tradeoffs between human health and planetary health goals. Concepts and measurement of food security, dietary quality, and the triple burden of malnutrition, as well as related policy interventions, will be discussed. Links between agriculture, biodiversity, climate change, diets, nutrition, and health will be analysed from a global perspective and with empirical examples from low-, middle-, and high-income countries. Case studies will be used to evaluate specific food systems topics from a comprehensive sustainable development perspective. Case studies will include topics such as organic farming, GMOs, meat consumption, palm oil, nutrition-sensitive agriculture, and the supermarket revolution, among others.						
Learning outcomes							
After a successful completion of the course, the students...							
<ul style="list-style-type: none"> - are able to define key terms related to food security and sustainable diets. - can explain how food systems relate to the various sustainable development goals (SDGs). - can identify policy needs and analyse the sustainability implications of specific interventions. - can evaluate the arguments in the public debate around sustainable agriculture and nutrition. - can construct and use dietary surveys and nutrition assessment tools. 							
2. Prerequisites							
obligatory							
recommended							
Maximum number of students							
3. Study program allocation							
Study program				Compulsory/ Elective			Semester
M.Sc. Agricultural and Food Economics				E			1 or 3.
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)				C			1.
M.Sc. Nutrition Science				E			3.
M.Sc. Molecular Food Technology				E			3.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L	during the semester		English	120	4,0	56,0	124,0
5. Course cycle			6. Workload [h]		7. Duration		8. Credits (ECTS)
WS			180		1		6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor	
Written exam [780763269]				graded	English	100%	
Academic Achievements							

Module Title: Food Security and Sustainable Food Systems
Module ID/Code: APO-260 [780763260]
10. Module coordination
Module coordinator
Prof. Dr. Matin Qaim
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information

Module Title: Conservation and Use of Genetic Resources							
Module ID/Code: ARTS-A03 [780750020]							
1. Content and intended learning outcomes							
Learning content:	Genetic resources form an important basis of crop and livestock production. In this module, students are familiarized with the importance of genetic resources for agriculture, and with methods and approaches to conserve and utilize them. This includes insights into seed sciences, gene bank management, molecular genetics in plants and animals, and modern biotechnological approaches. The module includes a seminar, in which students present graded talks related to the course topics.						
Learning outcomes							
After a successful completion of the course, the students... - will know the basics of plant and animal genetics as relevant for agriculture. - will understand the importance of and how to maintain biodiversity - will know current methods of conserving and using genetic diversity for agriculture. - will be able to integrate their knowledge of different genetic and biotechnological approaches to develop strategies of preserving and using genetic resources.							
2. Prerequisites							
obligatory							
recommended	Knowledge of fundamental plant and animal biology						
Maximum number of students	40 students						
3. Study program allocation							
Study program					Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)					C	1.	
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L (blocked)	afternoon block		English	40	3,0	40,0	80,0
S* (blocked)	afternoon block		English	40	1,0	20,0	40,0
5. Course cycle			6. Workload [h]		7. Duration		8. Credits (ECTS)
WS			180		1		6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor	
Presentation [780750029]				graded	English	100%	
Academic Achievements							
10. Module coordination							
Module coordinator							
Dr. Mariana Báez							
Teaching person							
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/							
Institute/ Department							
Agrar-, Forst- und Ernährungswissenschaften							
11. Further information							

Module Title: Agricultural Production Systems							
Module ID/Code: ARTS-A04 [780750030]							
1. Content and intended learning outcomes							
Learning content:	<p>Students acquire the know-how about the structure, use and effects of current plant and animal production systems in different environments of the (sub)tropics.</p> <p>1. (sub)tropical plant production Overview of production systems in different climatic zones including field crops, vegetables, fruits, agro-forestry; - plant diseases and protection; - plant nutritional disorders and nutrient management; - energy value and use of plants; and - management of plant production systems; modelling of agricultural production systems.</p> <p>2. (sub)tropical animal production systems Animal production systems in different climatic zones and socio-economic environments including: - breeding, nutrition, animal health, mechanization, differentiation and integration of production goals.</p> <p>They understand the different challenges and benefits of these production systems in the context of sustainability challenges.</p>						
Learning outcomes							
After a successful completion of the course, the students... - recognize different types of production systems. - understand interactions between system components. - understand the different challenges and benefits of these production systems							
2. Prerequisites							
obligatory							
recommended							
Maximum number of students	25 students						
3. Study program allocation							
Study program					Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)					C	1.	
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L (blocked)	afternoon block	Crop production systems	English	25	2,0	30,0	60,0
L (blocked)	afternoon block	Animal production systems	English	25	2,0	30,0	60,0
5. Course cycle				6. Workload [h]		7. Duration	8. Credits (ECTS)
WS				180		1	6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor	
Written exam [780750039]	Presentation			yes	English	50 %	
Presentation				yes	English	50 %	
Academic Achievements							

Module Title: Agricultural Production Systems
Module ID/Code: ARTS-A04 [780750030]
10. Module coordination
Module coordinator
Dr. Bibiana Betancur-Corredor
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information

Elective modules of the first semester (ARTS-A)

Two modules (6 ECTS-CP) must be completed.

Module Title: Crop Physiology									
Module ID/Code: NPW-005 [780800050]									
1. Content and intended learning outcomes									
Learning content:	Plant physiology is the analysis and causal explanation of live processes. The course will provide an update on the basics of plant physiology with an emphasis on physiological processes important for determination of crop yield. Specifically, this will include topics related to consumable parts of the plant and also physiological adaptations to stress situations. Through description of recent findings of new pathways and metabolic functions the course will emphasize that Crop Physiology integrates cell biology, biochemistry and molecular biology.								
Learning outcomes									
After a successful completion of the course, the students...									
- are able to describe key metabolic pathways.									
- are able to explain how plants acquire resources from the environment.									
- are able to describe and explain physiological adaptations underlying the development of consumable parts.									
2. Prerequisites									
obligatory									
recommended									
Maximum number of students									
3. Study program allocation									
Study program						Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	1.		
M.Sc. Crop Sciences						C	1.		
M.Ed. Agricultural Science (Teacher's Training)						E	1.		
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
L	during the semester	Crop Physiology	English	120	2,0	30,0	60,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
WS				90		1		3,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment		Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor		
eKlausur 45 min [780800059]					graded	English			
Academic Achievements									
10. Module coordination									
Module coordinator									
Prof. Dr. Andreas Meyer									
Teaching person									
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/									
Institute/ Department									
Agrar-, Forst- und Ernährungswissenschaften									
11. Further information									

Module Title: Crop Breeding Research									
Module ID/Code: NPW-006 [780800060]									
1. Content and intended learning outcomes									
Learning content:	Crop breeding refers to the genetic improvement of crop plants. This can be done using a wide variety of methods, most of which are derived from specific genetics and genomics concepts. This module aims to present an overview of these concepts and methods, including highlights from classical research as well as current research topics and approaches.								
Learning outcomes									
After a successful completion of the course, the students...									
<ul style="list-style-type: none"> - are able to describe how relevant genetic principles can be applied for crop improvement and breeding research - understand and can explain what is meant by crop genetic and genomic resources - are able to suggest experiments to test specific crop breeding hypotheses - are able to explain and understand when to apply different crop breeding methods 									
2. Prerequisites									
obligatory									
recommended									
Maximum number of students	150								
3. Study program allocation									
Study program						Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	1.		
M.Sc. Crop Sciences						C	1.		
M.Ed. Agricultural Science (Teacher's Training)						E	1.		
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
L	during the semester	Crop Genetics and Breeding	English	120	2,0	30,0	60,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
WS				90		1		3,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment		Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor		
Written exam [780800069]					graded	English	100%		
Academic Achievements									
10. Module coordination									
Module coordinator									
Prof. Dr. Annaliese Mason									
Teaching person									
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/									
Institute/ Department									
Agrar-, Forst- und Ernährungswissenschaften									
11. Further information									

Module Title: Production Ecology									
Module ID/Code: NPW-004 [780800040]									
1. Content and intended learning outcomes									
Learning content:	This module focuses on the ecology of crops and cropping systems and deals with biotic interactions including competition, compensation, facilitation, complementation, parasitism, herbivory, allelopathy, and symbiotic relationships, such as biological nitrogen fixation or pollination. Building on the understanding of these interactions, the module then provides principles for the understanding and design of sustainable cropping systems and concentrates on applications of ecological theory in cropping systems, such as in crop diversification, evolutionary plant breeding, and provision of ecosystem services.								
Learning outcomes									
After a successful completion of the course, the students are able to...									
<ul style="list-style-type: none"> - reproduce the main aspects of biotic interactions and their underlying mechanisms in cropping systems. - understand the components and complexity of ecological interactions in cropping systems with regard to biotic interactions. - analyse and evaluate the potential of a diversified cropping system - e.g. as described in primary scientific literature - to protect resources. - design a diversified cropping system based on ecological theories. 									
2. Prerequisites									
obligatory									
recommended									
Maximum number of students									
3. Study program allocation									
Study program				Compulsory/ Elective			Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)				E			1.		
M.Sc. Crop Sciences				C			1.		
M.Ed. Agricultural Science (Teacher's Training)				E			1.		
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
L	during the semester	Crop Ecology	English	120	1,5	22,0	45,0		
T	during the semester	Cropping System Design II	English	30	0,5	8,0	15,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
WS				90		1		3,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor			
eKlausur [780800047]				graded	German and English	75%			
Project work [780800048]				graded	English	25%			
Academic Achievements									

Module Title: Production Ecology
Module ID/Code: NPW-004 [780800040]
10. Module coordination
Module coordinator
Prof. Dr. Thomas Döring
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information

Module Title: Resource Conservation							
Module ID/Code: NPW-003 [780800030]							
1. Content and intended learning outcomes							
Learning content:	This module focuses on the resource conservation in cropping systems and is divided into two main parts. While the first part deals with the mechanisms of the abiotic interactions (e.g. with regard to water, light, crop nutrients, and CO ₂), the second part builds on the understanding of these interactions for the design of sustainable cropping systems. In the second part, the module concentrates on various applications for resource conservation and the provision of ecosystem services, e.g. through irrigation, tillage, and rotation design.						
Learning outcomes							
After a successful completion of the course, the students are able to...							
<ul style="list-style-type: none"> - understand and reproduce the main aspects of abiotic interactions and their underlying mechanisms in cropping systems. - understand the components and complexity of abiotic interactions in cropping systems. - analyse and evaluate the potential of a cropping system - e.g. as described in a scientific article - to protect resources. - design a sustainable cropping system based on knowledge about resource conservation. 							
2. Prerequisites							
obligatory							
recommended							
Maximum number of students							
3. Study program allocation							
Study program				Compulsory/ Elective			Semester
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)				E			1.
M.Sc. Crop Sciences				C			1.
M.Ed. Agricultural Science (Teacher's Training)				E			1.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L	during the semester	Resource conservation	English	120	1,5	22,0	45,0
T	during the semester	Cropping system design I	English	30	0,5	8,0	15,0
5. Course cycle			6. Workload [h]		7. Duration		8. Credits (ECTS)
WS			90		1		3,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor	
eKlausur [780800037]				graded	German and English	75%	
Project work [780800038]				graded	English	25%	
Academic Achievements							

Module Title: Resource Conservation
Module ID/Code: NPW-003 [780800030]
10. Module coordination
Module coordinator
Prof. Dr. Thomas Döring
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
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11. Further information

Elective Modules of the Second and Third Semester (ARTS-B) - System Approaches

**You can choose 18-30 ECTS-CP from the elective modules.
The specialisation System approaches is only awarded if 24 ECTS-CP
from this specialisation are completed.**

Module Title: Soil Resources of the World							
Module ID/Code: ARTS-BS01 [780790230]							
1. Content and intended learning outcomes							
Learning content:	<p>In this course students will be introduced to the major soils of the world, their classification, genesis, land-use options, and associated risks.</p> <p>The course is structured in</p> <ul style="list-style-type: none"> - Lecture + seminar on major soil types according to World Reference Base of Soil Resources (WRB) classification, principles of their genesis, major properties and land-use options. The course provides advanced knowledge on specific processes associated with different soils relevant for global element cycles or food security. - Practical courses: Here the students learn how to classify soils according to WRB and Soil Taxonomy on the basis of analytical data sheets, photographs and/or archived soil monoliths and/or field sites in Western Germany with relicts of tropical soils 						
Learning outcomes							
<p>After a successful completion of the course, the students...</p> <ul style="list-style-type: none"> - can describe the major soil properties and classification of soil types occurring around the globe. - can compare soils according to their potential use for agricultural production. - can identify risks associated with different types of land-use on these soils. - can demonstrate soil classification procedures for the major reference groups. 							
2. Prerequisites							
obligatory							
recommended	ARTS-A01, A06, A03, A04, NPW-003 and NPW-004						
Maximum number of students	25 students						
3. Study program allocation							
Study program						Compulsory/ Elective	Semester
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	2.
M.Sc. Nature Conservation and Landscape Ecology						E	2.
M.Sc. Crop Sciences						E Focus PERC	2.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L	during the semester	Soils of the world	English	25	1,5	15,0	45,0
S*	during the semester	Soil management around the world	English	25	1,0	10,0	40,0
P* (blocked)	full-day block	Soil classification	English	25	2,0	30,0	40,0
5. Course cycle				6. Workload [h]		7. Duration	8. Credits (ECTS)
SS				180		1	6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor	
Written exam [780790239]	Presentation in the seminar, regular attendance			graded	English		
Academic Achievements							

Module Title: Soil Resources of the World
Module ID/Code: ARTS-BS01 [780790230]
10. Module coordination
Module coordinator
Dr. Sara Bauke
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information
Zech, W., Hintermeier-Erhard, G., Schad P (eds). 2020. Soils of the world. Springer- Verlag, 190 pages

