JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

Faculty 09

Syllabi M.Sc. Sustainable Transition

Winter Semester

Content

Core Modules

MK-067-EN-DI Theory and Practice of Economic Development

Instructor	Prof. Dr. Martin Petrick
Chair	Agriculture, Food and Environmental Policy
Contact	martin.petrick@agrar.uni-giessen.de
Instruction mode	This course will be held fully online with complementary meetings in presence. Asynchronous teaching based on a teaching module made available on the ILIAS platform accessible via the StudIP course site. Synchronous meetings for in-depth discussion of individual topics either in presence in a seminar room of Zeughaus, Senckenbergstrasse 3 in 35390 Giessen, or on a digital platform to be announced.
Language	English
Prerequisites	Participants should have a basic understanding of economics and statistics. Furthermore, they should be able to read and understand English language texts and follow English teaching.

Examination and Grading Policy

The final grade for MSc students consists of two components: the average grade of the excerpts plus a written exam on the four parts of the course. The excerpts contribute 60% to the final grade, the exam another 40%.

Every third week, the Professor randomly selects one out of the three excerpts each student has submitted, grade it and return feedback to the student. The grading evaluates the accuracy of the responses with regard to the two items, adherence to the word count, and how focused, succinct and readable the excerpt is written. Missing excerpts are graded with non-sufficient (nicht bestanden).

As a written exam, I ask you to submit an essay on one of the core topics of the lecture. Please consult the separate information sheet on the structure of the essay and how to submit it. A binding FlexNow registration is compulsory for taking part in the written exam. Registration is only possible within fixed deadlines, which are published by the FB09 examination office.

Course Description

The course introduces the students to key concepts for analysing economic development and applies them to a range of current development topics. I place specific emphasis on the role of natural resources and institutions in the process of development. While the course takes an economics perspective, it considers economic development as a multidisciplinary topic and integrates viewpoints from neighbouring social sciences into a problem-centred approach. It is divided into four parts (I to IV), each consisting of three sessions. Starting with an introduction to essential theories and models of economic growth and structural change in part I, the roles of natural resources and agriculture will be explored in part II. Part III focuses on institutions and the pivotal governance mechanisms of growth and development. In part IV, I will extend the concepts learned so far to investigate current problems of finance and development aid, culture, corruption, religion and violent conflict. Throughout the course, students will be exposed to case studies and applications with a specific eye on emerging and transition economies.

Learning Outcomes

By the end of this semester, students

- are familiar with key concepts for analysing economic development;
- are able to apply them to a range of current development topics,
- are aware of the role of natural resources and institutions in the process of development;
- consider economic development as a multidisciplinary topic and are enabled to integrate viewpoints from neighbouring social sciences into a problem-centred approach.

Recommended textbooks

- The CORE Team (2017): The Economy. Economics for a changing world. New York: Oxford University Press. Online at https://www.core-econ.org/.
- De Janvry, Alain; Sadoulet, Elisabeth (2016): Development Economics. Theory and Practice. London: Routledge.
- Roland, Gérard (2014): Development economics. London: Routledge. Available as online full text via Ebscohost.
- Todaro, Michael P.; Smith, Stephen C. (2020): Economic Development. 13th ed. Boston: Pearson.

Course Outlines

Part I: Introduction to development economics

1 Economic development & transition (19 October)

- An overview of concepts to understand growth
- Determinants of growth
- Governance mechanisms: market, state & community

- Current interpretations of what induces development
- Why & how to study development (economics)
- Development vs. transition

2 Models of growth & development (26 November)

- Neoclassical growth theory
- Endogenous growth
- Institutional determinants of growth
- Structural transformation
- Underdevelopment as a coordination failure

Required reading 01:
Krugman, Paul (1995): The Fall and Rise of Development Economics. In Paul Krugman (Ed.): Development, Geography, and Economic Theory. Cambridge, Mass., London: The MIT Press (The Ohlin Lectures, 6), pp. 1–29.

Excerpt 01 is due 25 October

3 Trade, globalisation & development strategy (2 November)

- Comparative advantage
- Multilateral trade institutions
- Is globalisation beneficial for development outcomes?
- Development strategies & industrial policy
- The Big Push

Required reading 02:
Krueger, Anne O. (1998): Why Trade Liberalisation is Good for Growth. In Economic Journal 108, pp. 1513–1522.

Excerpt 02 is due 1 November

Part II: Natural resources

4 The resource curse (9 November)

- What is the resource curse?
- Effects of wealth in natural resources & the Dutch Disease
- Why it has proven so difficult to manage wealth in natural resources

Required reading 03:
Venables, Anthony J. (2016): Using Natural Resources for Development: Why Has It Proven So Difficult? In Journal of Economic Perspectives 30, pp. 161–184.

Excerpt 03 is due 8 November

5 Agriculture (16 November)

- Land tenure worldwide
- Structure & transition of agrarian systems
- Large-scale agricultural investments
- Agricultural contracts in land & labour
- Land reform

Required reading 04:
Collier, Paul (2008): The Politics of Hunger. How Illusion and Greed Fan the Food Crisis. In Foreign Affairs 87 (6), pp. 67–79.

Excerpt 04 is due 15 November

6 Development & the natural environment (23 November)

- Environment & the commons
- Main environmental issues in development: water, deforestation, air pollution, global warming
- Poverty & environmental degradation
- Common property resources & local cooperation

No excerpt due on 22 November!

Part III: The role of institutions

7 Institutions & economic organisation (30 November)

- What are institutions & what do they do?
- Informational problems
- The tragedy of the commons
- Persistence of inefficient institutions
- Markets & hierarchies
- The central planning debate
- The boundaries of the firm

Required reading 05:
Olson, Mancur (1996): Big Bills Left on the Sidewalk: Why some Nations are Rich and Others Poor. In Journal of Economic Perspectives 10 (2), pp. 3–24.

Excerpt 05 is due 29 November

8 Political, legal & fiscal institutions (7 December)

- Political regimes
- Autocracy vs democracy
- Common vs civil law
- Fiscal institutions & taxation

- Local government & governance

Required reading 06:
Petrick, Martin; Gramzow, Andreas (2012): Harnessing communities, markets and the state for public goods provision: Evidence from post-socialist rural Poland. In World Development 40 (11), pp. 2342–2354.

Excerpt 06 is due 6 December

9 Property rights & market development (14 December)

- The mystery of capital
- The informal sector
- Privatisation
- Institutions & market development
- Market liberalisation

Required reading 07:
Galiani, Sebastian; Gertler, Paul J.; Schargrodsky, Ernesto (2005): Water for Life: The Impact of the Privatization of Water Services on Child Mortality. In Journal of Political Economy 113, pp. 83–120.

Excerpt 07 is due 13 December

Part IV: Current topics in development

10 Finance & development aid (11 January)

- International financial flows
- Microfinance
- Development aid
- Effectiveness of aid
- Improving aid strategies

Required reading 08:
Ravallion, Martin (2014): On the role of aid in The Great Escape. Review of The Great Escape: Health, Wealth, and the Origins of Inequality, by Angus Deaton (Princeton University Press, USA, 2013). In Review of Income and Wealth 60, pp. 967–984.

Excerpt 08 is due 10 January

11 Culture & corruption (18 January)

- Culture & institutions
- Cultural obstacles to economic development
- Defining & measuring corruption
- Culture & corruption
- Fighting corruption

Required reading 09:
Guiso, Luigi; Sapienza, Paola; Zingales, Luigi (2006): Does Culture Affect Economic Outcomes? In Journal of Economic Perspectives 20, pp. 23–48.

Excerpt 09 is due 17 January

12 Religion & violent conflict (09 February)

- The Protestant Ethic & the Spirit of Capitalism
- Islam & economic development
- Historical sources of economic underdevelopment in Muslim countries
- Political instrumentalisation of Islam
- Theories of violent conflict
- Empirical determinants of conflict

Q&A on the lecture contents (1 February)

Essay preparation (8 February)

Essay submission date first exam period (22 February)

Essay submission date second exam period (5 April)

MK-102-EN-DI Global Food Markets

Instructor	Dr. Birgit Gassler, Prof. Dr. Ramona Teuber
Chair	Agricultural and Food Market Analysis
Contact	birgit.gassler@agrar.uni-giessen.de ramona.teuber@agrar.uni-giessen.de
Instruction mode	Online (BigBlueButton), Thursdays 08:30 – 12:00
Language	English
Prerequisites	Knowledge of microeconomics is an asset.

Examination and Grading Policy

- An 'open-book' Take-Home Assignment in which students have to provide answers to questions demonstrating economic analysis and reasoning skills. This counts for 50% of the final grade.
- A presentation (in groups) and discussion of a selected research paper focusing on current agri-food trade or agri-food system related issues. This counts for 50% of the final grade.

Course Description

This course will investigate how global food systems and international agricultural trade can contribute to achieving the goals of the 2030 Agenda for Sustainable Development (in particular SDG 2 "Zero hunger"). Therefore, we will look at past and current trends shaping the world food economy and identify key drivers of change. We will focus on the contributions of international trade and global value chains in respect of global food security. We will discuss which measures are taken at global, regional, and national levels that influence food prices and make food systems more inclusive and safe.

We will first deepen our understanding of the effects of past and current events on food supply and demand with the help of basic economic analysis. We will then look at why nations trade, what they trade, and who gains from this trade by drawing on economic concepts and models of international trade. We will analyze the welfare implications of agricultural trade policy (e.g., tariffs and quotas) and domestic food policy schemes (e.g., production subsidies and consumption taxes) using micro-economic tools. We will stress the role of consumers, emerging new technologies, and standard-setting bodies in shaping global value chains.

In this course, you will further deepen your knowledge and understanding of global food systems by independently working with scientific literature and prepare a scientific presentation. We will therefore discuss guidelines of good scientific practice.

This course will use basic economic analysis – our aim is to explain and illustrate economic principles and the effect of trade and domestic policies on global food systems. We will thus forego the extensive use of mathematics and will use graphical analysis instead.

Learning Outcomes

By the end of this semester, students

- are familiar with the global trends shaping the world food economy and can identify the key drivers of change in food value chains.
- know the potential impact pathways how agriculture, trade and global food systems can contribute to achieve the Sustainable Development Goals (SDGs).
- understand the effects of past and current events on supply and demand in global food markets in general and on food prices, food security, and food safety in particular.
- can describe the causes and consequences of international trade by drawing on economic principles and models of international trade.
- can analyze the effects and welfare implications of agricultural trade policy (e.g., tariffs and quotas) and domestic food policy schemes (e.g., production subsidies and consumption taxes) using partial equilibrium models.
- can describe how food markets are interconnected along global value chains, and know empirical evidence of the role of consumers and food standards and labels in shaping these value chains.

Course Outline

This course is split into two components: a lecture (LE) and a seminar (SE).

The lecture (08:30 – 10:00) will be a mix of online lectures (in Microsoft Teams) and blended learning. Drawing on an instructional strategy known as 'flipped classrooms' we will ask you to prepare for selected classes by reading short texts or lecture slides, which we will then discuss in our online meetings.

For the seminar (10:30 – 12:00), you will receive a research paper that you will work on in groups of three to four. We ask each group to prepare a 20-minutes presentation. You will record and upload the presentation as a video stream in ILIAS so that your fellow students can view the respective presentation in advance of the seminars (asynchronous part). In addition, a discussion on your presentation will take place in the seminar (synchronous part). Each student will receive an individual grade based on presentation and discussion performance.