Module Title: Crop Ecology, Water Management and Bioclimatology							
Module ID/Code: NPW-021 [780800210]							
1. Content and intended learning outcomes							
Learning content:	<p>Students acquire in-depth knowledge on the principles of water management and bioclimatology, and on how crop interacts with climate and water. The understanding of processes will enable them to analyse the implications of changing environmental conditions on water management and crop production. In addition, they will be able to apply agro-meteorological methods to determine crop responses. Finally, ecological attributes of crops with major economic importance will be discussed, allowing students to define social-ecological niche environments for major crop production and water management strategies.</p> <p>Contents comprise:</p> <p>General principles on water management.</p> <p>Strategies and implications of water management incl. model applications;</p> <p>Methods & application of bioclimatology in agro-ecosystems;</p> <p>Ecological requirements of major crop types and species;</p> <p>Effects of temperature, precipitation, humidity, radiation, day length and wind on microclimates of non-uniform terrain, and crop responses;</p> <p>Crop adaptation strategies to changing ecological conditions;</p> <p>Case study examples</p>						
Learning outcomes							
<p>After a successful completion of the course, the students...</p> <ul style="list-style-type: none"> - understand key concepts and implications of bioclimatology. - can apply concepts of water management. - have acquired the skills to understand water models can be used to analyse water demand. - can relate botanical attributes to ecological requirements of crops. - can evaluate interactions between climate, management attributes and land use systems. 							
2. Prerequisites							
obligatory							
recommended	ARTS-A01, A06, A03, A04, NPW-003 and NPW-004						
Maximum number of students	25 students						
3. Study program allocation							
Study program					Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)					E	2.	
M.Sc. Crop Sciences					E Focus PERC	2.	
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L (blocked)	afternoon block	Bioclimatology, water management and crop ecology	English	25	2,4	30,0	90,0
S (blocked)	afternoon block	Practical and applied cases on water management, crop ecology and bioclimatology	English	25	1	10,0	40,0
E	One day	Visit to the International Centre for Water Resources and Global Change (UNESCO), Koblenz	English	25	0,6	5	5
5. Course cycle				6. Workload [h]		7. Duration	8. Credits (ECTS)
SS				180		1	6,0

Module Title: Crop Ecology, Water Management and Bioclimatology				
Module ID/Code: NPW-021 [780800210]				
9. Requirements for the rewarding of credits (ECTS)				
Types of Assessment	Prerequisites for admission to the Assessment	Graded yes/no	Language (exam)	Weighting factor
Term paper [780800219]		graded	English	70%
Presentation [780800218]		graded	English	30%
Academic Achievements				
10. Module coordination				
Module coordinator				
Prof. Dr. Ana Mejjide				
Teaching person				
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/				
Institute/ Department				
Agrar-, Forst- und Ernährungswissenschaften				
11. Further information				

Module Title: Land Use Systems in the Tropics and Subtropics							
Module ID/Code: ARTS-BS03 [780750040]							
1. Content and intended learning outcomes							
Learning content:	Acquire knowledge about land use systems and implications of different land uses on ecosystem services. Understand the attributes and functioning of major tropical production systems and social-ecological interactions. Contents: - Diversity of land use systems - Ecosystem services, threats to biodiversity and conservation practices - Land use systems and gender - Species interactions and adaptation strategies in different land uses - Attributes and management in dryland, wetland and forest use systems - Human development and environment policy effects on land use Seminar presentations of case studies and of innovative interventions in land-use systems to improve their sustainability are elaborated and presented by students and findings are discussed						
Learning outcomes							
After a successful completion of the course, the students... - understand implications of land use on ecosystem services and threats to biodiversity. - understand how aspects related to sustainable land use practices intersect with gender issues. - understand key attributes of major production system types and their interactions with management. - can apply concepts of ecosystem services and adapted land use practices to case study examples. - can analyse production and land use systems for developing sustainable alternatives to current land use. - are sensitized to and can independently develop sustainable alternatives to current land use in the tropics and sub-tropics. - can assess the impact of land use and trade policies on land use and related challenges.							
2. Prerequisites							
obligatory							
recommended	ARTS-A01, A06, A03, A04, NPW-003 and NPW-004						
Maximum number of students	25 students						
3. Study program allocation							
Study program					Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)					E	2.	
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L	weekly	Land use and production systems	English	25	2,0	28,0	42
S	weekly	Synthesize knowledge on land use systems and land use challenges	English	25	2,0	28,0	82
5. Course cycle				6. Workload [h]		7. Duration	8. Credits (ECTS)
SS				180		1	6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment		Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor
Presentation [780750048]		The students present during the seminar case studies and innovative interventions in land use systems.			graded	English	100%
Academic Achievements							

Module Title: Land Use Systems in the Tropics and Subtropics
Module ID/Code: ARTS-BS03 [780750040]
10. Module coordination
Module coordinator
Jun-Prof. Dr. Lisa Biber-Freudenberger
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
11. Further information

Module Title: Animal Production Systems in the Tropics							
Module ID/Code: TW-017 [780810170]							
1. Content and intended learning outcomes							
Learning content:	The students will be provided with lectures on - animal (Cattle, sheep, goat, buffalo and poultry) production systems in tropical climate - association between production system, species distribution and climate zones - challenges of animal production system in various climatic zones						
Learning outcomes							
After a successful completion of the course, the students... - can classify and understand animal production systems in the tropics and subtropics. - are able to characterize challenges of animal production systems in tropical climate.							
2. Prerequisites							
obligatory							
recommended	ARTS-A01, A06, A03, A04, NPW-003 and NPW-004						
Maximum number of students	25 students						
3. Study program allocation							
Study program						Compulsory/ Elective	Semester
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	2.
M.Sc. Animal Science						E	2.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L (blocked)	afternoon block	Animal production systems in the tropics	English	25	2,0	30,0	60,0
5. Course cycle			6. Workload [h]		7. Duration		8. Credits (ECTS)
SS			180		1		6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor	
Written exam [780810179]				graded	English		
Academic Achievements							
10. Module coordination							
Module coordinator							
Prof. Dr. Thomas Hartinger							
Teaching person							
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/							
Institute/ Department							
Agrar-, Forst- und Ernährungswissenschaften							
11. Further information							

Module Title: Element Cycles in Tropical Agroecosystems									
Module ID/Code: ARTS-BS05 [780800180]									
1. Content and intended learning outcomes									
Learning content:	<p>Students get acquainted with the principles and processes of element transformation in (sub)tropical environments, including the management of organic waste and other secondary raw materials. Students are exposed to project-related research work, team-oriented work, holistic thinking and the comprehension of abstract relationships and complex interactions. Contents include:</p> <p>Pools, fluxes and transformation processes of major elements (water, C, N, P, S) in tropical environments. Ecological conditions and implications for the nutrition of tropical crops.</p> <p>Waste treatment and treatment technologies (composting, anaerobic digestion) and use of organic waste as fertilizer. Use and potential of staple isotopes.</p> <p>He will be able to assess and analyse the availability of major (nutrient)elements in a range of environments and to determine the quantity and quality of organic matter and various secondary raw materials. Finally the students will be able to apply their knowledge to plan intervention strategies for improved crop plant nutrition in environments with variable ecological conditions.</p>								
Learning outcomes									
After a successful completion of the course, the students...									
<ul style="list-style-type: none"> - are able to assess and analyse the availability of major (nutrient)elements in a range of environments. - are able to determine the quantity and quality of organic matter and various secondary raw materials. - are able to plan intervention strategies for improved crop plant nutrition in environments with variable ecological conditions. - are able to synthesize secondary information on topics related to element cycles in the form of a seminar presentation. 									
2. Prerequisites									
obligatory									
recommended	ARTS-A01, A06, A03, A04, NPW-003 and NPW-004								
Maximum number of students	25 students								
3. Study program allocation									
Study program						Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	2.		
M.Sc. Crop Sciences						E Focus PERC	2.		
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
L (blocked)	afternoon block	Element cycle lectures	English	25	2,5	40,0	50,0		
S (blocked)	afternoon block	Case studies	English	25	1,5	10,0	80,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
SS				180		1		6,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment		Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor		
Report (presentation) [780800189]					graded	English			
Academic Achievements									

Module Title: Element Cycles in Tropical Agroecosystems
Module ID/Code: ARTS-BS05 [780800180]
10. Module coordination
Module coordinator
Prof. Dr. Mathias Becker
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information

Module Title: Organic Agriculture in the Tropics and Subtropics							
Module ID/Code: ARTS-BS06 [780800130]							
1. Content and intended learning outcomes							
Learning content:	The module gives an insight in organic farming systems mainly under tropical conditions with a special focus on important permanent cash crops. Contents include: Approaches in Organic Agriculture research; development and assessment of sustainable production systems; ecological effects of inappropriate land use; soil fertility management; rotation design, performance of leguminous crops and BNF, agroforestry, alley cropping, ecological challenges in tropical agriculture; organic agriculture and world nutrition; a focus of the module lies on cropping systems and techniques of important crops such as rice, sugar cane, cotton, coffee, cocoa, citrus, vegetables and fruits.						
Learning outcomes							
After a successful completion of the course, the students...							
<ul style="list-style-type: none"> - have extensive knowledge on challenges of tropical agriculture. - understand the principles of field trial design and management. - are able to give a scientific presentation in English language. - are able to analyse cropping systems from an agronomic and ecological perspective. 							
2. Prerequisites							
obligatory							
recommended							
Maximum number of students							
3. Study program allocation							
Study program						Compulsory/ Elective	Semester
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	3.
M.Sc. Crop Sciences						E Focus PERC	3.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L	during the semester	Organic Agriculture in the Tropics and Subtropics	English	80	2,0	30,0	60,0
S	during the semester	Selected aspects of tropical organic agriculture	English	20	2,0	30,0	60,0
5. Course cycle				6. Workload [h]		7. Duration	8. Credits (ECTS)
WS				180		1	6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment		Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor
Written exam [780800139]					graded	English	
Academic Achievements							
10. Module coordination							
Module coordinator							
Dr. Daniel Neuhoff							
Teaching person							
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/							
Institute/ Department							
Agrar-, Forst- und Ernährungswissenschaften							
11. Further information							

Module Title: Crop and Ecosystem Analysis and Modelling

Module ID/Code: NALA-029 [780790290]

1. Content and intended learning outcomes

Learning content:	<p>The content of the module can be summarized by the following headings</p> <ul style="list-style-type: none"> - Systems theory and methods of systems analysis - Types of models - Conceptualizing of crops or ecosystems systems - Mathematical formulation of relationships (including practical exercises) - Implementation of mathematical algorithms (including practical exercises) - Methods of model calibration and parameterisation - Sensitivity and uncertainty analysis - Model verification, validation and evaluation <p>Students learn to analyse and model crops and ecosystems. Important relationships determining crop and ecosystem responses to environmental conditions and how these can be modelled will be understood. Students obtain basic knowledge in mathematical (mainly numerical) modeling and apply these to develop models for selected crop and ecosystem processes. They also learn to apply models to solve practical problems.</p>
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Learning outcomes

After a successful completion of the course, the students...

- can distinguish different types of systems and models and can give examples.
- are able to construct simple models of cropping systems based on defined assumptions.
- are able to apply dynamic simulation models.
- understand the principles of dynamic modelling.

2. Prerequisites

obligatory	
recommended	Modul "Pflanzenbau" (B.Sc. Agrarwissenschaften)
Maximum number of students	30 students

3. Study program allocation

Study program	Compulsory/ Elective	Semester
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)	E	2.
M.Sc. Nature Conservation and Landscape Ecology	E	2.
M.Sc. Crop Sciences	E Focus PERC	2.

4. Teaching and learning methods

Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L	during the semester		English	30	2,0	30,0	60,0
pT	during the semester		English	30	2,0	30,0	60,0

5. Course cycle	6. Workload [h]	7. Duration	8. Credits (ECTS)
SS	180	1	6,0

9. Requirements for the rewarding of credits (ECTS)

Types of Assessment	Prerequisites for admission to the Assessment	Graded yes/no	Language (exam)	Weighting factor
Presentation [780790299]		graded	English	50%
Report [780790298]		graded	English	50%

Academic Achievements

Module Title: Crop and Ecosystem Analysis and Modelling
Module ID/Code: NALA-029 [780790290]
10. Module coordination
Module coordinator
Dr. Thomas Gaiser
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
11. Further information

Module Title: Horticultural Production and Research									
Module ID/Code: ARTS-BS08 [780800120]									
1. Content and intended learning outcomes									
Learning content:	<ul style="list-style-type: none"> - Overview of major horticultural production systems, in regional and global contexts - Overview of horticultural value chains - In-depth discussion of selected critical issues in horticultural production - Horticultural approaches to agricultural development - Sustainability concerns in horticulture - Climate change and its impacts on horticulture - Horticultural modeling - Critical discussion of horticultural literature - Literature search, scientific writing and presenting 								
Learning outcomes									
After a successful completion of the course, the students...									
<ul style="list-style-type: none"> - will be able to critically interpret horticultural literature. - will be able to explain how major horticultural commodities are produced and provide examples of various production systems. - will be able to analyse horticultural production systems and identify strengths and weaknesses. - will be able to assess horticultural literature and provide a balanced and logically rigorous evaluation. - will be able to compose a scientifically rigorous paper on selected topics, based on extensive analysis of published sources. 									
2. Prerequisites									
obligatory									
recommended	Modul "Gartenbauliche Kulturen" (B.Sc. Agrarwissenschaften)								
Maximum number of students	50 students								
3. Study program allocation									
Study program						Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	3.		
M.Sc. Crop Sciences						E Focus PERC	3.		
M.Ed. Agricultural Science (Teacher's Training)						E	3.		
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
L	during the semester	Horticultural Production and Research	English	50	1,0	15,0	20,0		
S	during the semester	Horticultural literature study	English	10	3,0	45,0	100,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
WS				180		1		6,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor			
Presentation [780800129]				graded	English	20%			
Term paper [780800128]				graded	English	40%			
Assignment [780800127]				graded	English	40%			
Academic Achievements									

Module Title: Horticultural Production and Research
Module ID/Code: ARTS-BS08 [780800120]
10. Module coordination
Module coordinator
Prof. Dr. Eike Lüdeling
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information
Baudoin et al., 2013: Good Agricultural Practices for greenhouse vegetable crops - Principles for Mediterranean climate areas. FAO (http://www.fao.org/3/a-i3284e.pdf) Baudoin et al., 2017: Good Agricultural Practices for greenhouse vegetable production in the Southeast European countries. FAO (http://www.fao.org/3/a-i6787e.pdf) Dixon & Aldous, 2014: Horticulture: Plants for People and Places (Vol. 1-3). Springer Marcelis & Heuvelink, 2019: Achieving sustainable greenhouse cultivation. Burleigh Dodds Taiz & Zeiger, 2006: Plant Physiology, das Original mit Übersetzungshilfen, Spektrum Akademischer Verlag Tromp et al. (Eds.), 2005: Fundamentals of Temperate Zone Tree Fruit Production. Backhuys Publishers von Zabertitz, 2011. Integrated Greenhouse Systems for Mild Climates. Springer

Module Title: Spatial Ecology and Conservation Biology							
Module ID/Code: NPW-055 [780800550]							
1. Content and intended learning outcomes							
Learning content:	Students will learn the basic principles of conservation biology, with a special focus on applications related to spatial ecology and management of natural resources (including those in agroecosystems). The course will cover the goals of conservation, elaborating on the main current threats to biodiversity (e.g. land-use change, habitat loss, climate change, invasive species, etc.), the units of conservation (e.g. genes, populations, species, habitats, ecosystem services, etc.), and the existing conservation measures (e.g. agri-environment schemes, protected areas, etc.) and their evaluation. Students will learn about the biological basis of conservation, including insights from spatial ecology of populations and species. Practical conservation issues, such as how to select areas for conservation, the role of indicator/flagship species in conservation, restoration and rewilding programmes, will be critically discussed. The course will include a practical exercise using spatial data and spatial prioritization software on personal laptops.						
Learning outcomes							
After a successful completion of the course, the students... - learn key concepts in conservation biology and current pressing threats to biodiversity. - learn on the different units of conservation, and different spatial scales at which conservation measures act. - understand the basic principles of spatial ecology and the features of spatial data. - understand how to evaluate the effectiveness of conservation measures. - apply basic (spatial) ecology concepts to propose solutions to practical conservation problems. - present and critically discuss recent published articles in the field of conservation biology and spatial ecology.							
2. Prerequisites							
obligatory	none						
recommended	Basic knowledge of the programming language R is necessary to complete the practical exercises. Basic knowledge of spatial data/software (e.g. ArcGIS, QGIS) is desirable. Own laptop is required to complete the practical exercises.						
Maximum number of students	20 students						
3. Study program allocation							
Study program					Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)					E	1./3.	
M.Sc. Nature Conservation and Landscape Ecology					E	1./3.	
M.Sc. Crop Sciences					E Focus PERC	1./3.	
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L	during the semester	Theory of spatial ecology and conservation biology	English	20	1,0	14,0	20,0
S*	during the semester	Presentation and discussion of journal articles	English	20	1,0	14,0	40,0
pT*	during the semester	Practical exercise with laptop		20	2,0	28,0	64,0
5. Course cycle				6. Workload [h]		7. Duration	8. Credits (ECTS)
WS				180		1	6,0

Module Title: Spatial Ecology and Conservation Biology				
Module ID/Code: NPW-055 [780800550]				
9. Requirements for the rewarding of credits (ECTS)				
Types of Assessment	Prerequisites for admission to the Assessment	Graded yes/no	Language (exam)	Weighting factor
Assignment [780800557]		graded	English	100%
Academic Achievements				
Project work, Colloquium and participation in practical exercise				
10. Module coordination				
Module coordinator				
Stephanie Roilo				
Teaching person				
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/				
Institute/ Department				
Agrar-, Forst- und Ernährungswissenschaften				
11. Further information				
Spatial Ecology and Conservation Modelling - Springer (https://link.springer.com/book/10.1007/978-3-030-01989-1) Conservation Biology - Springer (https://link.springer.com/book/10.1007/978-3-030-39534-6)				

Module Title: Climate-Smart Ecosystem Management							
Module ID/Code: NPW-059 [780800590]							
1. Content and intended learning outcomes							
Learning content:	<p>In this course, students will gain insights into Climate-Smart Ecosystem Management (CSEM), focusing on key concepts and strategies for effectively managing diverse ecosystems in a changing climate. Lectures will cover climate change patterns and trends, and its impacts on agriculture, forestry, and peatlands. Students will learn about techniques for measuring greenhouse gas (GHG) and water fluxes from various ecosystems (e.g., chambers, eddy covariance, and remote sensing), including a visit to a GHG measurement station. The course will also address the effects of management practices across these ecosystems as tools to mitigate climatic impacts, with a focus on reducing GHG emissions and increasing soil organic carbon sequestration. International agreements and policies related to climate change mitigation will be presented, alongside emission inventories. Students will become familiar with strategies for climate change adaptation and mitigation, including climate-smart integrated production systems (e.g., agroforestry, etc.). The seminars will include lectures by stakeholders working in CSEM and presentations of case studies by students in groups. This module will equip students with the knowledge and skills to devise innovative solutions for mitigating climatic impacts from diverse ecosystems and building climate-resilient ecosystems.</p>						
Learning outcomes							
<p>After a successful completion of the course, the students...</p> <ul style="list-style-type: none"> - outline the core concepts and practices of CSEM, identify examples from different ecosystems, and describe their impact on climate change mitigation and adaptation. - describe the mechanisms responsible for GHG production and consumption in ecosystems. - know about water and energy fluxes in various ecosystems and the microclimatic effects of ecosystem management practices. - acquire basic knowledge of measurement techniques for GHG and water fluxes from agriculture, forest and peatlands. - identify international organizations and relevant actors in climate mitigation and adaptation. - interpret climate change patterns and trends, and discuss their implications on crop yields, forest productivity, water availability, and other relevant factors. - identify key practices for mitigating GHG emissions and increasing soil organic carbon storage. - analyse the effectiveness of different climate-smart ecosystem management plans and strategies and propose modifications and improvements. 							
2. Prerequisites							
obligatory	none						
recommended							
Maximum number of students	24 students						
3. Study program allocation							
Study program						Compulsory/ Elective	Semester
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	1./3.
M.Sc. Nature Conservation and Landscape Ecology						E	1./3.
M.Sc. Crop Sciences						E	1./3.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L	during the semester	CSEM Lectures	English	24	2,0	30,0	60,0
S*	during the semester	Case studies and stakeholders	English	24	2,0	30,0	60,0
5. Course cycle				6. Workload [h]		7. Duration	8. Credits (ECTS)
WS				180		1	6,0

Module Title: Climate-Smart Ecosystem Management				
Module ID/Code: NPW-059 [780800590]				
9. Requirements for the rewarding of credits (ECTS)				
Types of Assessment	Prerequisites for admission to the Assessment	Graded yes/no	Language (exam)	Weighting factor
Presentation [780800599]	Participation in project work	graded	English	30%
Report (presentation) [780800598]	Report in form of a poster - doing a presentation is a prerequisite	graded	English	30%
Oral exam [780800597]		graded	English	40%
Academic Achievements				
10. Module coordination				
Module coordinator				
Prof. Dr. Ana Meijide				
Teaching person				
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/				
Institute/ Department				
Agrar-, Forst- und Ernährungswissenschaften				
11. Further information				
Guest lectures from key stakeholders and experts in the field (N.N.), including representatives from private companies and international organizations				

Module Title: Ecological Climatology							
Module ID/Code: NPW-060 [780800600]							
1. Content and intended learning outcomes							
Learning content:	Students will learn about the atmospheric processes responsible of local and global climates and how they influence ecosystem processes and fluxes in the plant-soil-air interface. They will also understand how ecosystems feed back to the atmosphere at local and global scales. This will set the basis for understanding the impact of climate change on ecosystems. The lectures will give an overview on atmospheric variables such as radiation, humidity, temperature, and wind and their interactions with terrestrial ecosystems. In the seminar/exercise class, the understanding will be deepened by quantitative exercises and group presentations. The students will be trained in quantitative and qualitative scientific methods to describe and study climate-dependent physical, chemical and biological processes in terrestrial ecosystems enabling them to understand and evaluate the current discussion on climate change and its impact on terrestrial ecosystems.						
Learning outcomes							
After a successful completion of the course, the students...							
<ul style="list-style-type: none"> - identify the key components of cycles of earth systems and climate. - recall the most important climatological and hydrological variables and what governs them at different scales. - explain how climate controls the functioning and distribution of plants in different terrestrial environments. - comprehend how interactions between climate and terrestrial ecosystems function and how these may feed back into climate change. - illustrate the climatological, hydrological and nutrient conditions in different terrestrial environments. - assess how changes in land cover or land use impact the climatological, hydrological and nutrient conditions at local and regional scales. - evaluate how changes in climate reflect on different terrestrial ecosystems. - recognise suitable approaches and methods to study interactions between climate and terrestrial ecosystems. 							
2. Prerequisites							
obligatory	none						
recommended							
Maximum number of students	24 students						
3. Study program allocation							
Study program					Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)					E	1./3.	
M.Sc. Nature Conservation and Landscape Ecology					O	1./3.	
M.Sc. Crop Sciences					E	1./3.	
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L	during the semester	Basics of ecological climatology	English	24	2,0	30,0	60,0
S*	during the semester	Practical exercises related to the course	English	24	2,0	30,0	60,0
5. Course cycle				6. Workload [h]		7. Duration	8. Credits (ECTS)
WS				180		1	6,0

Module Title: Ecological Climatology				
Module ID/Code: NPW-060 [780800600]				
9. Requirements for the rewarding of credits (ECTS)				
Types of Assessment	Prerequisites for admission to the Assessment	Graded yes/no	Language (exam)	Weighting factor
Oral exam [780800609]		graded	English	50%
Presentation [780800608]	participation in project work and its presentations	graded	English	50%
Academic Achievements				
10. Module coordination				
Module coordinator				
Prof. Dr. Ana Mejjide				
Teaching person				
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/				
Institute/ Department				
Agrar-, Forst- und Ernährungswissenschaften				
11. Further information				
We will partially follow the structure and use some of the material from the book "Ecological Climatology" 2016, by Bonan Gordon.				

Module Title: Introduction to Tropical Forestry

Module ID/Code: ARTS-BS11 [780750110]

1. Content and intended learning outcomes

Learning content: Tropical forests harbour vast biodiversity and provide essential ecosystem functions such as water regulation and erosion control. However, climate change, deforestation and unsustainable land use practices threaten many tropical forest ecosystems, creating the need for forest restoration and smart and sustainable management of remaining forest resources. This is an introductory module for students with an interest in tropical forestry. No previous forestry knowledge is required.

The module gives an overview of global forest resources, dynamics and threats. It classifies important forest types across the tropics, covering the moist to dry tropics and azonal forest types such as mountain forests or mangroves. For each forest type, importance and key functions, management-relevant characteristics and examples of sustainable management strategies are discussed. The module covers forest management approaches such as conservation-oriented close-to-nature forestry with extensive resource exploitation (e.g. of non-timber forest products), wood production-oriented management in (near) natural and secondary tropical forests, agroforestry and plantation forestry, which will also be discussed in the context of community forestry approaches and the design of resilient and sustainable landscapes. The acquired knowledge on sustainable forest management will be consolidated in field trips to nearby forest stands.

Students have to give a 10 min oral presentation on a forestry-related topic (30% of the grade for this module) and moderate the presentation of one colleague. At the end of the winter semester, there is a written exam (70% of the grade).

Note: The module 'Introduction to Tropical Forestry' (winter semester, 2 SWS, 3 credits) combines well with the module 'Basics of Central European Forestry' (summer semester, 2 SWS, 3 credits). For students with an interest in forestry, it is recommended to take both these modules.

Learning outcomes

- After a successful completion of the course, the students...
- have acquired knowledge on important tropical forest types, their distribution and defining characteristics.
 - have obtained knowledge on sustainable forest management principles.
 - can apply acquired knowledge on tropical forests to identify potential management options for a given tropical region.
 - can apply obtained knowledge on sustainable forest management to critically assess land-use practices across the tropics.
 - can give and moderate a scientific presentation on a selected forest ecosystem to fellow students (mandatory student presentation).

2. Prerequisites

obligatory	
recommended	interest in forest ecology and/or forest management
Maximum number of students	

3. Study program allocation

Study program	Compulsory/ Elective	Semester
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)	E	1./3.
M.Sc. Nature Conservation and Landscape Ecology	E	1./3.