Road Map:

- Introduction
- Key drivers of food markets
- Introduction to standard trade theory (comparative advantage)
- Trade and food security
- Trade policies and domestic policies
- Political economy of food prices
- Consumer behavior: acceptance of innovations
- Food standards and labels
- Globalizing food systems

Course Materials

are based on the following books:

- Koo, W.W. & Kennedy, P.L. (2005). International Trade and Agriculture. Blackwell Publishing.
- Krugman, P.R., Obstfeld, M., & Melitz, M.J. (2018). International Trade: Theory & Policy, 11th Edition, Harlow, UK: Pearson Education
- Reed, M. (2016). International Trade in Agricultural Products, CreateSpace Independent Publishing Platform.
- Swinnen, J. (2018). The Political Economy of Agricultural and Food Policies, Palgrave Studies in Agricultural Economics and Food Policy.

We will also draw from selected scientific articles and online sources – these will be highlighted on the lecture slides.

MK-109-EN-DI Climate Change & Economic Development

Instructor	Dr. Michael Hübler
Chair	Agriculture, Food and Environmental Policy
Contact	michael.huebler@agrar.uni-giessen.de
Instruction mode	Lecture videos + script (StudIP, on-demand/asynchronous), students' presentations (MS Teams, synchronous), consulting via email, telephone, webconference (synchronous)
Language	English
Prerequisites	Basic knowledge in economics and/or political or social sciences, knowledge in other disciplines, such as engineering, are also helpful

Examination and Grading Policy

Tasks: Each student of the module is required to write a seminar paper and prepare a presentation to pass the course successfully. It is possible to work individually (alone) or in a group of two or three students. The seminar paper should be written in the form of a literature review of 10-12 pages per person (including title page, reference list, appendix and everything else). Students are free to write in English (or German), the topic for the seminar paper must be chosen among one of the ten topics listed below. Alternatively, students can choose another related topic.

If students decide to work in a group, they should make sure that the work is divided equally. In order to prove that at the beginning of each section of your paper, you should write the name of the author with the main responsibility for this section. For guidelines on reference style, structure etc. see the separate pdf in StudIP. You may also check, e.g.: https://www.elsevier.com/journals/ecological-economics/0921-8009/guide-for-authors. Each participant will give a 10-12 min. presentation of her/his part in English, followed by a group discussion (in English). The outline of the paper and the reference list must be presented at the end of each presentation.

Overall, the final grade will consist of the marks for the presentation, including active participation in the lectures and discussions (50 %) and the seminar paper (50%).

Course Description

Each topic can be treated in a general way dealing with different countries and regions, or in a specific way focusing on one or two countries or regions, for example, Southeast Asia (Vietnam, Cambodia etc.), China, Northern Africa, Sub-Sahara Africa, Latin America etc. Other interesting or more specific topics can be suggested and discussed with us. Importantly, topics should be specific

and not too broad. The references shall provide a starting point. Further references can be found within these articles or via web search (for example, Google Scholar). It is not mandatory to work on all references listed below a topic. And it is a good idea to screen the literature for other seminar topics too.

Learning Outcomes

By the end of this semester, students

- are aware of the international challenges in dealing with climate change,
- understand the climate change risks in different developing regions,
- are able to discuss the potential of climate change mitigation and adaptation strategies and ways to implement and finance them.

Course Outlines

Successfully tackling climate change crucially depends on emissions reductions in emerging and developing countries. At the same time, emerging economies like China and India grow fast so that their carbon emissions increase. The challenge is to decouple economic growth and resource use. Other countries like Sub-Sahara African countries are stuck in poverty and will additionally be hit by climate change. The challenge is to lift those countries to a more promising development path. Moreover, coastal regions and islands are at risk of flooding, so life might become impossible there.

Against this backdrop, the first necessary step is to get a clear picture of these risks in different developing regions. The second important step is to think about the potential of climate mitigation and adaptation measures to reduce these risks. One can, for example, think about different climate policy schemes and their impacts on developing countries under fairness aspects, ways to finance the expansion of renewable energies in developing countries, or ways to finance adaptation projects. Since developing countries lack advanced technologies, we also need to think about market-based mechanisms of international technology diffusion and possible policy instruments to support technology transfer. These instruments are, for instance, green technology funds, a future Clean Development Mechanism or intellectual property rights.

Time Schedule

- Asynchronous lectures, choosing a topic and forming working teams at the beginning of the semester,
- development of the seminar paper outline, writing the paper, preparation of the presentation during the middle of the semester,
- students' presentations starting at the middle proceeding towards the end of the semester,
- submission of the seminar paper before the end of the semester,
- details will follow online in StudIP.

MK-112-EN-DI International Economics

Instructor	Prof. Dr. Jürgen Meckl, Marius Braun (M.A.)
Chair	Economics and Business Studies
Contact	
Instruction mode	Lecture via videos (asynchronous; ILIAS) Tutorials via MS Teams (synchronous), Wednesday 10:15 – 11:15 am (details see below)
Language	English
Prerequisites	Access to StudIP and ILIAS

Examination and Grading Policy

There will be a single final exam (no intermediate tests) in form of a term paper.

Course Description

This course is a module of both the BSc-Programme „Economics" and the MSc-Programme "Sustainable Transition". The course has both a theory and a policy perspective focusing on four central aspects of international economics, especially international trade: trade patterns, gains from trade, distributional effects of globalization, and design of trade policy. The course does not cover topics from the field of international monetary economics.

The course is organized as lectures with integrated tutorials. You have to register for the module on StudIP. Course materials including a set of web-based trainings complementing the lectures/tutorials will be available on ILIAS (approach ILIAS via StudIP).

- Lectures: Face-to-face lectures that will be additionally available as (asynchronous) videos on the platform ILIAS for the materials of each week (cf. the Time Schedule below); live lectures are scheduled for Thursday, 12:15 - 1:45pm, starting on Thursday, October 21, (CW 42); instructor: Jürgen Meckl;
- Tutorials: Live tutorials via MS teams to work out problems of the problem set each week on Wednesdays, 10:15 - 11:45 am, starting on Wednesday, October 20 (CW 42); instructor: Marius Braun;
  Note: Tutorials in the first two weeks are for refreshing the basics in microeconomics that are essential for the class.
  Please prepare for the tutorials on basis of the Problem Set according to the time schedule below!

- Access for all materials (videos, set of slides, problem sets, ect.) requires registration for the class on StudIP

We will provide the following lecture materials:

- A complete set of lecture slides will be available successively on StudIP starting in calender week 42; a set of problems for the tutorials will be available on StudIP
- Lecture videos will be available successively for streaming on ILIAS from October 20, 2021 to March 31, 2022; videos will be available for 4 weeks starting two days after the face-to-face lectures corresponding to the time schedule given below; access to videos will be restored again 4 weeks before the final exam.
- **Note**: All this material is for your personal use in the module "International Economics" only. You are not allowed to distribute that material to others or to share it via the internet!
- **Note**: No additional materials will be handed out w.r.t. the tutorials. Please make sure to attend all tutorials to collect all notes needed!

There will be a single final exam (no intermediate tests), either in form of a written exam (BSc Economics) or a term paper (MSc Sustainable Transition).

Learning Outcomes

By the end of this semester, students

- have basic knowledge of theories of international trade and trade policies including their methodological, decision-theoretic and mathematical foundations and historic development;
- are able to interpret and critically discuss simple models from this field;
- have computational skills necessary for handling such models and to apply them to analyse real-world problems.

Course Outlines

1. Introduction

1.1 Topics in International Economics

1.2 Some Stylized Facts on International Trade

1.3 Historical Evolution of Trade Theories

2. International Trade Theory

2.1 The Principle of Comparative Advantage

2.2 Labor Productivity and Comparative Advantage: the Ricardian Model

2.3 Specific Factors and Income Distribution: the Specific-Factors Model

2.4 Factor Endowments and Trade: the Heckscher-Ohlin Model

2.5 New Trade Theory, Intrasectoral Trade, and Firms in the Global Economy

3. International Trade Policy

3.1 The Instruments of Trade Policy

3.2 Analysis of Trade Policy: Partial-Equilibrium Approach

3.3 Analysis of Trade Policy: General-Equilibrium Approach

3.4 Controversies in Trade Policy

Literature

The class heavily draws on the following textbooks:

- Krugman, Paul R., Maurice Obstfeld und Marc J. Melitz (2017), International Trade: Theory and Policy, 11th ed., Addison Wesley: Boston/MA.
- Feenstra, Robert C. und Alan M. Taylor (2021), International Trade, 5th ed., Worth Publishers: New York.

A complete set of lecture slides containing additional information on the literature will be available on StudIP.

Time Schedule

Week (CW)	Lecture	Tutorial
1 (42)	Chap. 1	Microeconomic Basics
2 (43)	Sec. 2.1 & 2.2	Microeconomic Basics
3 (44)	Sec. 2.2 (contd.)	Problem 1
4 (45)	Sec. 2.2 (contd.)	Problems 1 (contd.) & 2
5 (46)	Sec. 2.3	Problems 2 (contd.) & 3
6 (47)	Sec. 2.3 (contd.)	Problem 3 (contd.)
7 (48)	Sec. 2.4	Problem 4
8 (49)	Sec. 2.4 (contd.)	Problems 4 (contd.) & 5
9 (50)	Sec. 2.5	Problems 5 (contd.) & 6
10 (2)	Sec. 2.5 (contd.)	Problem 7
11 (3)	Sec. 3.1	Problems 7 (contd.) & 8
12 (4)	Sec. 3.2	Problems 8 (contd.) & 9
13 (5)	Sec. 3.3	Problem 9 (contd.)
14 (6)	Sec. 3.4	Exam preparation
15 (7)	Sec. 3.4 (contd.)	Q&A session

MK-123-EN-DI Transdisciplinary Sustainability Research

Instructor	Prof. Dr. Jasmin Godemann und Vera Lange
Chair	Communication and Engagement in Agriculture, Nutritional and Environmental Science; Department of Consumer Research, Communication and Food Sociology,
Contact	Vera.lange@fb09.uni-giessen.de
Instruction mode	The teaching consists of synchronous lectures and self-study
Language	English
Prerequisites	Proficiency in English

Examination / Course Requirements

- Term paper about the transdisciplinary project (7-10 pages)
- An oral presentation about a research method (10-15 minutes)

The module grade is composed of 50 per cent oral presentation and 50 per cent portfolio.

Late Work Policy / Missed Exams

Term paper (10 pages)

Course Description

Even though the importance of sustainable development and the Sustainable Development Goals are increasingly acknowledged and accepted throughout society, we still need to identify tangible ways it can be implemented in practice. The course provides a general introduction to the theory and methodologies of sustainability research and it will show how transdisciplinary approaches can deliver better solutions in practice.

The course is structured in three main parts: I) origins of sustainable development and the core idea of sustainable research. Using international and regional cases to provide active student participation and critical reflection II) Introduction to inter- and transdisciplinary research and collaboration. Students will look at the process of transdisciplinary collaboration and investigate the use of specific tools and methodologies which can apply to various sectors III) Social science methods are important in transdisciplinary projects. Students explore how empirical methods are used to achieve solutions in the field of sustainable development.