4. Teaching and learning methods

Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
S	during the semester	tropical forestry	English	30	2,0	30,0	60,0

5. Course cycle	6. Workload [h]	7. Duration	8. Credits (ECTS)
WS	90	1	3,0

Module Title: Introduction to Tropical Forestry				
Module ID/Code: ARTS-BS11 [780750110]				
9. Requirements for the rewarding of credits (ECTS)				
Types of Assessment	Prerequisites for admission to the Assessment	Graded yes/no	Language (exam)	Weighting factor
Written exam [780750119]		graded	English	70%
Presentation [780750118]		graded	English	30%
Academic Achievements				
10. Module coordination				
Module coordinator				
Dr. Alexander Röhl				
Teaching person				
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/				
Institute/ Department				
Agrar-, Forst- und Ernährungswissenschaften				
11. Further information				

Module Title: Basics of Central European Forestry									
Module ID/Code: ARTS-BS12 [780750120]									
1. Content and intended learning outcomes									
Learning content:	<p>Forests harbour vast biodiversity and provide essential ecosystem functions such as water regulation and erosion control. Climate change and unsustainable land-use practices are a threat to many forest ecosystems, creating the need for resilient and sustainable restoration and management of the remaining forest resources. This is an introductory module for students with an interest in forest ecology and forest management. No previous forestry knowledge is required.</p> <p>The module 'Basics of Central European Forestry' covers the history, ecology and sustainable management of forests in Central Europe and particularly in Germany. This includes forest management approaches such as conservation-oriented close-to-nature forestry, wood production-oriented management, agroforestry and plantation forestry, which will also be discussed in the context of resilient and sustainable landscape design. Part of the module will take place in the field as exercises related to forest inventory, vegetation ecology, pedology and silviculture. In this context, students have to give a 10 min poster presentation (30% of the grade for this module). At the end of the summer semester, there is a written exam (70% of the grade).</p> <p>Note: The module 'Basics of Central European Forestry' (summer semester, 2 SWS, 3 credits) combines well with the module 'Introduction to Tropical Forestry' (winter semester, 2 SWS, 3 credits). For students with an interest in forestry, it is recommended to take both these modules.</p>								
Learning outcomes									
After a successful completion of the course, the students...									
<ul style="list-style-type: none"> - have acquired knowledge on important Central European forest types, their distribution and defining characteristics. - have obtained knowledge on sustainable forest management principles. - can apply acquired silvicultural knowledge to identify potential management options for a given forest stand. - can apply obtained knowledge on sustainable forest management to critically assess land-use practices across Central Europe. - can give a scientific poster presentation on a selected silvicultural method to fellow students (mandatory student presentation). 									
2. Prerequisites									
obligatory									
recommended	interest in forest ecology and/or forest management								
Maximum number of students									
3. Study program allocation									
Study program						Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	2./4.		
M.Sc. Nature Conservation and Landscape Ecology						E	2./4.		
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
S	during the semester	Central European forestry	English	30	2,0	30,0	60,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
SS				90		1		3,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment		Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor		
Written exam [780750129]					graded	English	70%		
Presentation [780750128]					graded	English	30%		
Academic Achievements									

Module Title: Basics of Central European Forestry
Module ID/Code: ARTS-BS12 [780750120]
10. Module coordination
Module coordinator
Dr. Alexander Röhl
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information

Module Title: Soundscape Ecology: Theory and Passive Acoustic Monitoring							
Module ID/Code: NALA-044 [780790470]							
1. Content and intended learning outcomes							
Learning content:	<p>Students will learn the fundamentals, methods, and applications of soundscape ecology in agricultural landscapes. They will gain an understanding of the ecological importance of sounds and learn to use acoustic monitoring devices (e.g., AudioMoth) for passive acoustic monitoring (PAM) of biodiversity. They will critically discuss how PAM can contribute to advancing the understanding of ecological communities and addressing the biodiversity crisis in European agroecosystems. The course encompasses both the ecological principles of soundscape ecology, highlighting the role of sound in shaping society's relationship with nature, the physics of sound and applications in biodiversity monitoring and conservation.</p> <p>Module content:</p> <ul style="list-style-type: none"> -Terminology, development and interdisciplinary nature of soundscape ecology as a discipline - Components of the soundscape and basics of the physics of sound - Ecological significance of sound in various ecosystems - Basic principles of PAM and important monitoring devices - Hands-on experience with PAM devices (e.g., AudioMoth) such as setting up and deploying them in the field, calibration, data storage and troubleshooting - Processing and visualizing acoustic data (e.g., spectrograms) - Human-nature interactions and benefits of nature's sounds to human well-being - Recent developments in research and application 						
Learning outcomes							
<p>After a successful completion of the course, the students...</p> <ul style="list-style-type: none"> - recall key terminology, concepts and principles of soundscape ecology. - interpret spectrograms collected from field samples. - implement PAM in various field conditions. - use sound recognition models to analyse audio data. - evaluate PAM field design and acoustic data analysis methods. - propose and develop research questions making use of PAM technology. 							
2. Prerequisites							
obligatory	none						
recommended	Basic knowledge of community or landscape ecology is recommended						
Maximum number of students	15 students						
3. Study program allocation							
Study program					Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)					0	2.	
M.Sc. Nature Conservation and Landscape Ecology					0	2.	
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L	during the semester	Principles of soundscape ecology and PAM	English	15	1,0	15,0	35,0
S*	during the semester	Applications in research and practice	English	15	2,0	30,0	50,0
pT* (blocked)	full-day block	Practical work (preparatory, field & post-processing)	English	5	2,0	30,0	20,0
5. Course cycle				6. Workload [h]		7. Duration	8. Credits (ECTS)
SS				180		1	6,0

Module Title: Soundscape Ecology: Theory and Passive Acoustic Monitoring				
Module ID/Code: NALA-044 [780790470]				
9. Requirements for the rewarding of credits (ECTS)				
Types of Assessment	Prerequisites for admission to the Assessment	Graded yes/no	Language (exam)	Weighting factor
Report [780790479]	Participation in practical courses	graded	English	50%
Presentation [780790478]	Regular class attendance	graded	English	50%
Academic Achievements				
10. Module coordination				
Module coordinator				
Prof. Dr. Anna Cord				
Teaching person				
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/				
Institute/ Department				
Agrar-, Forst- und Ernährungswissenschaften				
11. Further information				
Useful literature: Principles of Soundscape Ecology: Discovering Our Sonic World (Bryan C. Pijanowski; https://press.uchicago.edu/ucp/books/book/chicago/P/bo187218508.html)				

Elective modules of the second and third semester (ARTS-B) - Molecular approaches

**You can choose 18-30 ECTS-CP from the elective modules.
The specialisation Molecular approaches is only awarded if 24 ECTS-CP
from this specialisation are completed.**

Module Title: Genome Analysis in Plant Breeding									
Module ID/Code: NPW-048 [780800480]									
1. Content and intended learning outcomes									
Learning content:	The students will be introduced to the theoretical and practical aspects of plant genome analysis techniques which are relevant to plant breeding. Students will learn methods for the molecular and genomic analysis of heritable traits in crops. Students will have the opportunity to learn a broad range of methods for genome analysis, including DNA marker techniques and analysis of whole genome DNA sequencing data. They will also learn how genomic resequencing data can be used for specific breeding applications.								
Learning outcomes									
After a successful completion of the course, the students...									
<ul style="list-style-type: none"> - comprehend and are able to apply DNA marker techniques. - comprehend next generation sequencing techniques and their applications - comprehend and are able to apply analysis methods to whole genome sequencing data - understand principles of genetic linkage analysis and development of linkage maps - understand principles of trait by gene association analyses (QTL mapping, GWAS). - understand the relevance of genome analysis to plant breeding 									
2. Prerequisites									
obligatory									
recommended	Basic knowledge of genetics								
Maximum number of students	30 students								
3. Study program allocation									
Study program						Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	3.		
M.Sc. Crop Sciences						E	3.		
M.Sc. Plant Sciences									
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
L	during the semester		English	30	2,0	30,0	60,0		
P (blocked)	full-day block		English	30	2,0	30,0	60,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
WS				180		1		6,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment		Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor		
Written exam [780800489]		Completion of the practical course			graded	English	100%		
Academic Achievements									

Module Title: Genome Analysis in Plant Breeding
Module ID/Code: NPW-048 [780800480]
10. Module coordination
Module coordinator
Prof. Dr. Annaliese Mason
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information

Module Title: Crop Abiotic Stresses							
Module ID/Code: NPW-022 [780800220]							
1. Content and intended learning outcomes							
Learning content:	Students carry out experiments in the greenhouse, in which crops are exposed to different abiotic stresses (for example, nutrient deficiencies, salinity, drought, UV, Cold, iron toxicity, particulate matter/pollutants). Stress responses in contrasting genotypes are monitored regularly by non-invasive measurements including manual phenotyping, spectral reflectance measurements, gas exchange measurements, etc. Plants are then harvested and subjected to biochemical analyses in the laboratory, such as mineral analyses. At the end of the module, students present a seminar talk and a report, in which they provide scientific background on one particular abiotic stress, present a scientific paper dealing with this stress, and present their own results.						
Learning outcomes							
After a successful completion of the course, the students...							
<ul style="list-style-type: none"> - will be able to prepare and execute stress experiments with crops. - will be able to diagnose and analyse stress response in plants. - will be able to compare and evaluate the stress response in different genotypes. - will be able to devise and design meaningful stress experiments with crops. - summarize, report and write-up results and draw conclusions from them. 							
2. Prerequisites							
obligatory							
recommended	Basic understanding of plant stress biology and (bio)chemistry						
Maximum number of students	30 students						
3. Study program allocation							
Study program						Compulsory/ Elective	Semester
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	2.
M.Sc. Crop Sciences						E Focus PERC	2.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
P* (blocked)	afternoon block		English	15	4,0	60,0	120,0
5. Course cycle			6. Workload [h]		7. Duration		8. Credits (ECTS)
SS			180		1		6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor	
Presentation [780800229]	Participation in the practical work			graded	English	50%	
Report [780800228]	Participation in the practical work			graded	English	50%	
Academic Achievements							

Module Title: Crop Abiotic Stresses
Module ID/Code: NPW-022 [780800220]
10. Module coordination
Module coordinator
Dr. Shyam Pariyar
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information

Module Title: Soil Microbiology								
Module ID/Code: NALA-018 [780790180]								
1. Content and intended learning outcomes								
Learning content:	<p>In this module, students gain advanced knowledge in soil microbiology. In the lectures, the soil as habitat for microorganisms is introduced and the role of microorganisms in soils is discussed. This includes their contribution to biogeochemical cycles, especially their important role in carbon and nitrogen cycling. Furthermore, biotic and abiotic factors that determine life of soil microorganisms will be discussed. Methodological approaches will be explained that allow to analyse the presence and activity of microorganisms in soil.</p> <p>In the tutorial, recently published research articles will be jointly discussed. Students have to read these articles in advance.</p> <p>In the seminar, each student will present a specific research article.</p>							
Learning outcomes								
<p>After a successful completion of the course, the students...</p> <ul style="list-style-type: none"> - have obtained knowledge about the life of microorganisms in soil, the functions microorganisms fulfil in soil and about methods used to study soil microorganisms. - can summarize the findings of and discuss research articles in the field of soil microbiology. - are able to prepare and present research results and discuss them with the audience. - can critically evaluate research articles. 								
2. Prerequisites								
obligatory								
recommended								
Maximum number of students	20 students							
3. Study program allocation								
Study program						Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	2.	
M.Sc. Nature Conservation and Landscape Ecology						E	2.	
M.Sc. Crop Sciences						E Focus MCS	2.	
4. Teaching and learning methods								
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]		
						Contact time	Self-study	
L	during the semester		English	20	2,0	20,0	60,0	
T	during the semester		English	20	0,5	5,0	40,0	
S	during the semester		English	20	1,5	15,0	40,0	
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)
SS				180		1		6,0
9. Requirements for the rewarding of credits (ECTS)								
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor		
Presentation [780790189]				graded	English	50%		
Written exam [780790188]				graded	English	50%		
Academic Achievements								

Module Title: Soil Microbiology
Module ID/Code: NALA-018 [780790180]
10. Module coordination
Module coordinator
Prof. Dr. Claudia Knief
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information

Module Title: Animal Breeding and Genetics							
Module ID/Code: ARTS-BM05 [780750050]							
1. Content and intended learning outcomes							
Learning content:	From this course students are going to learn - principles of animal breeding and genetics - animal genetic resources - modern animal breeding techniques - breeding for sustainable animal production and diversity						
Learning outcomes							
After a successful completion of the course, the students... - understand the scientific explanation about animal breeding and genetics. - understand breeding strategies. - understand various animal genetic resources and their effective utilizations.							
2. Prerequisites							
obligatory							
recommended	ARTS-A01, A02, A03, A04, AM05a and AM05b						
Maximum number of students	25 students						
3. Study program allocation							
Study program					Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)					E	2.	
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L (blocked)	afternoon block		English	25	1,0	15,0	75,0
S (blocked)	afternoon block		English	25	1,0	15,0	75,0
5. Course cycle				6. Workload [h]		7. Duration	8. Credits (ECTS)
SS				180		1	6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor	
Written exam [780750059]				graded	English	70%	
Presentation [780750058]				graded	English	30%	
Academic Achievements							
10. Module coordination							
Module coordinator							
Dr. Ernst Tholen							
Teaching person							
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/							
Institute/ Department							
Agrar-, Forst- und Ernährungswissenschaften							
11. Further information							

Module Title: Advances in Plant Breeding Methodology								
Module ID/Code: NPW-047 [780800470]								
1. Content and intended learning outcomes								
Learning content:	Students will gain an overview of the diversity of different plant breeding methodologies and learn how to design a plant breeding project and decide on appropriate methodologies to reach specific breeding goals. Students will learn how to collect, analyse and present data and troubleshoot methodology for a specific breeding project.							
Learning outcomes								
After a successful completion of the course, the students... - know and understand different breeding methodologies - can evaluate and select appropriate breeding methodologies to reach specific breeding goals - have gained experience with data collection, experimental and analytic troubleshooting and data analysis in a plant breeding context - know how to present and write up scientific reports related to plant breeding experiments								
2. Prerequisites								
obligatory								
recommended	Fundamental of knowledge of plant breeding and genetics							
Maximum number of students	30 students							
3. Study program allocation								
Study program						Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	2.	
M.Sc. Crop Sciences						E	2.	
M.Sc. Plant Sciences						E	2.	
4. Teaching and learning methods								
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]		
						Contact time	Self-study	
L	during the semester		English	30	1,9	28,0	60,0	
PC (practical course)	During the semester		English	30	1,9	30,0	60,0	
S (blocked)	full-day block		English	15	0,2	2,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)
SS				180		1		6,0

Module Title: Advances in Plant Breeding Methodology				
Module ID/Code: NPW-047 [780800470]				
9. Requirements for the rewarding of credits (ECTS)				
Types of Assessment	Prerequisites for admission to the Assessment	Graded yes/no	Language (exam)	Weighting factor
Project work [780800479]		graded	English	100%
Academic Achievements				
Report (presentation) [780800478]				
10. Module coordination				
Module coordinator				
Dr. Mariana Báez				
Teaching person				
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/				
Institute/ Department				
Agrar-, Forst- und Ernährungswissenschaften				
11. Further information				

Module Title: Projects in Crop Protection Research									
Module ID/Code: NPW-027 [780800270]									
1. Content and intended learning outcomes									
Learning content:	Project activities are conducted in close association with ongoing research projects, permitting the application of state-of-the art methodologies and leading to an in-depth understanding of research concepts and problems associated with microbial and animal pathogenic organisms.								
Learning outcomes									
After a successful completion of the course, the students...									
- are able to appropriately select and apply methods required for specific research questions.									
- are able to understand and analyse scientific literature.									
- are able to plan a scientific project.									
2. Prerequisites									
obligatory									
recommended									
Maximum number of students	10 students								
3. Study program allocation									
Study program						Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	2./3.		
M.Sc. Crop Sciences						E Focus PERC	2./3.		
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
Proj	during the semester		English	10	3,0	45,0	90,0		
S	during the semester		English	10	1,0	15,0	30,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
WS/SS				180		1		6,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor			
Report (presentation) [780800279]				graded	English	80%			
Assignment [780800278]				graded	English	20%			
Academic Achievements									
10. Module coordination									
Module coordinator									
Prof. Dr. Florian Grundler									
Teaching person									
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/									
Institute/ Department									
Agrar-, Forst- und Ernährungswissenschaften									
11. Further information									

Cross-cutting modules of the second and third semester

You can choose 18-30 ECTS-CP from the elective modules.

Module Title: Land Use and Land Degradation								
Module ID/Code: ARTS-BC02 [780750060]								
1. Content and intended learning outcomes								
Learning content:	Learn about land uses, resource management strategies and their implications Apply simple field methods for ecosystem analysis Present case studies							
Learning outcomes								
After a successful completion of the course, the students are familiar with - different types of land degradation and their effects on agriculture, environment and social life. - suitable counter measures and resource management strategies. - the implications of different strategies. - compile a case study and present to plenum.								
2. Prerequisites								
obligatory								
recommended	Completion of >24 ECTS out of ARTS-A							
Maximum number of students	25 students							
3. Study program allocation								
Study program						Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	2.	
4. Teaching and learning methods								
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]		
						Contact time	Self-study	
E (blocked)	full-day block		English	25	4,0	60,0	120,0	
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)
SS				180		1		6,0
9. Requirements for the rewarding of credits (ECTS)								
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor		
Presentation [780750069]				graded	English	50%		
Report [780750068]				graded	English	50%		
Academic Achievements								
10. Module coordination								
Module coordinator								
PD Dr. Johannes Botschek								
Teaching person								
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/								
Institute/ Department								
Agrar-, Forst- und Ernährungswissenschaften								
11. Further information								

Module Title: Development Economics							
Module ID/Code: ARTS-BC03 [780763240]							
1. Content and intended learning outcomes							
Learning content:	Empirical patterns in economic development, poverty analysis, economic growth models, causes of differential economic growth and development across countries, including the role of institutions, policies, climate change, and natural resource scarcities. Sustainable management of natural resources for development and poverty reduction: key theoretical concepts, critical discussion of empirical policy problems, policy evaluation.						
Learning outcomes							
After a successful completion of the course, the students...							
<ul style="list-style-type: none"> - are able to describe key concepts and structure of economic growth models and drivers of socio-economic development. - can explain the role of institutions, labour markets, migration and sustainable natural resource management for economic development. - are able to apply learned concepts for analysis of development policies. - can contrast methods for conducting research on sustainable natural resource management topics. - will appraise empirical examples through case studies. - are able to generalize lessons learnt from case studies to broader development issues. 							
2. Prerequisites							
obligatory							
recommended							
Maximum number of students							
3. Study program allocation							
Study program				Compulsory/ Elective			Semester
M.Sc. Agricultural and Food Economics				E			2.
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)				E			2.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L	during the semester	Development Economics	English	25	4,0	56,0	124,0
5. Course cycle			6. Workload [h]		7. Duration		8. Credits (ECTS)
SS			180		1		6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor	
Written exam [780763249]				graded	English	100%	
Academic Achievements							
10. Module coordination							
Module coordinator							
Prof. Dr. Matin Qaim							
Teaching person							
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/							
Institute/ Department							
Agrar-, Forst- und Ernährungswissenschaften							
11. Further information							

Module Title: Decision Analysis and Forecasting in Agriculture							
Module ID/Code: NPW-023 [780800230]							
1. Content and intended learning outcomes							
Learning content:	<ul style="list-style-type: none"> - Introduction to decision analysis - Forecasting and cognitive biases - Calibration training - Participatory modeling building - Decision modeling in R - Group project on decision analysis 						
Learning outcomes							
After a successful completion of the course, the students... <ul style="list-style-type: none"> - will understand the value of decision analysis approaches for agricultural research. - will be able to recognize their own biases and provide accurate range estimates for uncertain variables. - will be able to analyse a decision context. - will be able to draw conclusions from a decision model and recommend steps forward. - will be able to develop decision models, comprehensively evaluate their findings and compose a report about the model they developed. 							
2. Prerequisites							
obligatory							
recommended							
Maximum number of students	30 students						
3. Study program allocation							
Study program					Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)					E	2.	
M.Sc. Crop Sciences					E Focus PERC	2.	
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L (blocked)	during the semester	Decision analysis and participatory modeling	English	24	2,0	30,0	30,0
PS (blocked)	during the semester	Practical decision analysis project	English	12	2,0	30,0	90,0
5. Course cycle			6. Workload [h]		7. Duration		8. Credits (ECTS)
SS			180		1		6,0

Module Title: Decision Analysis and Forecasting in Agriculture				
Module ID/Code: NPW-023 [780800230]				
9. Requirements for the rewarding of credits (ECTS)				
Types of Assessment	Prerequisites for admission to the Assessment	Graded yes/no	Language (exam)	Weighting factor
Report [780800238]	Project work complete, so that a report on it can be composed	graded	English	100%
Academic Achievements				
Project work [780800239]				
10. Module coordination				
Module coordinator				
Dr. Cory Whitney				
Teaching person				
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/				
Institute/ Department				
Agrar-, Forst- und Ernährungswissenschaften				
11. Further information				
<p>Hubbard, 2014. How to Measure Anything: Finding the Value of "Intangibles" in Business (3rd edition). Wiley.</p> <p>Luedeling and Shepherd, 2016. Decision-focused agricultural research. Solutions 7, 46-54. https://www.thesolutionsjournal.com/article/decision-focused-agricultural-research/</p> <p>Whitney et al., 2018. Decision analysis methods guide. Working paper, World Agroforestry Centre, Nairobi. https://www.researchgate.net/publication/324978583_Decision_analysis_methods_guide_agricultural_policy_for_nutrition</p> <p>Lanzanova et al., 2019. Improving development efficiency through decision analysis: Reservoir protection in Burkina Faso. Environmental Modelling & Software 115: 164–175. (contact instructors)</p> <p>Shepherd et al., 2015. Development goals should enable decision-making. Nature 523: 152–154. https://www.nature.com/news/policy-development-goals-should-enable-decision-making-1.17915</p> <p>Whitney et al., 2017. Homegardens and the future of food and nutrition security in southwest Uganda. Agricultural Systems 154: 133–144. (contact instructors)</p>				

Module Title: Agricultural Entomology							
Module ID/Code: NPW-008 [780800080]							
1. Content and intended learning outcomes							
Learning content:	Insects are major pests in agriculture but can provide beneficial effects such as pollination or pest control. This module increases the in-depth understanding of entomological aspects in agriculture and presents examples of beneficial and harmful organisms regarding the following aspects: <ul style="list-style-type: none"> - Functional morphology and anatomy - Identification of insects - Host-parasite interactions - Development of symptoms - Case studies from major crop types - Antagonists of insect pests - Use of insects in IPM approaches - Options for insect control - Insecticide resistance 						
Learning outcomes							
After a successful completion of the course, the students... <ul style="list-style-type: none"> - have obtained specific entomological knowledge. - are able to comprehend and explain complex biological interactions. - can explain specific problem issues related to biocontrol or the use of insecticides. 							
2. Prerequisites							
obligatory							
recommended							
Maximum number of students	20 students						
3. Study program allocation							
Study program						Compulsory/ Elective	Semester
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	2.
M.Sc. Crop Sciences						E Focus PERC	2.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L (blocked)	full-day block	Agricultural Entomology		20	2,0	10,0	50,0
T	during the semester	Agricultural Entomology	English	20	1,0	40,0	20,0
S	during the semester	Agricultural Entomology	English	20	1,0	40,0	20,0
5. Course cycle				6. Workload [h]		7. Duration	8. Credits (ECTS)
SS				180		1	6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor	
Report (presentation) [780800089]				graded	English	80%	
Assignment [780800088]				graded	English	20%	
Academic Achievements							

Module Title: Agricultural Entomology
Module ID/Code: NPW-008 [780800080]
10. Module coordination
Module coordinator
Prof. Dr. Thomas Döring
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information

Module Title: Agricultural Nematology								
Module ID/Code: NPW-009 [780800090]								
1. Content and intended learning outcomes								
Learning content:	The module provides in-depth knowledge in Agricultural Nematology. The biology of the most important groups of plant-parasitic and entomopathogenic nematodes is presented including the following topics: <ul style="list-style-type: none"> -functional morphology and anatomy -identification of nematodes -host-parasite interactions and their mechanisms -development of plant symptoms -case studies in important crop plants -nematode antagonists -application and mode of action of entomopathogenic nematode -options for nematode control 							
Learning outcomes								
After a successful completion of the course, the students... <ul style="list-style-type: none"> - familiar with specific nematological expertise. - able to present and explain complex biological situations. - explain and evaluate specific problems in nematode pest control and application of beneficial nematodes. 								
2. Prerequisites								
obligatory								
recommended								
Maximum number of students	25 students							
3. Study program allocation								
Study program						Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	3.	
M.Sc. Crop Sciences						E Focus PERC	3.	
4. Teaching and learning methods								
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]		
						Contact time	Self-study	
L	during the semester	Agricultural Nematology	English	25	2,0	30,0	60,0	
T	during the semester	Agricultural Nematology	English	25	1,0	15,0	30,0	
S	during the semester	Agricultural Nematology	English	25	1,0	15,0	30,0	
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)
WS				180		1		6,0
9. Requirements for the rewarding of credits (ECTS)								
Types of Assessment	Prerequisites for admission to the Assessment				Graded yes/no	Language (exam)	Weighting factor	
Report (presentation) [780800099]					graded	English	80%	
Assignment [780800098]					graded	English	20%	
Academic Achievements								

Module Title: Agricultural Nematology
Module ID/Code: NPW-009 [780800090]
10. Module coordination
Module coordinator
Prof. Dr. Florian Grundler
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information

Module Title: Sustainable Entrepreneurship & Venturing									
Module ID/Code: ARTS-BC08 [780750100]									
1. Content and intended learning outcomes									
Learning content:	<p>The module "Sustainable Entrepreneurship & Venturing" is designed for students interested in start-ups and how entrepreneurship may help foster urgent sustainability transformations. The module provides an overview of the entrepreneurial process of discovering, evaluating, and implementing new business ideas and models to promote sustainable development. During the course, students will explore the concept of sustainable entrepreneurship, which encompasses the fundamentals of entrepreneurship and sustainable business models as well as entrepreneurial tools for sustainability.</p> <p>Building on this, sustainable venturing embraces an active role and aims to harness the innovative power of entrepreneurship to solve global social and environmental challenges. In this context, students will work in teams to develop a sustainable business idea. Course participants will be able to identify social and environmental problems, develop ideas for solutions, analyse and evaluate alternatives, and develop plans to implement their solution. Students are guided through the process of applying entrepreneurial tools to advance their entrepreneurial ideas and turn them into business models. Students are also familiarized with concepts and tools for presenting their business idea.</p>								
Learning outcomes									
After a successful completion of the course, the students...									
<ul style="list-style-type: none"> - understand the specifics and requirements of sustainable entrepreneurship. - are able to apply tools for sustainability-oriented idea generation and evaluation. - have knowledge and skills to identify, develop, evaluate, and determine sustainable business models. - create the foundations of an entrepreneurial mindset. 									
2. Prerequisites									
obligatory	At least second semester								
recommended	none								
Maximum number of students	25 students								
3. Study program allocation									
Study program						Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	2.		
M.Sc. Nutrition Science						E	2.		
M.Sc. Molecular Food Technology						E	2.		
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
S	weekly		English	25	4,0	45,0	135,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
SS				180		1		6,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor			
Project work [780750109]	Regular participation			graded	English				
Academic Achievements									

Module Title: Sustainable Entrepreneurship & Venturing
Module ID/Code: ARTS-BC08 [780750100]
10. Module coordination
Module coordinator
Prof. Dr. Denise Fischer-Kreer
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information