Learning Outcomes

Upon successful completion of this course, the students

- gain a comprehensive, interdisciplinary perspective on sustainability science: its theory, research horizons, and practical applications,
- understand how multiple disciplines contribute to the understanding of interactive social-environmental systems and to the capacity for guiding such systems in a transformation toward sustainability,
- gain insight into the possibilities and limitations of research and its role in society,
- are able to critically assess and approach current challenges for sustainable development from various perspectives,
- are able to demonstrate the ability to integrate knowledge and gain specialised methodological knowledge for transdisciplinary research
- develop communication skills required for participation in inter- and transdisciplinary teams.

Course Outlines

- Origins of the concept of sustainable development and its challenges,
- Applications across regions will be woven into discussions,
- Core ideas of sustainability science,
- Social-environmental systems as complex systems,
- Understanding of inter- and transdisciplinary research and collaboration,
- Research methods for transformative sustainability research,
- Challenges of knowledge integration and linking knowledge with action for sustainable development,
- Role of communication in transdisciplinary research and transformation processes.

Literature

The lecturer will provide presentations and additional literature during the semester.

Time Schedule

- Synchronous lectures are delivered at a **scheduled time each week** (regular attendance and active participation); Joining StuIP/ ILIAS to attend lectures
- Self-study (Repetition of the contents and preparation for the following lectures)

Profile Modules

MK-002-EN-DI Applied Statistics

Instructor	Prof. Dr. Matthias Frisch
Chair	Biometry and Population Genetics
Contact	matthias.frisch@agrar.uni-giessen.de
Instruction mode	Videoclips (on-demand/asynchronous) Question and answer sessions via Jitsi (synchronous)
Language	English
Prerequisites	-

Examination and Grading Policy

Grading is based on either three graded exercises (one for every to topics of the course) during the semester or a take-home exam or an oral examination conducted via videochat after the lectures have ended. The type and duration of the examination is announced by the lecturer before the start of the semester.

Late Work Policy / Missed Exams

Graded exercises / take-home exams: Late work that is submitted after the announced due date(s) is not accepted and graded with 0 %.

Graded exercises missed due to illness: A medical certificate has to be submitted to the lecturer by students who miss one of the three graded exercises due to illness. A repeat graded exercise is offered after the end of the lectures for these students. This repeat graded exercise consists of content from all course topics without any restrictions, regardless of which graded exercise was missed.

Missed take-home exams and missed oral examinations are treated according to the examination regulations of the faculty.

Course Description

The course first provides an introduction to basic statistical methods for the evaluation of experiments such as the one- and two-factor analysis of variance and multiple pairwise comparisons. It then covers the basic principles of experimental designs in agriculture and provides examples on how to analyse different data sets. The last part of the course is dedicated to mixed linear models

which are currently applied in a wide range of research topics not only in agriculture but in other disciplines as well.

The courses consists of two hours lectures and two hours tutorials per week. The lectures cover the theoretical background of the statistical methods. The tutorials start with an introduction to the statistics software R and then build on the lectures by showing how the presented analyses are done with R. Afterwards, students are required to work on additional exercises in which more data sets are analysed.

Students can choose if they want to work on the course content individually or together with fellow students. Support is provided in written form in the Stud.IP forum throughout the course and in optional question & answer sessions via videochat.

Learning Outcomes

By the end of this semester, students

- have knowledge of statistical methods
- know the basic principles of experimental designs
- are able to analyse different types of experiments and studies using the statistics software R

Course Outlines

The main course topics are

1. Analysis of variance (ANOVA),
2. Multiple comparisons and linear contrasts,
3. Balanced multi-factor analysis of variance,
4. Experimental designs,
5. Matrix algebra, and
6. Mixed linear models.

Literature

A course script is provided by the lecturer. Additional literature is presented during the course.

Time Schedule

A time schedule is provided at the beginning of the semester.

MP-163-EN-DI Python for Environmental Scientists

Instructor	Dr. David Windhorst
Chair	Prof. Dr. Lutz Breuer
Contact	david.windhorst@umwelt.uni-giessen.de
Instruction mode	Synchronous (BigBlueButton) & asynchronous
Language	English
Prerequisites	None

Examination / Course Requirements

Success in the course will be evaluated by completing assignments (50%) and oral presentation (50%). There are no explicit course requirements.

Late Work Policy / Missed Exams

Failed assignments can be revised within 4 weeks.

Course Description

The 2 weeks block course is meant to get students from not knowing how to program with Python at all, to being able to use the pandas library to work with data and prepare figures with matplotlib. The topics are taught in a universal way, so that their application is not restricted to environmental science. The title is meant to refer that this course covers things, that are useful when working in environmental science and is less about environmental science itself.

Learning Outcomes

The students:

- understand the basic concepts of Python,
- can work with data from different sources and formats,
- know common scientific Python packages and what they are used for,
- can perform basic time series analysis,
- can create graphics using environmental data,
- can perform basic statistics in Python.

Course Outlines

This is a reversed classroom course, which means that during the 2 weeks of the course the students are meant to take a look at the notebook on the day before class, watch all the videos selected by the

instructor and at least read the practice questions. In the daily online classroom, the students and instructor discuss the practice questions and then the students do the exercises on their own, but can ask the instructor at any time to help them out. This way enables the students to get the most knowledge out of their teachers.

Time Schedule

- Week 1 Python Basics
- Week 2 Python Research Tools

MP-208-EN-DI Concepts of Ecological Economics

October 16, 2023

Instructor	**Dr. Stéphanie Domptail**
Professorship	Prof. Dr. Martin Petrick (Agriculture, food and environmental policy)
Contact	Stephanie.domptail@agrar.uni-giessen.de
Instruction mode	hybrid
Language	English

Prerequisites

There are no formal prerequisites to this course.

Basic principles of economic mainstream concepts as well as an introduction to environmental economics are an interesting background if you plan to take these courses. Students in environmental sciences are also welcome and will bring in a basic understanding of current ecological issues, a second major issue of the course.

The course is held in English and will require students to read scientific papers and report on them in writing, to discuss the papers in English and to present results of their own research about one topic orally and in writing. Thus, students must possess a good command of English in reading, speaking and writing as well as a good command of scientific writing.

Time Schedule and participation:

- Weekly, Mondays from 8:30 to 12:00
- Online via Blue tooth (link in StudIP) and in presence in seminar room S4 of the Zeughaus.
- Synchronic : meaning that students need to take part in the class at the teaching hours online or in presence for the entire time
- Functional microphone is an absolute necessity
- Cameras of online participants are necessary and shall be turned on during the entire course, unless discussed ahead with the lecturer.
- The first meeting is on the 17.10.2022 at 8:30.

Course Description

The course introduces the students to key socioeconomic concepts and theories in ecological economics. Together, we will discover and read seminal ecological economics papers and authors and engage in the attempt of ecological economics to reduce inequalities and foster sustainability by improving the man-nature relationship. Reading, writing and discussing are the key activities during this phase. After learning a series of key concepts for thinking about our economy, the course introduces methods of analysis via the seminar contribution that the students will have prepared. Finally, students will apply all gained theoretical and methodological knowledge to the analysis of a case study.

Learning Outcomes

- You will have profound insights into current trends in ecological economics
- You will engage with the concept of sustainability and be able to critically address the complexity of our current ecological crises
- You will have a thorough understanding of different concepts of evaluation, socioecological perspectives and economic systems
- You will gain a holistic perspective on local and global ecological problems
- You will have trained your analytical abilities and increased your capacity to analyze and solve multidimensional problems
- You will foster and improve your presentation abilities
- You will receive and give constructive peer-feedback

Examination/ grading

The final grade is composed as shown in the table below:

Work to be submitted	Deadline	Points	Grade
Mini essays to questions of understanding on selected scientific papers	Every week until mid-term test Fill directly in ILIAS	25%	Individual grade
Lecture input (presentation or video)	Due on the day of your topic (upload them in STUDIP on the day of your presentation)	50%	Group grade
Animation of a discussion round about your topic	Due on the day of your topic (take notes of the discussion points in the groups and upload them in STUDIP)		
Submission of a written summary about your method	Due one week before your session. (Upload in STUDIP – accessible to all)		
Submission of a case study analysis	Deadline TBA. Uploaded in ILIAS as an exercise (not accessible to all)	25%	Individual grade

Course Outline (subject to modifications, adaptations)

		Introduction
1	17.10	**Course start**: modalities, overview of program and presentation of the topics for group project. Group expectations. Roundtable discussion to get everyone to know one another.
		Theory
2	24.10	**Session 2: Ecological economics: What is ecological economics? Comparison to Environmental Economics and future trajectory** **Finalize groups for project work**
3	31.10	**Session 3: Weak and strong sustainability: concept of substitutability**
4	7.11	**Session 4: Economics within earth's boundaries**
5	14.11	**Session 5: Languages of valuation and monetary values**
6	21.11	**Session 6: On Commensurability of values and decision-making**
7	28.11	**Session 7: Degrowth**
8	5.12	**MID TERM TEST ad recap – no grade.**
		Methods
9	12.12	**Method 1: Multi-criteria analysis of scenarios** **Introduction to the case study: land use in the Okavango**
10	19.12	**Method 2: Valuation of ecosystem services and application to Payment for Ecosystem Services or REDD –** critical account and limits/risks in application
11	9.01	**Method 3: Political ecology and languages of valuation**: Possibility to present one case study from literature or the case of Dännerode Forest (Vogelsberg).
12	16.01	**Method 4**: **Sustainability assessments based on resource-accounting tools:** application to the analysis of the metabolism of local food systems
13	23.01	**Method 5**: **Ecological Unequal Exchange**: the role of trade in defining equity in global north-global south players. Possible application to Climate change
14	30.01	**Method 6: Assessment of well-being: socio-ecological and feminist indicators** Application of alternative indicators to one or two cases of your choice
		Finalizing and applying
15	7.02	**Evaluation + questions + Feedback**
	10.02	Deadline for handing in the case studies.

Requirements

1. Mini-Essays and Learning from reading material (scientific papers):

• Individual readings, **weekly.**

• Individual: Answer questions of understanding: Submit your answers to given questions about the reading material. Three answers will be selected randomly and graded with feedback to you for the graded exercises. **Graded (1/4 of total grade).**

• Individual: Prepare (at least) one interesting questions weekly on the ILIAS white board to start a discussion in the plenary or the group. Individuals will be asked randomly to contribute a question as a starter for a discussion. Focus the questions on concepts from reading material.

• Oral discussion: Contribution to the live discussion and attempt to use the concepts used in the reading material. Use your group to learn collectively. (+1 point for active continuous participation).

2. Project work: Presentation of a method/theory of ecological economics and its application to a case of your choice Group work **(graded – 1/2).**

Introduction of a method and its application to a case of your choice using three tools:

- An input (presentation or video)
- A discussion round
- A written summary of the method and its application potential. This needs to be submitted 6 days in advance of the presentation and should be read before the class by the rest of the class participants.

3. Individual analysis: Analysis of a case study: (graded work 1/4)

• Submit a written essay of 1,5 page maximum in which you will

- Present the key features of the case study
- compare methods which come into question for the analysis of this case
- and propose a method (or a combination) for the analysis of the case. Justify the appropriateness.