Module Title: An introduction to the Analysis of Complex Social-Ecological Systems								
Module ID/Code: ARTS-BC09 [780750150]								
1. Content and intended learning outcomes								
Learning content:	<p>Complexity is an innate characteristic of nature and societies and, therefore, a widespread feature of most research topics. However, scientific research is largely dominated by disciplinary approaches and methods. In this module, we will explore systems analysis as an approach and toolbox for understanding and managing complexity in real-life social-ecological systems (SES). The module is both theoretical and practical. Students will become familiar with the notions and premises for conceptualizing and understanding complex SES, as well as the tools for their evaluation and analysis. Group work on real-life examples will allow students to progressively apply the skills acquired and will serve as assessment proxy for the instructor.</p>							
Learning outcomes								
<p>After a successful completion of the course, the students...</p> <ul style="list-style-type: none"> - have gained familiarity with the notions and concepts of complexity science, systems thinking and social-ecological systems. - have acquired the ability to recognize and interpret a complex real-life situation under the premises of systems thinking. - have learned to unravel the complexity of a real-life situation, applying methods and tools related to systems analysis - are capable to disentangle the intrinsic functioning (feedback loops) of a complex real-life situation - are able to critically discern on a complex real-life situation, interpret it and analyse it with a view to its theoretical improvement - are able to communicate the entire process to a lay audience, with the aim of helping them understand and, ultimately, decide upon it 								
2. Prerequisites								
obligatory								
recommended								
Maximum number of students	16							
3. Study program allocation								
Study program					Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)					E	2.		
4. Teaching and learning methods								
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]		
						Contact time	Self-study	
L	weekly	Theory	English	16	1,0	15	15	
S	weekly	Practical tools	English	16	1,0	15	15	
PS	weekly	Project group work	English	16	0	0	30	
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)
SS				90		1		3,0
9. Requirements for the rewarding of credits (ECTS)								
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor		
Project work [780750157]	Module registration			graded	English	0,3		
Presentation [780750158]	Module registration			graded	English	0,3		
Report [780750159]	Module registration			graded	English	0,4		
Academic Achievements								

Module Title: An introduction to the Analysis of Complex Social-Ecological Systems
Module ID/Code: ARTS-BC09 [780750150]
10. Module coordination
Module coordinator
Daniel Callo-Concha
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information

Module Title: Agroforestry systems and practice								
Module ID/Code: NPW-062 [780800620]								
1. Content and intended learning outcomes								
Learning content:	The module introduces students to the principles and practical applications of agroforestry. It covers ecological and agronomic foundations of tree-crop and tree-livestock interactions, system design and management, and the role of agroforestry in climate adaptation, biodiversity conservation and sustainable land use. Case studies from temperate and tropical regions illustrate implementation pathways, economic considerations and policy frameworks. Practical components include analyzing real agroforestry systems, characterizing livelihood contexts and evaluating system performance from ecological, agronomic and socio-economic perspectives.							
Learning outcomes								
After a successful completion of the course, the students...								
<ul style="list-style-type: none"> - know how to classify agroforestry systems, identify different types and understand the potential benefits of agroforestry across contexts - are familiar with the broad paradigms that guide agroforestry interventions, as well as other interventions aiming to make agriculture more sustainable - are able to characterize challenges and opportunities associated with the adoption and scaling of agroforestry - are able to apply knowledge on agroforestry to case study- explore different professional and career pathways for engaging with sustainability issues - are able to differentiate between different evaluation strategies for agroforestry systems - are able to design agroforestry options that exploit synergies and manage trade-offs between components 								
2. Prerequisites								
obligatory								
recommended								
Maximum number of students	30							
3. Study program allocation								
Study program						Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	2./4.	
M.Sc. Crop Science						E	2./4.	
M.Sc. Nature Conservation and Landscape Ecology						O	2./4.	
M.Sc. Agricultural and Food Economics (AFECO)						O	2./4.	
4. Teaching and learning methods								
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]		
						Contact time	Self-study	
L	during the semester		English	30	2,0	30,0	30,0	
S	during the semester		English	30	1,5	22	30	
E	Full-day block		English	30	0,5	8	0	
SG	during the semester		English	30	0	0	60,0	
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)
SS				180		1		6,0
9. Requirements for the rewarding of credits (ECTS)								
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor		
Presentation [780800628]	Individual presentation on selected topics			graded	English	0,5		
Project work [780800629]	Fieldwork based group project, presented in class (plus short report)			graded	English	0,5		
Academic Achievements								

Module Title: Agroforestry systems and practice
Module ID/Code: NPW-062 [780800620]
10. Module coordination
Module coordinator
Prof. Dr. Eike Lüdeling und Dr. Kai Mausch
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
INRES
11. Further information

Compulsory modules of the second and third semester (ARTS-C)

30 ECTS-CP must be completed.

Module Title: Current Issues of Resource Management									
Module ID/Code: ARTS-C01 [780750070]									
1. Content and intended learning outcomes									
Learning content:	New trends in resource management (presentations by invited guest speakers) Participation at international conference (Tropentag)								
Learning outcomes									
After a successful completion of the course, the students... - have learned about current issues in resource management. - have exercised discussing implications with speakers. - are able to analyse and synthesize information acquired at Tropentag conference.									
2. Prerequisites									
obligatory									
recommended									
Maximum number of students	60 students								
3. Study program allocation									
Study program						Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						C	2.-3.		
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
S*	during the semester		English	60	1,0	20,0	60,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
WS+SS				180		3		6,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor			
Presentation [780750079]	Participation (presence) at >20 lectures/seminars			graded	English				
Academic Achievements									
10. Module coordination									
Module coordinator									
Jan Ellenberger									
Teaching person									
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/									
Institute/ Department									
Agrar-, Forst- und Ernährungswissenschaften									
11. Further information									

Module Title: Scientific Communication							
Module ID/Code: ARTS-C02 [780800190]							
1. Content and intended learning outcomes							
Learning content:	Students acquire technical skills to effectively communicate with other scientists (writing of research papers and theses, preparing posters, oral presentations)						
Learning outcomes							
After a successful completion of the course, the students...							
<ul style="list-style-type: none"> - know about scientific communication strategies. - are able to target research journals based on aim and scopes. - can structure scientific data for oral presentations. - can arrange research data in the form of posters. - can analyse research papers. - can compose own research paper. 							
2. Prerequisites							
obligatory							
recommended	all compulsory modules ARTS A						
Maximum number of students	50 students						
3. Study program allocation							
Study program						Compulsory/ Elective	Semester
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						C	3.
M.Sc. Crop Sciences						E Focus PERC	3.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L (blocked)	afternoon block		English	50	2,0	30,0	70,0
P (blocked)	afternoon block		English	50	2,0	20,0	60,0
5. Course cycle			6. Workload [h]		7. Duration		8. Credits (ECTS)
WS			180		1		6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment				Graded yes/no	Language (exam)	Weighting factor
written exam							
Academic Achievements							
10. Module coordination							
Module coordinator							
Dr. Janina Dierks							
Teaching person							
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/							
Institute/ Department							
Agrar-, Forst- und Ernährungswissenschaften							
11. Further information							

Module Title: Sustainability, Risk and Transformation

Module ID/Code: NPW-020

1. Content and intended learning outcomes

Learning content: Knowledge about sustainability, risk(s) and transformation is key to understanding the societal challenges of global change and to considering them in one's own field of action. In this course we take an interdisciplinary approach to teaching these concepts integrating knowledge from social and natural theory and science.

Starting from the current state of global sustainability problems and transformation perspectives as well as associated political processes, this interdisciplinary and multi-perspective course first illustrates the fundamentals of the terms 'sustainability', 'risk' and 'transformation' as well as other related concepts and terms. Building on this theoretical underpinning, particular attention is paid to the 2030 Agenda for Sustainable Development by critically discussing aspects such as implementation and measurement of the Sustainable Development Goals (SDGs) including the basics and critical aspects of economic growth.

Furthermore, we explore how farmers, consumers and insurances take decisions in the face of increasing risks associated with global change as well as transformation. This is done by providing insights into the field of sustainable consumption, such as on types, motives and barriers of sustainable production and consumption, as well as on measures to promote sustainable consumer behaviour. We furthermore explore how natural ecosystems manage risks and if and how these principles could be also applied in an agricultural context e.g. in the context of pest management. Furthermore, we introduce complex systems thinking as a tool to deal with risks.

The examples used during the course often refer to agriculture and the food industry but are intentionally not limited to them. Besides the continuous use of built-in short exercises, interactive teaching formats (e.g. live quizzes, case studies, simulation game), students will be engaged in lively discussions on the topics and encouraged to bring in own perspectives.

As a basis for the grading, students will engage in group work to develop and implement either a board game or a small self-experiment (will be decided each year) incorporating aspects of risks, sustainability or transformation. The results of this group work will be presented during a public game or poster presentation.

Learning outcomes

- After a successful completion of the course, the students ...
- know about the different scientific and political debates as well as their development in the context of sustainability, risks and transformation
 - have developed a general and interdisciplinary understanding of complex challenges and concepts related to sustainability, risks and transformation
 - understand the practical challenges and chances related to these concepts for agriculture in different contexts (different countries, different farm sizes etc.)
 - are able to apply these concepts in the context of research questions related to agriculture and land use

2. Prerequisites

obligatory	
recommended	
Maximum number of students	50

Module Title: Sustainability, Risk and Transformation								
Module ID/Code: NPW-020								
3. Study program allocation								
Study program					Compulsory/ Elective	Semester		
M.Sc. Agricultural and Food Economics					E	3.		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)					C	3.		
M.Sc. Crop Science					E Focus PERC	3.		
4. Teaching and learning methods								
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]		
						Contact time	Self-study	
L	weekly		English	50	4,0	41,0	139,0	
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)
WS				180		1		6,0
9. Requirements for the rewarding of credits (ECTS)								
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor		
Presentation of Game or Experiment				yes	English			
Academic Achievements								
10. Module coordination								
Module coordinator								
Jun-Prof. Dr. Lisa Biber-Freudenberger								
Teaching person								
Jun-Prof. Dr. Lisa Biber-Freudenberger, Prof. Dr. Zita Sebesvari, Jun-Prof. Dr. Daniel Herrmann, Prof. Dr. Niklas Möhring, Dr. Schulte-Filthaus, Jun-Prof. Dr Wolfram Barfuss, Jun-Prof.Dr. Dominic Lemken, Jun-Prof. Janina Dierks								
11. Further information								
External guests e.g. farmers to talk about their perspectives on sustainability, risks and transformation								

Module Title: International Research Management and Proposal Writing							
Module ID/Code: ARTS-C04 [780750080]							
1. Content and intended learning outcomes							
Learning content:	International organizations for technical, scientific and financial support Donors for international research and development projects (aims, scope, requirements) Discussion strategies for research planning Technical aspects of proposal planning and development (budget, time plan, break-down structure, Log Frame) Do's and don'ts in proposal writing basic understanding of teamwork and research ethics Principles of peer-reviewing Proposal writing, presentation and defense						
Learning outcomes							
After a successful completion of the course, the students... - know about donors and potential partners. - can effectively select and approach donors and partners. - can plan and develop elements of a research proposal. - can effectively review and assess the work of others (peer reviewing). - can formulate a research proposal and target it to donors. - can present and defend the content of the proposal to a donor or reviewer.							
2. Prerequisites							
obligatory							
recommended	ARTS A modules (knowledge and comprehension of resources for agricultural production)						
Maximum number of students	25 students						
3. Study program allocation							
Study program					Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)					C	3.	
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L (blocked)	afternoon block	International organizations	English	25	1,0	10,0	20,0
T* (blocked)	afternoon block	Proposal elements	English	25	1,0	10,0	40,0
S (blocked)	afternoon block	Assessing proposal quality	English	25	1,0	10,0	20,0
PS (blocked)	afternoon block	Developing a research proposal	English	25	1,0	10,0	60,0
5. Course cycle			6. Workload [h]		7. Duration		8. Credits (ECTS)
WS			180		1		6,0

Module Title: International Research Management and Proposal Writing				
Module ID/Code: ARTS-C04 [780750080]				
9. Requirements for the rewarding of credits (ECTS)				
Types of Assessment	Prerequisites for admission to the Assessment	Graded yes/no	Language (exam)	Weighting factor
Project work [780750089]	Presence at >10 lectures / exercises	graded	English	100%
Academic Achievements				
Assignment [780750088] Homework exercise on breakdown, budget table Ghannt chart				
Colloquium [780750087] Presentation of at least 1 homework assignment				
10. Module coordination				
Module coordinator				
Jun. Prof. Dr. Janina Dierks				
Teaching person				
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/				
Institute/ Department				
Agrar-, Forst- und Ernährungswissenschaften				
11. Further information				

Module Title: Data Analysis and Visualization									
Module ID/Code: ARTS-C05 [780800010]									
1. Content and intended learning outcomes									
Learning content:	Introduction to planning of field experiments and their analysis (Feldversuchswesen). Introduction to statistics and to statistical software „R“: exploratory data analysis and visualization of data, hypothesis testing, analysis of variance, regression. Introduction to research data management. Introduction to system analysis and modeling.								
Learning outcomes									
After a successful completion of the course, the students... - can generate and interpret box plots, histograms, scatter plots. - can perform and interpret basic hypothesis tests, ANOVA and linear regression.									
2. Prerequisites									
obligatory									
recommended	at least 5 successfully completed modules in ARTS-A								
Maximum number of students									
3. Study program allocation									
Study program						Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						C	3.		
M.Sc. Crop Sciences						C	1.		
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
L	during the semester	Methods for agricultural research data	English	120	3,0	45,0	45,0		
P	during the semester	Computer exercises methods for agricultural research data	English	30	2,0	30,0	60,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
WS				180		1		6,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor			
Assignment [780800019]				graded	English				
Academic Achievements									
10. Module coordination									
Module coordinator									
Prof. Dr. Heiko Schoof									
Teaching person									
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/									
Institute/ Department									
Agrar-, Forst- und Ernährungswissenschaften, Mathematik									
11. Further information									

Free elective modules

A maximum of 12 ECTS-CP can be completed from free elective modules.