Late Work Policy / Missed Exams

1. Mini essays. There is no possibility to submit mini-essays after deadline. However, there are 6 essays to be written and only 3 will be graded (dates at which an essay of a specific student is picked is prefixed through a random picking process).
2. There is no alternative to present the lecture input at another date than initially planned (or only in exceptional and well justified cases).
3. There is no late submission option for the case study analysis.

In one of the requirements are not on time, the student will get no points for this particular requirement.

Didactic concept: Flipped classroom and peer to peer teaching

Flipped classroom means that students get to know new concepts and material by reading it themselves and not through frontal inputs. Instead the interaction with the teacher and peers is used to activate the new material and concepts in discussion, exercises or through asking understanding questions.

Peer to peer teaching means that peers play a role in teaching the material. In this case, they will support learning during the group discussions, the group work and also through the submission of learning material on a specific method.

A typical session for Part 1: theory
Offline work (in preparation of the live session):

- Participants read the reading material and answer understanding questions on ILIAS.
- They think of ONE key question they may want to discuss.

Live session:

- Organisatory questions
- Lecturer highlights main points of the readings.
- Discussion groups are organized.
- Plenary
- Time for group work (1 hour) and counselling (5-10 min per group).

A typical session for part 2: Methods:
Offline work (in preparation of the live session:

- Read the summary of the method to be presented and prepare 1 main question, individually
- Prepare own seminar input in groups

Live Session:

- Presentation of the group and discussion
- Joint discussion and summary.

Literature

The full literature and readings list will be uploaded in STUDIP 2 weeks prior to the course.

MP-211-EN-DI Agriculture, Ecosystem Functioning and Climate Change

Instructor	Prof. Dr. Rainer Waldhardt
Chair	Prof. Dr. Till Kleinebecker
Contact	rainer.waldhardt@umwelt.uni-giessen.de
Instruction mode	synchrone online on BigBlueButton
Language	English
Prerequisites	none

Examination / Course Requirements

Oral exam (50 %), oral presentation (25 %), written assignment (25 %)

Late Work Policy / Missed Exams

Form of module retake examination: Written examination

Course Description

Lectures and exercises in small groups on current and international issues of the relationship between climate change, land management, biodiversity, ecosystem processes and ecosystem services

Learning Outcomes

The students

- understand the importance of climatic conditions and effects of climate change for agricultural production and ecosystem functioning,
- understand the biochemical processes in agriculture resulting in greenhouse gas emissions and carbon sequestration,
- know how to quantify greenhouse gas emissions from agriculture on local to regional scales,
- know measures in agriculture to mitigate and adapt to climate change

Course Outlines

- Abiotic controlling factors in agriculture and for ecosystem functioning
- Biochemical processes of CO2, nitrous oxide and methane release in agriculture
- Calculation methods of greenhouse gas emissions from agriculture on various spatial scales
- Climate as driver of biodiversity change
- Climate mitigation and adaptation strategies in agriculture

- CO2 footprints of agricultural products

Literature

Kulshreshtha SN, Wheaton EE (eds), 2018. Sustainable Agriculture and Climate Change. 230 pages. SBN 978-3-03842-726. https://www.mdpi.com/journal/sustainability

Locatelli B, 2016. Ecosystem Services and Climate Change. In: Routledge Handbook of Ecosystem Services. M. Potschin, R. Haines-Young, R. Fish and R. K. Turner (eds). Routledge, London and New York, pp. 481-490. ISBN 978-1-138-02508-0. https://www. routledge. com/products/9781138025080

IPCC-IPBES, 2021: Biodiversity and Climate Change. 222 pages. https://ipbes.net/sites/default/files/2021-06/2021_IPCC-IPBES_scientific_outcome_20210612.pdf

Further literature will be provided during the course.

Time Schedule

The first lecture is on October 18, 2022, from 8:15 to 11:30 am CET, and weekly sessions (lectures and exercises) will take place from 8:15 to 11:30 am CET until January 31, 2023.

Oral presentation: December 6, 2022, from 8:15 to 11:30 am CET

Delivery of the written assignment: February 7, 2023

Oral exam: February 7, 2023

MP-218-EN-DI The Economics of Nitrate Pollution

Instructors	Dr. Bente Castro Campos, Sten Seegel
Chair	Prof. Dr. Martin Petrick
Contact	bente.castro-campos@agrar.uni-giessen.de
Instruction mode	In class and online
Language	English
Prerequisites	Very good English language skills, high-speed internet access, basic understanding of economics, phone applicable for filmmaking, critical thinking

Examination / Course Requirements

Assignments (70%)

Work progress report (30%)

Participants should have a basic understanding of economics and statistics as taught in bachelor's programmes in social sciences. They should also be able to read and understand English-language texts and follow English lessons. As the course material is provided on the Ilias platform, participants must have internet access to access the course material. For the joint ethnographic film production, students are also expected to have an interest in filmmaking. During the course, basic filmmaking skills are taught. Weekly face-to-face meetings usually takes place on Wednesdays from 10-12(noon) in person in a seminar room in the Zeughaus. Only the students of the online master "Sustainable Transition" will participate online. Exceptions for other students who do not live in Giessen can be granted on personal request.

Late Work Policy / Missed Exams

Depending on the personal needs of the students, individual solutions are worked out.

Course Description

Nitrogen is essential for plant growth but too much can cause groundwater contamination, eutrophication, loss of biodiversity, and human health issues. Agricultural activities are the main reason for nitrate pollution of soils and water sources. The course places special emphasis on the problem of nitrate pollution from the perspective of (1) environment, (2) in/formal institutions, (3) behaviours and (4) innovations. As part of a project in the framework of the course, we will link the problem of nitrate pollution to the specific case of food waste, which has a significant impact on

resource consumption and thus on the climate, of which the nitrate footprint is only one. During the course, students will work with other participants to develop a collaborative ethnographic film about food waste and its impact on the environment. Students are introduced to ethnographic filmmaking and learn to think critically. In the process of collaborative filmmaking, students learn teamwork skills. Presentation and writing skills are fostered. Students receive a holistic learning experience where not only the content but also the creative and critical evaluation of the content is central to the course.

Learning Outcomes

- Students can understand and discuss the global nitrogen problem and its relation to the environment, institutional frameworks, and behaviour.
- Students can think critically about food waste and engage artistically with the issue.
- Students can produce short ethnographic films with their mobile phones and understand and apply the basic technical and aesthetic requirements of filmmaking.

Course Outline

Part one: Nitrogen challenge
19.10. – 23.11. Lectures on different aspects of nitrogen (environment, institutions, behaviours, innovation) and learning how to produce short ethnographic films.

Part two: Food waste filmmaking
30.11. – 15.02. Production of short film sequences and joint film and exhibition.

See detailed time schedule below.

Literature

Bellemare, M. F., Çakir, M., Peterson, H. H., Novak, L., & Rudi, J. (2017). On the Measurement of Food Waste. *American Journal of Agricultural Economics*, *99*(5), 1148–1158. https://doi.org/10.1093/ajae/aax034

Castro Campos, B. (2022). The Rules-Boundaries-Behaviours (RBB) framework for farmers' adoption decisions of sustainable agricultural practices. *Journal of Rural Studies*, *92*, 164–179. https://doi.org/10.1016/j.jrurstud.2022.03.012

Heider, K. G. (2006). *Ethnographic Film: Revised Edition*. University of Texas Press. http://ebookcentral.proquest.com/lib/unigiessen/detail.action?docID=3443058

Kanter, D. R., Bartolini, F., Kugelberg, S., Leip, A., Oenema, O., & Uwizeye, A. (2020). Nitrogen pollution policy beyond the farm. *Nature Food*, *1*(1), 27–32. https://doi.org/10.1038/s43016-019-0001-5

Mariam, N., Valerie, K., Karin, D., Angelika, W.-R., & Nina, L. (2020). Limiting food waste via grassroots initiatives as a potential for climate change mitigation: A systematic review. *Environmental Research Letters*, *15*(12), 123008. https://doi.org/10.1088/1748-9326/aba2fe

OECD. (2017). *Diffuse Pollution, Degraded Waters: Emerging Policy Solutions, OECD Studies on Water, OECD Publishing, Paris, https://doi.org/10.1787/9789264269064-en.*

Vannini, P. (2020). *The Routledge International Handbook of Ethnographic Films and Video*. Routledge.

Time Schedule

	Recorded lectures *Ilias – self-paced*	Film making *10 – 12 (German time)*	Assignments
		ILIAS survey on the previous experiences of students	
Part 1: The Nitrogen Challenge and the Basics of Filmmaking			
01 19.10.		Presentation of learning objectives Outline of the semester Getting to know each other Signing the consent form	Reading →*26.10.* Heider (2006). Ethnographic Film - Chapter 4: Making ethnographic films. (p. 110 - 117)
02 26.10.	**Nitrogen as global challenge** →*02.11.* Global Nitrogen Challenge The nitrogen cycle The Haber Process & Le Chatelier´s principle European Nitrogen Assessment	Teamwork and group building Methodology Storytelling & ethnographic films Epistemological foundations	Self-learning material →*02.11.* Image composition rules Each student takes a photo that shows the nitrogen challenge based on image composition rules →*02.11.*
03 02.11.	**Nitrogen and the environment** →*09.11.* Agriculture Air-pollution Water pollution Environmental externalities	Presentation of photos Reflection and discussion	Self-learning material →*09.11.* Camera technology and sound recordings Shoot a short movie (5 min) of an interview related to a topic from the lectures on nitrogen and the environment. Decide on your roles (camera(wo)man, interviewer, interviewee). Pay particular attention to what you have learned on camera technology and sound recordings. →*09.11.*
04 09.11.	**Nitrogen and institutions** →*16.11.* Regulations of nitrate pollution Formal institutions Informal institutions	Presentation of short movies Reflection and discussion Interviews legal requirements	Self-learning material →*16.11.* Interview techniques Shoot a short movie (5 min) of an interview related to a topic from the lectures on nitrogen and institutions. Decide on your roles (camera(wo)man, interviewer, interviewee). Pay particular attention to what you have learned on the interview techniques. You can include non-members in the course by complying with the legal requirements. →*16.11.*
05 16.11.	**Nitrogen and behaviours** →*23.11.* Behavioural factors Choice theories Nudging	Presentation of short movies Reflection and discussion	Reading →*23.11.* Castro Campos (2022). The Rules-Boundaries-Behaviours (RBB) framework for farmers' adoption decisions of sustainable agricultural practices. Journal of Rural Studies, 92, 164–179. https://doi.org/10.1016/j.jrurstud.2022.03.012 Self-learning material →*23.11.* Film cutting techniques
06 23.11.	**Nitrogen and innovations** →*30.11.* Colombo Declaration International Nitrogen Initiative Innovation theories Innovations to overcome nitrate pollution	Questions & answers about the course content and the acquired knowledge about filmmaking Applying film cutting techniques	

Part II: Film project on food waste			
07	**30.11.**	Introducing the film project on food waste Defining roles in the group: 1) camera(wo)man, 2) person being filmed and interviewed, 3) person asking questions about food waste behaviour	Shoot a short film (5-10 minutes) →*07.12.* Setting: Preparing a meal and document and discuss the food waste generated in the process (kitchen)
08	**07.12.**	Watching short films Checking for constitution of meanings, interruptions (moral dilemmas, etc.), alternatives Discussion	Shoot an interpretation of the short film (5-10 minutes) →*14.12.* Ask questions about interruptions/inconsistencies, talk about them, and come up with even more questions to show diversity Setting: the same setting (kitchen)
09	**14.12.**	Watching interpretations of the short films Discussion Summary	Reading material on the different food waste themes →*11.01.*
	Break		
10	**11.01.**	Themes Food waste in agricultural value chains Food sharing Food waste in protest Food waste and poverty Other themes based on students interest	Prepare a short film on a topic linked to the selected themes (5-10 minutes) →*18.01.* *Other persons shown in the film must sign a consent form*
11	**18.01.**	Watching short films Checking for constitution of meanings, interruptions (moral dilemmas, etc.), alternatives Discussion	Shoot an interpretation of the short film (5-10 minutes) →*14.12.* Ask questions about interruptions/inconsistencies, talk about them, and come up with even more questions to show diversity
12	**25.01.**	Watching interpretations of the short films Discussion Summary	Selection of movie scenes (storyline) from the short films that you would like to be included in the collaborative film →*01.02.*
13	**01.02.**	Developing the script for the collaborative film Scene selection and reasoning Receiving information on joint exhibition	Create a poster (A3-format) for the joint exhibition →*08.02.*
14	**08.02.**	Watching the collaborative film and fine-tuning Presenting the posters and receiving feedback Preparing joint exhibition	Different tasks linked to preparing the final version of the collaborative film and inauguration of exhibition →*15.02.*
15	**15.02.**	Showing the collaborative film and inauguration of exhibition Closing session and outlook	

MP-220-EN-DI Special Topics of the UN Sustainable Developments Goals I

Instructors	Dr. Alicia Correra, Dr. Sarah Robinson, Dr. Christoph Funk
Chair	Agricultural and Food Market Analysis, Prof. Dr. Ramona Teuber
Contact	Ramona.teuber@agrar.uni-giessen.de Christoph.Funk@wirtschaft.uni-giessen.de Alicia.Correa@zeu.uni-giessen.de
Instruction mode	Online (via BigBlueButton)
Language	English
Prerequisites	Knowledge of *R* (programming language) is an asset

Examination / Course Requirements

- Presentation of a selected research paper focusing on SDGs. The student should produce a ten-minute video of their presentation for uploading. This counts for 35% of the final grade. The presentations should be produced during the seminar/exercise classes in weeks 5 through 12.
- Short written evaluation of one of the other student presentations. This counts for 15% of the final grade.
- Production of poster and accompanying video presentation. The poster will reflect one of the SDG topics covered during the course, selected from a list provided by the lecturers. This counts for 50% of the final grade and is due at the end of the semester.

Late Work Policy

If deadlines are missed the student will obtain a zero score for the assignment in question.

Course Description

This course will provide an overview of the 2030 Agenda for Sustainable Development by providing a broad overview considering three aspects.

First, we will take a broad perspective and deepen our understanding of the 2030 Agenda for Sustainable Development by providing a brief historical overview of the SDGs and their relationship to the Millennium Development Goals. We will then investigate how sustainable development can be measured using country-level indicators. We will pay particular attention to the technical steps involved in constructing these indices and the different types of data required.

Second, we introduce the nexus approach, which goes beyond the study of individual SDGs and allows flexibility in identifying important context-specific linkages between SDGs. We focus on the water-energy-food (WEF) nexus as an example of how this approach can be applied. Further, we will explore the interconnections, trade-offs and competitions, the efficiency of resource uses and synergies. Evaluation and implementation study cases will complement this learning section.

Third, we look at SDG trade-offs in food systems, focusing on the livestock sector. We examine life-cycle approaches to the evaluation of livestock production systems, based on efficiency and focussing largely on environmental impacts. We then broaden our discussion to studies of livestock production systems which attempt to include multiple sustainability dimensions, asking what approaches or methods might help us to understand and evaluate these at different scales.

Learning Outcomes

By the end of this semester, students:

- are familiar with the basic concepts of the UN Sustainable Development Goals (SDGs);
- are familiar with different types of data that can be used to measure development progress, and learn the technical steps needed to construct an index for the SDGs;
- are able to explain the added-value of a nexus approach and are familiar with the challenges that come along with a nexus approach;
- can explain the complex water-energy-food nexus and are able to critically evaluate nexus interconnections;
- can conceptualize an application in specific cases: for example in their countries/cities;
- are familiar with use of different metrics to measure production efficiency and environmental footprint in livestock production systems;
- are able to critically evaluate the social and economic trade-offs inherent in livestock production and understand how these affect SDGs;
- acquire knowledge and understanding of some of the approaches used in trade-off analysis in agriculture, using examples from livestock production.
- acquire basic knowledge of the statistical analysis programme ‘R’ and are able to produce graphics to present key data on SDGs.

Course Outlines

This course is split into two components: a lecture and a seminar class.

Lectures will be pre-recorded and made available online along with recommended reading material.

In the first four seminar classes, you will be introduced to the R programming language and given practice exercises that we will discuss together in class. In addition, we will present some online tools to arouse your interest in UN Sustainable Developments Goals and to develop exercises on these open platforms.

In weeks 5 -12 of the module, seminar classes will consist of discussion sessions based on lectures and reading material, which will be made available beforehand. Parts II and III of the course will also include some practical work using R. During this period key papers for parts II and III of the course will be set for reading by all the students. Each student will select one of these papers to present themselves (via uploaded video), and another for which they will evaluate the presentation of another student. Presentations should be uploaded by 22 December to allow time for student evaluations.

Outline

Part I Introduction to SDGs

- Introduction to the 2030 Agenda
- Getting to know the Sustainable Development Goals
- Brief history of the SDGs and relationship to the millennium development goals
- The Global SDG indicator framework
- Introduction to SDG measurement
- Constructing an Index – Methodology and Data
- SDG Monitoring

Part II The Water-Energy-Food Nexus

- Introduction to the Water-Energy-Food Security (WEF) Nexus
- The WEF Nexus Approach
- WEF context analyses
- Assessment tools for decision support
- Variations of the WEF Nexus Model
- Governing the Nexus
- Case Studies: Evaluation and implementation

Part III The SDG nexus in food systems: analysis of the livestock sector

- Introduction: 'The livestock revolution'; perception of livestock production in society and in the media.
- 'Livestock's long shadow': Life cycle assessments of livestock production; comparisons with plant-based food production systems.
- Comparative efficiency and environmental footprint of different livestock production systems.
- Beyond efficiency – a broader assessment of livestock production systems and SDG outcomes.
- Inclusive growth in the livestock sector
- Farm-level sustainability assessment and trade-off analysis in the livestock sector.

Literature

Bleischwitz, R., Spataru, C., VanDeveer, S.D. *et al.* (2018). Resource nexus perspectives towards the United Nations Sustainable Development Goals*, Nature Sustainability*, 1: 737–743. https://doi.org/10.1038/s41893-018-0173-2

de Strasser, L., Lipponen, A., Howells, M., Stec, S., Bréthaut, C. (2016). A Methodology to Assess the Water Energy Food Ecosystems Nexus in Transboundary River Basins, *Water,* 8 (2): 59. doi:10.3390/w8020059

FAO (2018). *World Livestock: Transforming the livestock sector through the Sustainable Development Goals*. FAO Rome. Online available at: https://www.fao.org/3/CA1201EN/ca1201en.pdf

Hoff, H. (2011). Understanding the Nexus. Background Paper for the Bonn 2011 Conference: The Water, Energy and Food Security Nexus', Stockholm Environment Institute (SEI), Stockholm, Sweden.

Mathys, A. (2018). Multi-indicator sustainability assessment of global food systems, *Nature Communications*. doi: 10.1038/s41467-018-03308-7.

OECD (2008), Handbook on Constructing Composite Indicators: Handbook and User Guide, https://www.oecd.org/sdd/42495745.pdf

Steinfeld, H., Gerber, P., Wassenaar, P., Castel, V., Rosales, M. and de Haan, C. (2006). Livestock's Long Shadow. Environmental Issues and Options. Food and Agricultural Organization, Rome. Online available at: https://www.fao.org/3/a0701e/a0701e00.htm

Time Schedule

	Date	Lecture	Seminar Exercises
Part I		**asynchronous**	**asynchronous**
Week 1	20/10	Introduction to *R*	Introduction to *R*
Week 2	27/10	Introduction to the 2030 Agenda	Introduction to R / Constructing an Index I
Week 3	03/11	The Global SDG indicator framework	Constructing an Index II
Week 4	10/11	SDG monitoring and the Nexus approach	Constructing an Index III
Part II		**asynchronous**	**asynchronous**
Week 5	17/11	Introduction to the Water-Energy-Food Security (WEF) Nexus and relations with SDGs	Each week: questionnaires and exercises to reinforce the gained knowledge. Students work on presentation & evaluation for uploading.
Week 6	24/11	WEF context analyses & Assessment tools	
Week 7	01/12	Variations of the WEF Nexus Model & Governing the Nexus	
Week 8	08/12	WEF case studies	
Part III		**asynchronous**	**synchronous**
Week 9	15/12	Livestock's environmental footprint	Each week: group discussion on lecture and readings. Student evaluations of presentations
	22/12	NO LECTURE	
Week 10	12/01	Beyond efficiency: livestock production and SDG 2	
Week 11	19/01	(i) Inclusive growth in the livestock sector (ii) Methods for sustainability assessment & trade-off analysis	
Week 12	26/01	Exercises in R using data on the impact of livestock	Working on R scripts
Week 13	02/02	Q&A with lecturers	Time to work on assignment (poster)
Week 14	09/02	Time to work on assignment	Time to work on assignment (poster)

MP-220-EN-DI Special Topics of the UN Sustainable Developments Goals II

Instructor	Prof. Dr. Jorge Gómez-Paredes
Chair	Prof. Dr. Ramona Teuber, Agricultural and Food Market Analysis
Contact	ramona.teuber@agrar.uni-giessen.de; jorge.gomez-paredes@zeu.uni-giessen.de
Instruction mode	Online
Language	English
Prerequisites	None

Examination / Course Requirements

The course mode of evaluation is as follows:

Formative evaluation	***Midterm evaluation***	***Final evaluation***
- Class attendance and participation: 15% - Home and in-class assignments / exercises: 45%	- Oral exam or written assignment: 20%	- Oral exam or written assignment: 10% - Practical exercise: 10%
SUM: 60%	SUM: 20%	SUM: 20%
TOTAL: 100%		

To pass the course a minimum total score of 50% out of 100% is required.

Midterm and Final evaluations may include questions form lectures and reading assignments, hence course readings are required.

Late Work Policy / Missed Exams

Assignments must be delivered through the course's learning platform or via e-mail if having trouble accessing the platform. All assignments will be graded out of a maximum score of ten (10) points. Points will be deducted from all assignments turned in late. For each day late, or part thereof, late assignment grades will be reduced by a penalty of two (2) points. Hence, after five (5) days of being late the assignment grade would be zero (0).

Absences must be excused. Unexcused absences will lower the "class attendance and participation" grade.