Module Title: Technology and Sensors in Precision Crop Production									
Module ID/Code: NPW-002 [780800020]									
1. Content and intended learning outcomes									
Learning content:	Knowledge of the sensors used in precision farming and the motivation for their use. Including the fundamentals and use of precision localisation systems (e.g. GNSS and differential GNSS) for control traffic farming, planting and site specific management. The use of different sensors and sensing technology to estimate farm and crop health including multi-spectral imagery at different scales (e.g. from satellites, UAVs).								
Learning outcomes									
After a successful completion of the course, the students...									
<ul style="list-style-type: none"> - will have an understanding of precision farming principles. - will understand the function of different sensors and their use in precision farming. - will have an understanding of GNSS and differential GNSS. 									
2. Prerequisites									
obligatory									
recommended	Module "Precision Farming" (B.Sc. Agrarwissenschaften)								
Maximum number of students									
3. Study program allocation									
Study program						Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						O	3.		
M.Sc. Crop Sciences						C	1.		
M.Ed. Agricultural Science (Teacher's Training)						E	1.		
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
L	during the semester		English	120	2,0	30,0	60,0		
S	during the semester		English	30	2,0	30,0	60,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
WS				180		1		6,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment		Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor		
Written exam [780800029]					graded	English			
Academic Achievements									
10. Module coordination									
Module coordinator									
Dr. Lasse Klingbeil									
Teaching person									
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/									
Institute/ Department									
Agrar-, Forst- und Ernährungswissenschaften, Vermessungswesen									
11. Further information									

Module Title: Tree Phenology Analysis in R							
Module ID/Code: NPW-034 [780800340]							
1. Content and intended learning outcomes							
Learning content:	Using the chillR package for R, data on the timing of tree life cycle events will be related to temperature data and analysed in a number of ways. Students will learn how to: <ul style="list-style-type: none"> - Efficiently compute common chill and heat metrics - Illustrate and evaluate temporal trends in thermal metrics - Design functions for additional metrics - Relate phenology data to temperature records using multivariate statistics - Identify temperature response phases of temperate tree crops - Generate past and future temperature scenarios using a weather generator - Evaluate past and prospective future impacts of climate change on thermal metrics - Participate in a phenology monitoring experiment under semi-controlled conditions - Analyse a phenology dataset and compile a report about their findings - Use git and GitHub for version control and collaboration and R-Markdown for report writing 						
Learning outcomes							
After a successful completion of the course, the students... <ul style="list-style-type: none"> - will be able to apply R functions and develop code using version control (GitHub). - will be able to analyse phenology records and relate them to temperature data. - will be able to evaluate climate change impacts on thermal metrics. - will be able to compile a comprehensive and fully reproducible report on the agroclimatic history and prospects for a particular context, combining results from several analyses. - will be familiar with phenology monitoring protocols and able to apply them. 							
2. Prerequisites							
obligatory							
recommended							
Maximum number of students	12 students						
3. Study program allocation							
Study program						Compulsory/ Elective	Semester
M.Sc. Crop Sciences						E Focus DA	3.
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						O	3.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
PS	during the semester	Phenology data analysis	English	12	1,0	15,0	15,0
P	during the semester	Phenology monitoring and data analysis exercises	English	12	3,0	45,0	105,0
5. Course cycle				6. Workload [h]		7. Duration	8. Credits (ECTS)
WS				180		1	6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment		Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor
Term paper [780800349]					graded	English	
Academic Achievements							

Module Title: Tree Phenology Analysis in R
Module ID/Code: NPW-034 [780800340]
10. Module coordination
Module coordinator
Prof. Dr. Eike Luedeling
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information
<p>Luedeling, 2019. chillR: Statistical methods for phenology analysis in temperate fruit trees. https://cran.r-project.org/web/packages/chillR/index.html</p> <p>Luedeling et al., 2011. Climate Change Affects Winter Chill for Temperate Fruit and Nut Trees. PLoS ONE 6, e20155. https://doi.org/10.1371/journal.pone.0020155</p> <p>Luedeling, 2012. Climate change impacts on winter chill for temperate fruit and nut production: A review. Scientia Horticulturae 144, 218–229. https://doi.org/10.1016/j.scienta.2012.07.011</p> <p>Luedeling and Gassner, 2012. Partial Least Squares Regression for analyzing walnut phenology in California. Agricultural and Forest Meteorology 158–159, 43–52. https://doi.org/10.1016/j.agrformet.2011.10.020</p> <p>Luedeling et al., 2013. Differential responses of trees to temperature variation during the chilling and forcing phases. Agricultural and Forest Meteorology 181, 33–42. https://doi.org/10.1016/j.agrformet.2013.06.018</p> <p>Guo et al., 2015. Responses of spring phenology in temperate zone trees to climate warming: A case study of apricot flowering in China. Agricultural and Forest Meteorology 201, 1–7. https://doi.org/10.1016/j.agrformet.2014.10.016</p> <p>Benmoussa et al., 2018. Climate change threatens central Tunisian nut orchards. Int J Biometeorol 62, 2245–2255. https://doi.org/10.1007/s00484-018-1628-x</p> <p>Benmoussa et al., 2017. Performance of pistachio (<i>Pistacia vera</i> L.) in warming Mediterranean orchards. Environmental and Experimental Botany 140, 76–85. https://doi.org/10.1016/j.envexpbot.2017.05.007</p> <p>Each student needs a computer for the exercises.</p>

Module Title: Lecture Series on Future Competent Agricultural and Food Systems									
Module ID/Code: NPW-053 [780800530]									
1. Content and intended learning outcomes									
Learning content:	The interdisciplinary lecture series will take up the societal debate on the future of Agriculture and Food Systems. It will cover important aspects of sustainability, supply chains, planetary health, innovative production systems, biodiversity, life cycle assessment, digitalization among others to discuss the transformation of the current systems into future competent ones. In this context a system approach will be taken to discuss the challenges and how the different scientific fields could contribute to the solutions.								
Learning outcomes									
After a successful completion of the course, the students...									
<ul style="list-style-type: none"> - obtain an overview of a specific research field. - will have an understanding of agricultural and nutritional sciences in a societal context. - will understand the possible interactions between agriculture, food systems, and sustainability. - are able to discuss key topics of agricultural and food systems, sustainability, food supply chains. - will be able to take part in scientific discourse. - communicate and discuss findings and evaluations with colleagues/other students. 									
2. Prerequisites									
obligatory									
recommended	For each lecture a list of additional readings will be offered.								
Maximum number of students	25 students								
3. Study program allocation									
Study program						Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	1./3.		
M.Sc. Crop Sciences						E	1./3.		
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
L	during the semester		English	500	1,5	22,0	30,0		
S		single appointment	English	25	0,3	4,0	10,0		
C		single appointment	English	25	0,3	4,0	20,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
WS				90		1		3,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor			
Term paper [780800539]	Participation at minimum of 80% of lectures			graded	English	100%			
Colloquium [780800538]	Participation at minimum of 80% of lectures			not graded	English	0%			
Academic Achievements									

Module Title: Lecture Series on Future Competent Agricultural and Food Systems
Module ID/Code: NPW-053 [780800530]
10. Module coordination
Module coordinator
Dr. Thorsten Kraska
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
11. Further information
<p>The „Fakultätentag“ is the official organisation of Agricultural and / or Nutritional Sciences faculties at Germany Universities. Member faculties come from the Universities of Berlin, Bonn, Gießen, Göttingen, Halle, Hohenheim, Jena, Kassel-Witzenhausen, Kiel, Munich, and Rostock.</p> <p>The lectures will be given by scientists from member faculties or by invited speakers. The program will be corporately organized by the members of the Fakultätentag.</p> <p>While the examination is limited to 25 students of the M.Sc. programs, the lecture series open for guests.</p>

Module Title: Lecture Series on Current Topics in Agricultural and Food Research								
Module ID/Code: NPW-058 [780800580]								
1. Content and intended learning outcomes								
Learning content:	The interdisciplinary lecture series will take up current research topics from the member faculties of the "Fakultätentag Agrarwissenschaften und Ökotropologie. It will highlight ongoing research and future research fields.							
Learning outcomes								
After a successful completion of the course, the students... - obtain an overview of a specific research field. - will have an understanding of agricultural and nutritional research topics. - will understand the possible interactions between agriculture, food systems, and sustainability. - are able to discuss key topics of agricultural and food research, sustainability, food supply chains. - will be able to take part in scientific discourse. - communicate and discuss findings and evaluations with colleagues/other students.								
2. Prerequisites								
obligatory	none							
recommended	For each lecture a list of additional readings will be offered.							
Maximum number of students	30 students							
3. Study program allocation								
Study program				Compulsory/ Elective			Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)				O			1./3.	
M.Sc. Nature Conservation and Landscape Ecology				O			1./3.	
M.Sc. Crop Sciences				E			1./3.	
4. Teaching and learning methods								
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]		
						Contact time	Self-study	
L	during the semester	Agricultural and food systems of the future	English	500	1,5	22,0	22,0	
S*		Preparation for colloquium	English	30	0,3	4,0	10,0	
C*		Presentation and discussion of selected topics from the lecture series	English	30	0,2	4,0	28,0	
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)
WS				90		1		3,0
9. Requirements for the rewarding of credits (ECTS)								
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor		
Presentation [780800589]	Participation at minimum of 80% of lectures			graded	English			
Academic Achievements								

Module Title: Lecture Series on Current Topics in Agricultural and Food Research
Module ID/Code: NPW-058 [780800580]
10. Module coordination
Module coordinator
Dr. Thorsten Kraska
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information
<p>The „Fakultätentag“ is the official organisation of Agricultural and / or Nutritional Sciences faculties at Germany Universities. Member faculties come from the Universities of Berlin, Bonn, Gießen, Göttingen, Halle, Hohenheim, Jena, Kassel-Witzenhausen, Kiel, Munich, and Rostock.</p> <p>The lectures will be given by scientists from member faculties or by invited speakers. The program will be corporately organized by the members of the Fakultätentag.</p> <p>While the examination is limited to 30 students of the M.Sc. programs, the lecture series is open for guests.</p> <p>This lecture series will be every 2nd year</p>

Module title: Environmental Governance							
Modul ID/Code: ILR-03							
1. Content and intended learning outcomes							
Learning content:	<p>Governance is a set of social processes and structures guiding individual, group and organizational behaviour. The course provides a detailed overview of different governance theories and approaches to address environmental and sustainability challenges. The course examines why collective action problems arise between individual and group interests, and how different governance theories help explain different ways of organizing society and social institutions to shape our behaviour, incentives and outcomes. A variety of different governance theories will be reviewed to compare their analytical potential and challenges and furthermore examine how different governance theories from different disciplinary perspectives are useful for understanding the current complexity of environmental and sustainability problems. The role of interdisciplinary science will be explored in order to advance the understanding of complex human-environmental systems and their governance.</p>						
Learning outcomes							
<ul style="list-style-type: none"> - Understanding of how governance problems arise, the role of collective action and collective action problems, and why governance is a central social factor guiding individual, group and organizational behaviour - Knowledge of key social science terminology and concepts including institutions, rules, norms, social networks, and human behaviour - Knowledge of scales and cross-scale issues - Understanding the most prominent environmental governance theories across disciplines, their differences, analytical advantages and shortcomings - Critical thinking about environmental problems with a detailed understanding of how social institutions and organizations are organized and could be re-organized. - Knowledge of systems thinking approaches and current research frontiers in environmental governance - Knowledge of real case studies with different governance problems and solutions. - The ability to diagnose governance challenges in new cases with existing theories and frameworks 							
2. Prerequisites							
obligatory	none						
recommended	Knowledge of institutional economics or political science Knowledge of social and environmental sustainability concepts						
Maximum number of students							
3. Study program allocation							
Study program						Compulsory/elective	Semester
M.Sc. Agricultural Science and Resource Management in the Tropics (ARTS)						O	1.-4.
M.Sc. Agriculture and Food Economics (AFECO)						O	1.-4.
M.Sc. Nature Conservation and Landscape Ecology						O	1.-4.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L	During the semester	Environmental governance	English	180	4,0	45	135
5. Course cycle			6. Workload [h]		7. Duration		8. Credits
WS/SS			180		1		6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Examination language	Weighting factor	
Presentation				graded	English	33,3%	
Project work				graded	English	33,3%	
Written exam				graded	English	33,3%	
Studienleistung(en)							

Module title: Environmental Governance
Modul ID/Code: ILR-03
10. Modulorganisation
Modulverantwortliche(r)
Prof. Dr. Stefan Partelow
Lehrende(r)
Die durchführenden Lehrpersonen im aktuellen Semester finden Sie in basis: https://basis.uni-bonn.de/
Anbietende Organisationseinheit(en)
Agrar-, Forst- und Ernährungswissenschaften
11. Sonstiges

Module Title: Data Analysis of Ecosystem-Atmosphere Interactions							
Module ID/Code: NALA-045							
1. Content and intended learning outcomes							
Learning content:	This module introduces students to key concepts and methodologies for understanding and evaluating environmental interactions between ecosystems (soils and plants), and the atmosphere and how to use different environmental data. The course will introduce theory of different processes and mechanisms related to ecosystem-atmosphere interactions but has a strong focus on practical exercises of data analysis approaches. It will cover greenhouse gas emissions (e.g., CO ₂ and N ₂ O), evapotranspiration, photosynthesis and ecosystem respiration, air quality, drought indicators as well as the evaluation of meteorological variables such as precipitation, air temperature or soil moisture, including long-term data series to assess climate change. Using measured data and open-source datasets (Fluxnet, ERA5, etc.) a practical exercise focusing on each of these topics will be performed every 1-2 weeks. The course offers training in handling time-series of environmental data, focusing on data preparation, quality control and trend detection to assess climate change and its effects on ecosystem-atmosphere interactions, and will introduce spatial analysis methods for mapping spatial variability. Through practical exercises, students will learn about the different ecosystem-atmosphere interaction processes and mechanisms and how to integrate spatial and temporal data to monitor and evaluate environmental changes.						
Learning outcomes							
<ul style="list-style-type: none"> - Identify main ecosystem-atmosphere interaction processes and mechanisms, - Are aware of most relevant open-source environmental and climate datasets to analyze soil-plant-atmosphere interactions, - Identify data needed to address questions on ecosystem-atmosphere interactions, - Prepare and perform quality-control of time-series data, - Compute ecosystem greenhouse gas (GHG) fluxes and water fluxes based on different data sources, - Evaluate trends and patterns of different environmental data (i.e. climate data, ecosystem fluxes, air quality, drought, etc.), - Conduct spatial data analysis and mapping to assess spatial variability in meteorological, climatological and flux data, - Integrate multiple environmental datasets to assess ecosystem-atmosphere processes and interactions with the climate. 							
2. Prerequisites							
obligatory	Basic knowledge of R is recommended						
recommended							
Maximum number of students	15						
3. Study program allocation							
Study program				Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)				O	1./3.		
M. Sc. Nature Conservation and Landscape Ecology				O	1./3.		
M.Sc. Crop Science				O	1./3.		
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L	during the semester		English	15	1	15	30
P	during the semester	Practical exercises of ecosystem-atmosphere interactions	English	15	3	45	90
5. Course cycle			6. Workload [h]		7. Duration		8. Credits (ECTS)
WS			180		1		6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor	
Report				graded	English	40 %	
Project work	Having submitted all individual reports for each exercise			graded	English	60 %	
Academic Achievements							

Module Title: Data Analysis of Ecosystem-Atmosphere Interactions
Module ID/Code: NALA-045
10. Module coordination
Module coordinator
Prof. Dr. Ana Meijide
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
INRES
11. Further information
Students will have to submit the outcome of each of the individual exercises (i.e. figure or map evaluating different data); Final examination will be an individual project work evaluating specific datasets.