Course Description

Two years into the "Decade of Action"[1], we have reached a point in human history when unprecedented global environmental changes and social risks call for urgent and meaningful transformations in the way our societies and economies work.[2] Yet, there is a generalized lack of progress caused by the difficulty of dealing with these complex systems. Rather than addressing the daunting task of modifying entire systems, we should focus on understanding the dynamics and patterns of these systems and then identifying points where we can exert influences that can modify those dynamics/patterns and deliver change. In any case, we must learn to understand and deal with complexity in order to advance the achievement of the Sustainable Development Goals (SDGs).

This **6-credit course**, entitled "**Dealing with Complexity for Sustainability Transformations**" presents an introduction to some of the most pressing environmental and social issues facing humanity, as well as the notion of "sustainable development" as a way forward. To the extent possible, the course adopts a systemic and holistic approach[3] addressing:

a) a historical perspective of humanity and Sustainable Development,
b) the status and trends of phenomena that could trigger abrupt (non-linear) changes in natural and social systems (*i.e.*, "planetary boundaries" and "social boundaries"),
c) interconnections between socio-environmental issues (*i.e.*, socio-ecological systems),
d) influences across regions and countries (*i.e*., spillover effects),
e) the complex web of economic interactions and SDG nexus

Given that food systems are at the core of sustainability and touch on virtually all the SDGs, most sections of the course discuss the key role of food systems. In addition, the course includes lectures on value chain analysis and the application of Input-Output models for sustainable consumption and production assessments. There is a strong emphasis throughout the course on promoting students' critical thinking and exhorting students to rationally present and discuss their own views with their peers, with the professor acting as a moderator.

In this way, the course's ultimate aim is to prepare agents of change that will contribute to solving humanity's challenges. The latter is not only a requirement for creating a sustainable human society for the sake of future generations, but an urgent need for maintaining current global social stability and protecting ecosystems that support the livelihoods of human communities today.

[1] UN (2022) Decade of Action. https://www.un.org/sustainabledevelopment/decade-of-action/
[2] WEF (2022) Global Risks Report. https://www.weforum.org/reports/global-risks-report-2022
[3] See: "Education: Beyond a goal". *RUNAE: Revista Científica de Investigación Educativa* (article in Spanish)

Learning Outcomes

The course will give students essential knowledge for understanding today's world from the perspective of complex systems. It will touch on a wide range of issues, allowing students to:

a) get an overview of the main global challenges facing humanity,

b) get familiarized with concepts that dominate current discussions on Sustainable Development (e.g., "planetary boundaries", "Agenda 2030", "sustainable consumption and production"),

c) acquire an understanding of the underlying dynamics of some of those global challenges,

d) learn about how to grasp socio-ecological systems to propose sustainability transformations,

e) learn the basics about a macro-economic analytical tool to assess sustainability across economic interactions.

In addition, after taking the course students should have developed their:

f) critical thinking skills to reflect, research, and form opinions on debatable issues of sustainability,

g) capacity to debate common sustainability issues from multiple perspectives,

f) experience in mapping complex problems for a theoretical evaluation of challenges and solutions, and for communicating their dynamics,

g) reading skills of scientific and academic documents.

Course Outlines

The course is divided into six short units, whose contents may be subject to slight changes based on students' interests and opportunities. This units comprise:

Detail	*Content (covered topics)*
Unit 1: Introduction	
This unit will describe the course's contents, grading scheme, and class rules. It will then introduce some or the principles behind Sustainable Development and a simple tool to analyse complex systems, which will be used at different stages of the course.	Course description; let's save the planet?; principles of Sustainable Development; Sustainable Development as a normative concept and as a science of complex systems; causal diagrams and feedback loops
Unit 2: The State of the World	
This unit will give a quick view at key moments in the history of humanity, delving on events and aspects of our societies that have created many of the challenges that we face today.	The Holocene; the Neolithic revolution; socio-economic metabolism; the great acceleration; the IPAT equation; population growth; carrying capacity; the Malthusian catastrophe; the green revolution; Neo-Malthusianism
Unit 3: Planetary Boundaries	
This unit will present the latest scientific knowledge on nine global environment issues that could cause major (non-linear) changes to planetary-systems; namely, the so-called "Planetary Boundaries".	Why do we need Planetary Boundaries?; climate change; ocean acidification; stratospheric ozone depletion; loss of biosphere integrity; land systems change; freshwater use; disruption of biochemical flows; aerosol loading; introduction of novel entities
Unit 4: Social boundaries and systemic risks	
This unit will give an overview of issues that constitute risks to our social systems, the big challenge of human development in a limited planet, and the key role played by food systems.	Why social boundaries?; poverty and socio-economic inequality; "peak everything" and resource depletion; war; antimicrobial resistance; pandemics; the Fourth Industrial Revolution (4IR)
Unit 5: Sustainable Development as a solution	
This unit will delve into the history of Sustainable Development as a concept, with emphasis on the UN 2030 Agenda, and looking at how the 17 SDGs connect with the social and Planetary Boundaries. It will then discuss key socio-ecological systems that need to be addressed and transform.	Sustainable Development conferences; the SDGs; SDG interactions; the Six Transfor-mations; Green Growth; De-growth; Circular Economy
Unit 6: Social boundaries and systemic risks	
This last unit will provide a brief theoretical and practical understanding of Input-Output modelling and analysis as a tool to assess socio-environmental impacts across value chains.	Sustainable Consumption and Production; global value chains; SDG nexus; spillover effects; Input-Output models; Input-Output analysis

Literature

The course uses several information resources yet is heavily based on peered-reviewed academic literature. Main information sources are shown in the following table. Other material not mentioned in the table mainly comes from a selection of courses offered by the SDSN's SDG Academy,[4] and SDG Academy Library.[5]

Author(s)	***Title***	***Year***	***Journal / publisher***
Ford, F. A.	Modelling the environment	2009	Island Press, USA
Miller, R. E., & Blair, P. D.	Input-output analysis: foundations and extensions	2009	Cambridge University Press
Raworth, K.	Doughnut economics: seven ways to think like a 21st-century economist	2017	Chelsea Green Publishing.
Sachs, J. D.	The age of sustainable development	2015	Columbia University Press
Steffen, W., *et al.*	Planetary boundaries: Guiding human development on a changing planet	2015	Science, 347(6223), 1259855

Time Schedule

The course consists of fourteen (14) sessions, one per week, for a total of 14 weeks.

Each session consists of four (4) hours (where 1 hour = 45 minutes). All sessions include a short break in between.

The sessions take place on Tuesday from 14h00 to 18h00 (German time)

[4] See: SDSN's SDG Academy. https://sdgacademy.org/
[5] See: SDSN's SDG Academy Library. https://sdgacademylibrary.mediaspace.kaltura.com/

MP-230-EN-DI Sustainable Plant Protection

Instructor(s)	apl. Prof. Dr. Thomas Degenkolb/Dr. Tim Lüddecke
Chair	Applied Entomology
Contact	thomas.degenkolb@ernaehrung.uni-giessen.de
Instruction mode	Synchronous (Thursday Morning)
Language	English
Prerequisites	None (recommended: basic knowledge in Organic Chemistry, Zoology/Entomology, Molecular Biology, Microbiology, and Mycology)

Course Outlines

The course is divided into two parts – a lecture (approximately 10 appointments) and a subsequent seminar (3-4 appointments). Seminar attendance is compulsory for all course participants (see Examination Requirements). During the first three hours of every seminar, the PowerPoint presentations will be given, whereas the last hour is reserved for the lecture-related questions.

Examination / Course Requirements

Every student will receive a research paper or book chapter from the instructor, which provides a basis for a 10-15 min presentation. This seminar talk is followed by a 5 min discussion. Those students who have to give their seminar talk on a certain date (cf. course outlines) will individually be asked to answer a number of lecture-related questions. Presentation and discussion will account for 25%, whereas the answers to the lecture-related questions will account for 75% of the final course mark. Students are asked to give a PowerPoint presentation during the seminar but to upload a PDF of this document to stud.IP by 12 pm (CET) two days before the respective talk should be given.

Late Work Policy / Missed Exams

Failure to upload the seminar talk in time will result in a time management. Students who have failed their seminar talk will be given a different research paper or book chapter by the instructor upon request. They have to give the new seminar talk in the second examination period. Those who failed to answer the lecture-related questions also have to repeat the exam in the second examination period.

Course Outlines

The course is divided into two parts – a lecture (approximately 10 appointments) and a subsequent seminar (3-4 appointments). Seminar attendance is compulsory for all course participants (see

Examination Requirements). The first three hours of each of the seminars are reserved for the PowerPoint presentations, whereas the respective last hour is reserved for the lecture-related questions.

Course Description

As an introduction to the first part of this lecture, general aspects and history of chemical plant protection will be treated. This is followed by a detailed introduction to the major classes of pesticides used for chemical control of plant diseases, i.e., fungicides, herbicides, as well as insecticides, acaricides, and nematicides. In this regard, the impact of agriculture on biodiversity and insect decline will be discussed. Precision agriculture approaches and modern screening methods for new plant-protective compounds will be dealt with in the last chapter of the first part.

The second part of this lecture is devoted to biological control agents (BCAs) of plant diseases. Macrobiological control strategies, i.e., the use of beneficial insects as well as entomopathogenic nematodes, will be introduced. This is followed by a chapter on microbiological control in plant protection. Although this part of the lecture is focussed on entomopathogenic bacteria, viruses, and fungi, other ecophysiological groups of fungi such as mycoparasitic and nematophagous fungi will be considered here. Biotechnological control approaches, i.e., the use of semiochemicals (pheromones and allelochemicals) against insect pests, will be treated in the last chapter of the second part.

The third part of this lecture encompasses molecular and genetic approaches. Future prospects for RNA interference (RNAi) and genome editing (CRISPR/Cas9) in plant protection will be discussed and compared to the use of genetically modified organisms (GMO's).

The lecture will be closed by concluding remarks on sustainable plant protection and strategies for restoring biodiversity in agricultural landscapes.

Learning Outcomes

The students

- gain a comprehensive overview of the theoretical background and applied approaches of modern, sustainable plant protection.
- will be able to work in the field of plant protection in agri- and horticulture, in agrochemical and biotechnological industry, for regulation authorities, and in in plant health service.

Selected literature

P. Jeschke, M. Witschel, W. Krämer & U. Schirmer (Eds.) Modern crop protection compounds. Third completely revised and enlarged edition, 2019. Wiley-VCH Weinheim, Germany, 1734 pp.

Websites of the Fungicide (https://www.frac.info/), Herbicide (https://www.hracglobal.com/) and Insecticide (https://irac-online.org/) Resistance Action Committees; International Herbicide-Resistant Weed Database (https://www.weedscience.org/Home.aspx)

A. E. Hajek, J. Eilenberg (Eds.) Natural enemies - An introduction to biological control. Second edition, 2018. Cambridge University Press, Cambridge, UK, 440 pp.

S. Sarrocco, A. Herrera-Estrella, D. B. Collinge (Eds.). Plant disease management in the post-genomic era: from functional genomics to genome editing. Lausanne: Frontiers Media SA, 2020. doi: 10.3389/978-2-88963-560-3

B. Mezzetti, J. Sweet, L. Burgos (Eds.) RNAi for plant improvement and protection. CABI, UK, 184 pp.

MP-247-EN-DI Land Use Change Projection with Q-GIS

Instructor	Dr. David Windhorst, Dr. Suzanne Jacobs
Chair	Prof. Dr. Lutz Breuer
Contact	david.windhorst@umwelt.uni-giessen.de
Instruction mode	Synchronous (BigBlueButton) & asynchronous,
Language	English
Prerequisites	None

Examination / Course Requirements

Success in the course will be evaluated by completing assignments (8-10 pages in total). There are no explicit course requirements.