Module Title: Agricultural Excursion to the Tropics and Subtropics							
Module ID/Code: ARTS-F01							
1. Content and intended learning outcomes							
Learning content:	<p>This module provides students with the opportunity to deepen their understanding of agricultural systems in tropical and subtropical regions through a combination of preparatory sessions, a field excursion, and a written report.</p> <p>During the lecture period of the summer semester, several in-person meetings will be scheduled. In the first session, the structure and objectives of the excursion planned for the current semester will be introduced. Following this, students will collaboratively define presentation topics related to the specific focus of the excursion. In subsequent meetings, students will present their assigned topics, followed by group discussions. These presentations, along with the discussions, contribute 33% to the final grade.</p> <p>The excursion itself usually takes place in September and lasts between 6 and 10 days. It typically includes visits to multiple agricultural enterprises in the destination country. Additionally, the program aims to facilitate exchanges with local universities and companies from related sectors, such as agricultural input suppliers or processing industries.</p> <p>Following the excursion, each student is required to submit a written report of approximately five pages. The report should include a general reflection on experiences in the destination country and place a particular focus on the topic covered in the student's pre-excursion presentation. The written report contributes 67 % to the final grade.</p>						
Learning outcomes							
<p>After a successful completion of the course, the students...</p> <ul style="list-style-type: none"> - have gained specific knowledge on the agroecological zone(s) visited in the excursion. They are able to recall local cropping systems and the specific challenges for agriculture in the region. - can classify observed agricultural systems, find examples of similar agricultural systems in other parts of the world, and compare these systems. - can give and moderate a scientific presentation on a selected agricultural practice or processing technique (mandatory student presentation). - are able to check and critique production methods in joint discussions with local farmers. 							
2. Prerequisites							
obligatory	Students must fulfil the legal requirements for entry into the destination country. This includes visa requirements and mandatory vaccinations.						
recommended							
Maximum number of students	10						
3. Study program allocation							
Study program					Compulsory/ Elective	Semester	
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)					E	1./3.	
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
S	during the semester	Excursion preparation and presentation	English	10	1,0	10,0	35,0
E	during the semester		English	10	3,0	50,0	85,0
5. Course cycle			6. Workload [h]		7. Duration		8. Credits (ECTS)
WS			180		1		6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor	
Presentation				graded	English	33 %	
Report				graded	English	67 %	

Module Title: Agricultural Excursion to the Tropics and Subtropics
Module ID/Code: ARTS-F01
Academic Achievements
10. Module coordination
Module coordinator
Dr. Jan Ellenberger
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
INRES
11. Further information

Module Title: Sustainability in Practice							
Module ID/Code: ENV-290 [780764290]							
1. Content and intended learning outcomes							
Learning content:	This seminar will invite guest speakers from different NGOs, government organizations, research institutions, development organizations, and companies around the region and beyond to present their practical work with sustainability. The seminar offers insights into different career options in sustainability, development, and conservation. The course will also engage with different concepts, paradigms and values of sustainability and theories of change within organizations. A core purpose of the seminar is to put students in contact with sustainability ideas outside of a university setting to explore future career options and practice-based challenges, and to engage in critical discussions with invited individuals and organisations.						
Learning outcomes							
After a successful completion of the course, the students ...							
<ul style="list-style-type: none"> - understand different concepts of sustainability - understand how sustainability is framed by different organisations - assess how sustainability is utilized to advance organisational goals - understand the critiques and challenges to achieving sustainability in different sectors and contexts - explore different professional and career pathways for engaging with sustainability issues - understand actions and activities associated with sustainability discourse 							
2. Prerequisites							
obligatory							
recommended							
Maximum number of students							
3. Study program allocation							
Study program						Compulsory/ Elective	Semester
M.Sc. Agricultural and Food Economics (AFECO)						E	1.-4.
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						E	1.-4.
M.Sc. Nature Conservation and Landscape Ecology						E	1.-4.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
S	during the semester	Sustainability in practice	English	40	2,0	30,0	60,0
5. Course cycle			6. Workload [h]		7. Duration		8. Credits (ECTS)
WS/SS			90		1		3,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment		Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor
Term paper [780764299]					graded	English	1
Academic Achievements							

Module Title: Sustainability in Practice
Module ID/Code: ENV-290 [780764290]
10. Module coordination
Module coordinator
Prof. Dr. Stefan Partelow
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Agrar-, Forst- und Ernährungswissenschaften
11. Further information

Module Title: Gender, Justice and the Socio-Ecological Transformation of Land and Food Systems							
Module ID/Code: ARTS-F02 [780750140]							
1. Content and intended learning outcomes							
Learning content:	<p>This module explores the interconnectedness of gender, justice, and socio-ecological transformation processes in land and food systems of the Global South. It examines how gender roles, power dynamics, and social inequalities shape agricultural practices, resource access, and ecological and developmental outcomes. The course builds on feminist, transdisciplinary and critical approaches as well as theories to sustainable agriculture, land management, climate resilience, and transformation processes. The various concepts and dimensions of equity and justice are explained and linked to transformation processes in land and food systems.</p> <p>Students will learn about theories, methods, and tools to integrate gender and justice perspectives into research and implementation projects. The module fosters critical reflection on approaches, policies, case studies, and grassroots movements to develop inclusive, equitable, and ecologically sound agricultural interventions.</p>						
Learning outcomes							
After a successful completion of the course, the students...							
- are able to define gender, equity, justice and transformation and describe its relevance for land and food systems in the Global South							
-are able to explain and compare different theories and concepts such as feminist, decolonial or relational theories							
-are able to exemplify, summarize and compare different case studies on agricultural interventions for development							
-are able to apply participatory and feminist tools and methodologies in research and implementation projects							
-are able to analyse power dynamics, inequalities, and intersectionality in agricultural research for development							
-are able to assess the impacts and trade-offs of socio-ecological transformations on rural communities							
-are able to propose gender-responsive and justice-centered agricultural interventions and pathways for change							
2. Prerequisites							
obligatory							
recommended							
Maximum number of students	25						
3. Study program allocation							
Study program						Compulsory/ Elective	Semester
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						0	2.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
L	afternoon block	Theories and approaches of gender, justice and transformation	English	25	2,0	28,0	42,0
S	afternoon block	Exercises, case studies and in-depth analysis	English	25	2,0	28,0	82,0
5. Course cycle			6. Workload [h]		7. Duration		8. Credits (ECTS)
SS			180		1		6,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor	
Term paper [780750148]	regular participation			graded	English	0,5	
Presentation [780750149]	regular participation			graded	English	0,5	
Academic Achievements							

Module Title: Gender, Justice and the Socio-Ecological Transformation of Land and Food Systems
Module ID/Code: ARTS-F02 [780750140]
10. Module coordination
Module coordinator
Dr. Tina Beuchelt
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
Center for Development Research (ZEF)
11. Further information

Module Title: Sustainable Farming Practices for Agrobiodiversity									
Module ID/Code: NALA-047 [780790500]									
1. Content and intended learning outcomes									
Learning content:	This interdisciplinary module explores how biodiversity contributes to more sustainable and resilient farming systems. It combines conceptual foundations with practical approaches, enabling students to understand, assess, and apply principles of agrobiodiversity from field to landscape scale. The courses links ecological processes to real-world farming practices and focuses on how diversification, ecological intensification, and participatory approaches can support sustainability in farming systems.								
Learning outcomes									
After a successful completion of the course, the students...									
<ul style="list-style-type: none"> - know main principles of sustainable farming and agrobiodiversity. - know basic tools and methods for biodiversity monitoring at field and landscape scales. - understand interactions between farming practices, biodiversity an ecosystem functions. - are able to integrate ecological, social and policy perspectives when evaluating farming systems. - have co-designed a biodiversity-based farm management plan in a group setting. - have present and critically discussed recent published articles in the field. 									
2. Prerequisites									
obligatory									
recommended	Basic knowledge of spatial data/software (e.g. ArcGIS, QGIS) is desirable.								
Maximum number of students									
3. Study program allocation									
Study program				Compulsory/ Elective		Semester			
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)				0		2.			
M.Sc. Nature Conservation and Landscape Ecology				0		2.			
M.Sc. Crop Science				0		2.			
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
L	during the semester	Theoretical foundations and case studies	English	20	1,0	14,0	20,0		
pT	during the semester	Field and GIS-based exercises	English	20	2,0	28,0	64,0		
S	during the semester	Presentation and discussion of journals	English	20	1,0	14,0	40,0		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
SS				180		1		6,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor			
Presentation [780790507]	Regular class attendance and participation in journal club and group discussion			not graded	English	0			
Report [780790508]	Practical sessions and written report			graded	English	0,4			
Assignment [780790509]	Project work (biodiversity-based farm management plan) incl. oral presentation			graded	English	0,6			
Academic Achievements									

Module Title: Sustainable Farming Practices for Agrobiodiversity
Module ID/Code: NALA-047 [780790500]
10. Module coordination
Module coordinator
Dr. Clara Oliva Gonçalves Bazzo
Teaching person
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/
Institute/ Department
INRES
11. Further information

Masterthesis and Colloquium

The masterthesis credits 20 ECTS-CP and the colloquium 10 ECTS-CP.

Module Title: Masterthesis							
Module ID/Code: ARTS-D1 [8900]							
1. Content and intended learning outcomes							
Learning content:	Formulate a relevant research question Elaborate a research proposal Present the proposal at a department seminar Conduct independently thesis research activity Summarise and write-up research findings Discuss own results in relation to the state of knowledge Present key findings and defend thesis during a research colloquium						
Learning outcomes							
After a successful completion of the course, the students... - has shown proof to be able to independently formulate a research question. - ability to conduct research under guidance. - ability to synthesise results and present them in public. Die Bearbeitungsdauer beträgt mindestens zwei und höchstens sechs Monate.							
2. Prerequisites							
obligatory	All compulsory modules of the first and third semester are completed (54 ECTS credit points) At least 24 credit points have been achieved in the elective course modules						
recommended	Research concept has been presented during a department seminar						
Maximum number of students							
3. Study program allocation							
Study program						Compulsory/ Elective	Semester
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						C	4.
4. Teaching and learning methods							
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]	
						Contact time	Self-study
Proj	during the semester	individually agreed upon with supervisor	English	1		0,0	900,0
5. Course cycle				6. Workload [h]		7. Duration	8. Credits (ECTS)
SS				600		1	20,0
9. Requirements for the rewarding of credits (ECTS)							
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor	
Masterthesis [8900]				graded	English		
Academic Achievements							
10. Module coordination							
Module coordinator							
All independent teaching staff							
Teaching person							
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/							
Institute/ Department							
Agrar-, Forst- und Ernährungswissenschaften							
11. Further information							

Module Title: Colloquium and Rigorosum									
Module ID/Code: ARTS-D2 [8901]									
1. Content and intended learning outcomes									
Learning content:									
Learning outcomes									
Fähigkeit zur Präsentation zentraler Forschungsergebnisse in einem öffentlichen Kolloquium.									
2. Prerequisites									
obligatory		ARTS-D1							
recommended									
Maximum number of students									
3. Study program allocation									
Study program						Compulsory/ Elective	Semester		
M.Sc. Agricultural Science and Resource Management in the Tropics and Subtropics (ARTS)						C	4.		
4. Teaching and learning methods									
Type of course	Interval	Topic	Language of instruction	Group size	SWS	Workload [h]			
						Contact time	Self-study		
5. Course cycle				6. Workload [h]		7. Duration		8. Credits (ECTS)	
SS				300		1		10,0	
9. Requirements for the rewarding of credits (ECTS)									
Types of Assessment	Prerequisites for admission to the Assessment			Graded yes/no	Language (exam)	Weighting factor			
Kolloquium [8901]									
Academic Achievements									
10. Module coordination									
Module coordinator									
All independent teaching staff									
Teaching person									
The teaching persons in the current semester can be found in basis: https://basis.uni-bonn.de/									
Institute/ Department									
11. Further information									