Late Work Policy / Missed Exams

Failed assignments can be revised within 4 weeks.

Course Description

This course is meant to get students from not knowing anything about Q-GIS, to being able to use it for a basic land use change analysis in combination with Google Earth Engine. The materials consists of Jupyter notebooks followed by a first own project. Those contain explanations, videos and exercises. All data for the exercises is also stored in a repository. Part 1 is about Q-GIS basics, part 2 tackles land use analysis in Q-GIS with Google Earth Engine data and part 3 is about using the Google Earth Engine via the Python API.

The intended way to teach this course is the following: The students are meant to take a look at the notebook on their own. They have to watch all the videos and do all the exercises provided by the instructor. There are weekly Q&A sessions (each session lasts approximately 2 h) where students can ask questions about the course in the group and can get support when struggling with exercises.

Learning Outcomes

The students

- have mastered the basics of QGIS,
- can work with spatial data from different sources and formats,
- can perform landscape analyses with Q-GIS and develop land use scenarios based on these analyses,
- can develop spatial algorithms with Google Earth Engine.

Course Outlines

In addition to the online material, four mandatory joint online events (introduction, meeting after Notebook 1, meeting after Notebook 2, presentation of project ideas; each event lasts approximately 3 h) are planned, and further complemented by voluntary Q&A-sessions is offered weekly during the semester.

Literature

For further reading, we recommend the following course material:

- https://github.com/ucdavisdatalab/Intro-to-Desktop-GIS-with-QGIS (published under GNU Public License)
- https://github.com/google/earthengine-community (published under Apache-2.0 license, same as this repository)
- https://github.com/csaybar/EEwPython (published under Apache-2.0 license, same as this repository)

Time Schedule

- Week 1 - 4 Notebook 1 QGis
- Week 5 - 6 Notebook 2 QGIS with Google Earth Engine
- Week 7 Notebook 3 Google Earth Engine via the Python
- Week 8-12 Own Project

MP-252-EN-DI Sustainable Water Management

Instructor	Dr. Iskandar Abdullaev, Dr. Aliya Assubayeva
Chair	Centre for International Development and Environmental Research
Contact	Iskandar.Abdullaev@zeu.uni-giessen.de, Aliya.Assubayeva@zeu.uni-giessen.de
Instruction mode	Online
Language	English
Prerequisites	It is highly advisable for students to possess a foundational knowledge of natural resources and environmental sciences. Proficiency in the English language is essential as all course materials, discussions, and assessments will be conducted in English. This includes the ability to read, comprehend, and critically engage with English texts, as well as the capacity to communicate, write, and present effectively. Furthermore, students should come with strong motivation and curiosity, as we will create during the seminars a platform for active participation in discussions, and the development of individual research and policy analysis skills through written assignments.

Examination / Course Requirements

Prerequisites

It is highly advisable for students to possess a foundational knowledge of natural resources and environmental sciences. Proficiency in the English language is essential as all course materials, discussions, and assessments will be conducted in English. This includes the ability to read, comprehend, and critically engage with English texts, as well as the capacity to communicate, write, and present effectively. Furthermore, students should come with strong motivation and curiosity, as we will create during the seminars a platform for active participation in discussions, and the development of individual research and policy analysis skills through written assignments.

Requirements

Active engagement of students in the course is crucial, and we anticipate your participation in the following ways:

- Students are expected to attend seminars regularly and come prepared to discuss assigned articles and case studies. Engage in seminars through verbal contributions, group discussions, and by sharing thoughts in the chat.
- Independently work on and submit a written assignment, following the guidelines below.
- Deliver an oral presentation of your written assignment toward the end of the semester. Additionally, actively contribute by posing questions during your peers' presentations.

Please note that there will be no final examination at the end of the semester. Your assessment will primarily depend on your active participation, written assignment, and oral presentation.

Grading

The final grade consists of two components:

- *Written Assignment*: 50% of the final grade, evaluated based on adherence to assignment guidelines and timely submission.
- *Oral Presentation*: 50% of the final grade, assessed based on compliance with presentation guidelines and meeting the submission deadline.

Please note that we will require you to register for the exam by **11th December** by filling out the form in the StudIP course page.

Guidelines for the written assignment

The objective of the written assignment is to encourage students to engage in independent research within the scope of the course topics. Students are expected to write a country report delving into several relevant course topics, synthesizing the information to provide an in-depth analysis of a specific country or river basin.

Please note that this assignment is intended to be completed individually, allowing each student to explore their chosen topic in-depth and showcase their research skills and understanding of the course material. The case study (country or basin) of the written assignment should be submitted before **17th November** for instructors' approval.

The written assignment on sustainable water management aims to provide a comprehensive overview of a specific country's water-related challenges, policies, and practices. The goal is to analyze the current state of water management in the chosen country and propose recommendations for improvements. Choose a country that is of interest to you and has notable water management issues or successes. Ensure that there is sufficient data and information available for research.

We suggest the following structure for the written assignment:

- Introduction
- Overview of water system
- Water Management Challenges based on the seminar's topics (such as Transboundary Water Resources Management, SDG 6, and others).
- Conclusion
- References

Writing Style and Citations

- Use clear and concise language. Avoid jargon or overly technical terms unless necessary.
- Keep paragraphs and sections well-organized with subheadings for clarity.
- Properly cite all sources used in your memo, following the APA citation style.

The written assignment must not be longer than 10-12 pages incl. references. The written assignment should be correct in English spelling, punctuation, and grammar. Make sure all references are properly mentioned. The written assignment handed in will undergo a rigorous plagiarism check.

We will provide further resources (guidelines, templates) for the written assignment in the course of the semester.

Grading scheme for the written assignment:

Criteria	Excellent (15..10)	Passable (9..5)	Not passable (5..0)
The report organization	The report has a well-defined question or thesis and a logical organization.	It is orderly and has some focus. It shows serious concern with the issues dealt with.	None of the before.
Formalities	Formal guidelines are fully taken into account, the report is consistently and accurately formatted throughout, incl. tables and figures.	Consistent font size and type, as well as page layout.	None of the before.
Existing wisdom	Relevant literature is taken into account and properly cited.	It is not uninformed. Where relevant, it shows awareness of the relevant literature and it is cited.	None of the before.
Original contribution	The author articulates his position and/or findings intelligibly and carefully and relates them to the existing knowledge.	The author articulates some definite and cogent arguments in his/her own words. The author has some points.	The author fails to formulate a position or finding of his/her own or plagiarises material of others.
Language	The report is written in lucid and grammatical English.	The report is readable and minimally grammatical.	Hardly comprehensible, major English language issues.

The written assignment is **due on 17th February** and must be submitted via the ILIAS portal.

Interpretation of the grade scale: 0-4 – fail, 5-6 – sufficient, 7-9 – satisfactory, 10-12 – good, and 13-15 – very good.

Guidelines for oral presentations

Each student is required to deliver an individual presentation based on their written assignment. The presentation should be accompanied by ppt slides. The content of the presentation should cover the same points as the written assignment, including the key analysis and findings. Additionally, include one final slide with questions designed to stimulate group discussion. These questions can relate to intriguing aspects of your research, extensions of your findings, or critiques that you formulated in the reflection excerpts of your written assignment.

The schedule for presentations will be determined on **18th December 2023**, following the approval of individual assignment topics. This schedule will be communicated to all students well in advance.

The grading of oral presentations will be based on the following criteria: clarity of presentation delivery, adherence to time limit, answers to questions, and active participation in peers' presentations. Grading criteria will be similar to the written assignment.

Course Description

This course provides a comprehensive exploration of the significance of water resources policy and management within the context of sustainable development. The course delves into the complexities of water governance and management, emphasizing the interplay between social, technical, economic, and environmental factors. It addresses principles and critical aspects of Integrated Water Resources Management (IWRM), with lessons learned from the Central Asia region. The course also examines the challenges of water security and the role of water diplomacy in transboundary water management. Additionally, the course examines water management strategies under uncertainty induced by climate change and analyses the interconnectedness of water-related SDGs, identifying synergies and trade-offs to develop integrated approaches for achieving multiple sustainable development objectives.

The course objectives:

- To provide up-to-date knowledge on water resources management and water governance;
- To elaborate water-related challenges through an interdisciplinary approach, identifying synergies and tradeoffs for achieving sustainable development objectives;
- To demonstrate theoretical concepts through case studies and practical examples of water resources use and governance.

Learning Outcomes

The course will provide critical insights into contemporary water issues on a global scale with illustrations from different regions of the world. The socio-technical water management, transboundary water issues, SDGs, and water diplomacy issues. The students will be equipped with knowledge of the most up-to-date instruments, models, and methodologies.

Course Outlines

This course will be conducted **fully online**:

- Weekly seminars will be held from 16 October 2023 to 9 February 2024 on Mondays (14-18h) via the BigBlueButton platform (the links are attached in Contact Details below).
- Each seminar will be divided into two parts: the first part will consist of a presentation on the seminar topic, and the second part will involve interactive components such as group discussions, case studies, and Q&A sessions. During the second part of the seminar session, we kindly request that students turn on their cameras to facilitate active participation and engagement.

- All necessary guidelines, readings, seminar presentations, and supplementary materials will be accessible through the ILIAS platform of the course module. You can access the ILIAS module via the StudIP course page.
- The written assignment should be submitted on the ILIAS platform for evaluation.

Time Schedule

- 16th October - First day of the module
- 11th December - Register for the exam and select the topic and option of the written assignment
- 22nd & 29th January - Individual oral presentations
- 5th February - Last day of the module
- 17th February - Written assignment submission

Week 1 (16 October) - *Dr. Iskandar Abdullaev & Dr. Aliya Assubayeva*

Introduction to Water Resources Management

The teaching session devoted to the explanation of the main elements of the water resources: surface-ground, blue-green waters, and hydrological cycle. Students will be acquainted with water resources and role of water in economy, social development and political stability, water management, water governance: concepts, types and history. Moreover, water resources management: paradigms, development modes will be also introduced during the session. The case study on water sector developments in Central Asia will be also shared with students for their review and follow up discussions.

Readings (reading one of the following papers is sufficient):

- Pahl-Wostl, C., Jeffrey, P., Isendahl, N., & Brugnach, M. (2011). Maturing the new water manage-ment paradigm: progressing from aspiration to practice. Water resources management, 25, 837-856.
- Allan, J. A. (2005). Water in the environment/socio-economic development discourse: Sustainability, changing management paradigms and policy responses in a global system. Government and oppositi-on, 40(2), 181-199.
- Castaldo, C., & Malatesta, S. (2021). Water Management and Consumption Models. Atolls of the Maldives: Nissology and Geography, 77.
- Khilchevskyi, V., & Karamushka, V. (2021). Global Water Resources: Distribution and Demand. In Clean Water and Sanitation (pp. 1-11). Cham: Springer International Publishing.

Supplementary readings:

- De Stefano, L., Svendsen, M., Giordano, M., Steel, B. S., Brown, B., & Wolf, A. T. (2014). Water governance benchmarking: concepts and approach framework as applied to Middle East and North Africa countries. Water Policy, 16(6), 1121-1139.
- Vystavna, Y., Cullmann, J., Hipel, K., Miller, J., Soto, D. X., Harjung, A., ... & Gusyev, M. (2022). Bet-ter understand past, present and future climate variability by linking water isotopes and conventional hydrometeorology: summary and recommendations from the International Atomic Energy Agency and World Meteorological Organization. Isotopes in Environmental and Health Studies, 58(4-6), 311-315.

Week 2 (23 October) - *Dr. Aliya Assubayeva*

Agenda 2030 and SDG 6 (Clean Water and Sanitation)

This seminar aims to provide an in-depth understanding of sustainability and sustainable development, encompassing key frameworks such as the Millennium Development Goals and Sustainable Development Goals. Exploring the concept of spillover effects, students will engage in practical exercises using the SDG Index Dashboard and SDG6 Data Dashboard. Through these activities, participants will gain hands-on experience in evaluating and monitoring progress towards sustainable development objectives.

Readings:

- Sachs, J. D. (2015). Sustainable Development Goals (Chapter 14). In The Age of Sustainable Development. Columbia University Press.
- Sachs, J.D., Lafortune, G., Fuller, G., Drumm, E. (2023). Implementing the SDG Stimulus. Sustainable Development Report 2023. Paris: SDSN, Dublin: Dublin University Press, 2023. 10.25546/102924

Week 3 (30 October) - *Dr. Aliya Assubayeva*

SDG Interlinkages – Synergies & Tradeoffs

This seminar offers a critical examination of how advancements in one area may potentially impede progress in achieving other Sustainable Development Goals (SDGs). Various frameworks for assessing these interlinkages will be presented and discussed. In a practical exercise, students will engage with the SDG Synergy tool, gaining hands-on experience in understanding and addressing the complex web of SDG interactions.

R*eadings:*

- Pradhan, P., Costa, L., Rybski, D., Lucht, W., & Kropp, J. P. (2017). A systematic study of sustainable development goal (SDG) interactions. Earth's Future, 5(11), 1169-1179.
- Taka, M., Ahopelto, L., Fallon, A., Heino, M., Kallio, M., Kinnunen, P., ... & Varis, O. (2021). The potential of water security in leveraging Agenda 2030. One Earth, 4(2), 258-268.

Week 4 (6 November) - *Dr. Aliya Assubayeva*

Water Security: From Concept to Reality

This seminar delves into the conceptualization and operationalization of water security, offering a hands-on experience with the AWDO dashboard. Practical application of water security principles within the specific context of Central Asia will be thoroughly explored and demonstrated.

Reading:

- Gerlak, A. K., House-Peters, L., Varady, R. G., Albrecht, T., Zúñiga-Terán, A., de Grenade, R. R., ... & Scott, C. A. (2018). Water security: A review of place-based research. Environmental Science & Policy, 82, 79-89.

Supplementary readings:

- Cook, C., & Bakker, K. (2012). Water security: Debating an emerging paradigm. Global environmental change, 22(1), 94-102.
- Xenarios, S., Assubayeva, A., Xie, L., Sehring, J., Amirkhanov, D., Sultanov, A., & Fazli, S. A bibliometric review of the water security concept in Central Asia. Environmental Research Letters, 16(1), 013001.

Week 5 - 6 (13 & 20 November) - *Dr. Iskandar Abdullaev*

Integrated Water Resources Management (IWRM) Principles and Instruments

The teaching session is devoted to explain the Integrated Water Resources Management. During the first part the session history, theoretical aspects of WIRM will be explained. Also, critical perspective of IWRM will be discussed. The cases will be presented in order to illustrate both challenges and opportunities of IWRM.

In the second part of IWRM, instruments of IWRM such as Water Resources Assessment, Plans for IWRM, Efficiency in Water Use, Social Change Instruments, Conflict Resolution, Regulatory Instruments, Economic Instruments, Information Exchange and Assessment Instruments will be presented in detail. The illustrations of the application of different IWRM instruments will be presented.

Readings:

- Grigg, N. S. (2016). Integrated water resource management: an interdisciplinary approach. Springer.
- Tortajada, C. (Ed.). (2017). Revisiting integrated water resources management: from concept to im-plementation. Routledge.
- Saravanan, V. S., McDonald, G. T., & Mollinga, P. P. (2009). Critical review of integrated water resources management: moving beyond polarised discourse. In Natural Resources Forum (Vol. 33, No. 1, pp. 76-86). Oxford, UK: Blackwell Publishing Ltd.

Supplementary readings:

- Srinivasan, V., Cohen, M., Akudago, J., Keith, D., & Palaniappan, M. (2011, December). Integrated Water Resources Management: A Global Review. In AGU Fall Meeting Abstracts (Vol. 2011, pp. H11F-1123).
- Ibisch, R. B., Bogardi, J. J., & Borchardt, D. (2016). Integrated water resources management: con-cept, research and implementation (pp. 3-32). Springer International Publishing.

Week 7 - 8 (27 November & 4 December) - *Dr. Iskandar Abdullaev*

Socio-Technical Aspects of Water Resources Management

In this session, social aspects and dimensions of water such as water as a social good, water and society, and water and power will be presented. The theoretical part will include boundary concepts, objects, and settings will be explained. Moreover, water and economy will be presented through an explanation of the concept of virtual water, and water footprints. The water and societies section will highlight water dependency and water as spiritual good issues. The technological innovations for water conservation and distribution will also be analyzed. The session will focus on issues of balancing human needs and environmental sustainability. The case study will be devoted to the role of informal institutions in water services in Central Asia and Afghanistan.

Readings:

- Mollinga, P. P. (2014). Canal irrigation and the hydrosocial cycle: The morphogenesis of contested water control in the Tungabhadra Left Bank Canal, South India. Geoforum, 57, 192-204.
- Beal, C. D., Bailey, M. S., Hohenhaus, M., & Jackson, M. (2023). Community-based water demand management: socio-technical strategies for improving water security in Australian Indigenous commu-nities. Environmental Research: Infrastructure and Sustainability, 3(2), 025006.

- Abdullaev, I., & Mollinga, P. P. (2010). The socio-technical aspects of water management: emerging trends at grass roots level in Uzbekistan. Water, 2(1), 85-100.
- Gebler, M., Juraschek, M., Thiede, S., Cerdas, F., & Herrmann, C. (2022). Defining the "Positive Im-pact" of socio-technical systems for absolute sustainability: A literature review based on the identifica-tion of system design principles and management functions. Sustainability Science, 17(6), 2597-2613.

Supplementary readings:

- Ghazouani, W., Molle, F., & Rap, E. (2012). Water users associations in the NEN region: IFAD inter-ventions and overall dynamics. Draft, submitted to IFAD.
- GC19, R. K. (2016). Multiple Use Water Systems and Micro-Irrigation Technologies for Koshi Basin–Lessons from Gandaki Region, Nepal. The Water-Livelihoods-Gender Nexus to Advance Koshi Basin Management, 77.

Week 9 (11 December) - *Dr. Iskandar Abdullaev*

Water Management under Uncertainty: Climate and Water

The teaching session will be devoted to the phenomenon of climate change, its impact on water resources, socio- economy, political, and other potential issues related to the impact of climate change on water resources formation, use, and development. The session will focus on new levels of uncertainty in water planning and management processes due to climate change. The students will also receive information on water-related extreme events such as droughts and floods are increasing. The practical session will be devoted to the case study on Climate Change and Energy Development in Central Asia.

Readings:

- Vorosmarty, C. J., Green, P., Salisbury, J., & Lammers, R. B. (2000). Global water resources: vul-nerability from climate change and population growth. science, 289(5477), 284-288.
- Marston, L. (2022). Water use in a changing world. Nature Climate Change, 12(4), 317-319.
- Raneesh, K. Y. (2014). Impact of climate change on water resources. Journal of Earth Science & Cli-matic Change, 5(3), 1.

Supplementary reading:

- Arnell, N. W. (1999). Climate change and global water resources. Global environmental change, 9, S31-S49.
- Umirbekov, A., Akhmetov, A., & Gafurov, Z. (2022). Water-Agriculture-Energy Nexus in Central Asia through the Lens of Climate Change.

Week 10 & 13 (18 December & 8 January) - *Dr. Iskandar Abdullaev*

Transboundary Water Resources Management

This session will be devoted to transboundary, international water issues. The lecture will highlight the main definitions of transboundary water resources, basic information on TWM, issues of conflict, and cooperation aspects will be explained. The students will receive information on the principles and peculiarities of transboundary Water Management.

As a practical examples of TWM Central Asia, Mekong and Rhine river cases will be discussed as case studies.

Readings:

- Wolf, A. T. (2007). Shared waters: Conflict and cooperation. Annu. Rev. Environ. Resour., 32, 241-269.
- Giordano, M. A., & Wolf, A. T. (2003). Sharing waters: Post-Rio international water management. In Natural resources forum (Vol. 27, No. 2, pp. 163-171). Oxford, UK: Blackwell Publishing Ltd.

Supplementary readings:

- Schmeier, S. (2010). Governing international watercourses-perspectives from different disciplines: A comprehensive literature review. Hertie School of Governance Working Paper, (53).
- Fritzsche, K., Issayeva, G., Maas, A., & Rüttinger, L. (2016). Climate change and the wa-ter-energyagriculture nexus in Central Asia. Scenario workshop background paper.

Week 14 (15 January) - *Dr. Aliya Assubayeva*

Water Diplomacy: Bridging Hydropolitics, Law, and Cooperation

This seminar serves as an introduction to the political dimension of water, offering foundational definitions of key concepts including hydropolitics, international water law, water conflict, and water cooperation. It explores the interplay between conflicting and cooperative dynamics in the management of water resources, providing students with a comprehensive understanding of the complex political landscape surrounding this critical resource.

Readings:

- Zeitoun, M., & Warner, J. (2006). Hydro-hegemony–a framework for analysis of trans-boundary water conflicts. Water policy, 8(5), 435-460.
- De Stefano, L., Edwards, P., De Silva, L. and Wolf, A.T. (2010) Tracking cooperation and conflict in international basins: historic and recent trends. Water Policy, 12(6): 871–884.
- Sehring, J., Schmeier, S., ter Horst, R., Offutt, A., & Sharipova, B. (2022). Diving into Water Diplomacy–Exploring the Emergence of a Concept. Diplomatica, 4(2), 200-221.

Weeks 15 & 16 Student presentations (22 & 29 January)

In these seminars, students will take turns presenting their respective country reports, offering insights into their chosen nation's approach to sustainable water management. Following each presentation, active participation is encouraged as students engage in a constructive discussion, providing feedback and exchanging perspectives on their peers' work.

Week 17 Course Wrap-up and Future Perspectives (5 February) - *Dr. Iskandar Abdullaev & Dr. Aliya Assubayeva*

In the final seminar, we will consolidate the insights gained from our exploration of case studies in sustainable water management. We will engage in a critical discussion, examining the implications and potential future directions in this crucial field. This seminar offers a reflective and forward-looking perspective on the evolving landscape of sustainable water management.