Faculty of Economics and Management Science
Institute for Infrastructure and Resource Management

Jun.-Prof. Dr. Paul Lehmann

UNIVERSITÄT LEIPZIG

Integration Module „Sustainability Trade-offs“

Syllabus

Winter Term 2021/22

By means of the Integration Module, students will learn to integrate methodological skills with specialized knowledge. Cooperation in small groups of students will improve learning and increase the quality of the outcomes.

This year’s Integration Module focuses on the topic “Sustainability Trade-offs”. Public decisions on government regulation, spending and investment often affect different dimensions and objectives of sustainable development simultaneously positively as well as negatively. It is therefore a prime challenge for public decision-making to understand possible trade-offs (and synergies) regarding different sustainability objectives, and to develop strategies to mitigate these trade-offs (and strengthen synergies). These challenges will be examined in the Integration Module using different case studies for sustainable development. Students will examine these challenges by analysing case studies in small research groups.

Please read the following information and instructions. In case of any questions or uncertainties about the organization or contents of the course, please address these during the introductory sessions.

Thematic background and steps of analysis

Current patterns of economic development, production and consumption have led to an overuse of limited natural resources. As a consequence, mankind currently faces a multitude of environmental challenges, such as climate change, loss of biodiversity, degradation of soils or pollution and overexploitation of water bodies. Similarly, social challenges prevail, such as income inequality, or lacking access to basic water, sanitation, energy, or communication services. Consequently, societies need to embark on a transition towards sustainable development in a variety of sectors, such as energy, water, transportation, agriculture, or finance. Such development needs to account simultaneously for environmental, social and economic concerns of present and future generations.

Yet, taking societal decisions to foster the transition towards sustainable development is often a non-trivial task. When taking such decisions, decision-makers often face trade-offs. A trade-off occurs if a decision affects one dimension or aspect of sustainability positively but another negatively. In many instances, such trade-offs are inevitable. This can be illustrated by many examples. The deployment of renewable energy sources is an important means to decarbonize the energy sector. Yet, renewable energy sources also generate adverse environmental impacts, e.g., if bioenergy crops are produced with intensive use of fertilizers, or if wind turbines affect

local residents or bird and bat populations negatively. The designation of protected areas may foster biodiversity conservation. But it may also restrict the opportunities of local populations to develop economically. The extension of infrastructure, e.g. water and energy networks, or roads, may be a perquisite for regional economic development. However, it also disturbs local ecosystems. Banning glyphosate in agriculture may reduce the pollution of groundwater. But it may require more intensive means of tillage leading to issues of soil compaction, and it may result in overall higher food prices. In order for sustainability transitions to succeed, strategies are required to manage such trade-offs.

To develop a strategy to manage sustainability trade-offs, three steps of analysis need to be considered:

First, sustainability trade-offs need to be identified and assessed properly for a specific decision problem (**impact assessment**). This requires disentangling different objectives or criteria for sustainable development. Helpful classifications may involve, for example, the fundamental differentiation of sustainable development goals (SDGs) (Fosu Nerini et al. 2017, Meletiou et al. 2019). For different purposes the idea of sustainable development has also been translated into even more specific sets of indicators, e.g., for the energy transition (BMWi 2018, Rösch et al. 2018). Another helpful approach to disentangle different sustainability impacts and trade-offs may be the concept of ecosystem services (Cord et al. 2017, Daw et al. 2015, King et al. 2015, McShane et al. 2011). A particular challenge is the assessment of remaining uncertainty with respect to the assessment of impacts on sustainability objectives and criteria.

Second, once trade-offs are understood, a procedure for an aggregate assessment across multiple relevant sustainability objectives and criteria needs to be developed. (**decision analysis**). In particular, this requires a decision how the balance and weight different sustainability criteria and objectives. For this purpose, different decision-making tools may be deployed, such as cost-benefit analyses, multi-criteria decision analyses, or deliberative approaches. All approaches exhibit strengths and weaknesses (Brondizio et al. 2010, Orchard-Webb et al. 2016, O'Neill and Spash 2000, Pascual et al. 2010, Saarikoski et al. 2016). Moreover, certain ecological (irreversibilities, thresholds) and ethical limits (basic needs) to trading off different sustainability criteria against one another need to be considered (Daw et al. 2015, Klauer et al. 2017). Similarly, issues of uncertainty may be crucial for the overall assessment (Weitzman 2011).

Finally, a governance system needs to be designed to manages sustainability transitions properly in the presence of sustainability trade-offs (**governance analysis**) (e.g., van Zeijl-Rozema et al. 2008). Several important questions may be addressed in this context. Which actors should take decisions (supranational, national, regional, and/or local actors; private vs. public actors)? How should decisions be taken (top-down vs. bottom-up; means of participation) (e.g., Oates 1999, Strunz et al., Strunz et al. 2015)? Which policy instruments and mixes should be used to regulate decisions of private actors (command-and-control approaches like mandates or bans, planning approaches, e.g., urban and spatial planning, market-based instruments like taxes, information provision) (e.g., Gunningham and Sinclair 1999, Lehmann 2012, Lehmann et al. 2019, OECD 2007)?

Methodological background

Different methods need to be combined to carry out research projects:

The **impact assessment** first of all requires a concept to classify and disentangle impacts along different sustainability criteria and objectives (such as SDGs or ecosystem services). To assess impacts, different approaches from social, natural and engineering sciences can be used, e.g. life-cycle assessment, economic and ecological impacts assessments.

The **decision analysis** may build on approaches like cost-effectiveness analysis, cost-benefit analysis, multi-criteria decision analysis, deliberative decision procedures. It is meant to incorporate a critical reflection on respective strengths, weaknesses, and limitations of the decision analysis approaches.

The **governance analysis** involves approaches from social sciences, such actor and institutional analysis or the evaluation of policy instruments.

Clearly, methods are manifold and additions to the aforementioned list can be made easily. Methods can be selected and applied based on their value for the projects and the capacity of the supervisors in the Integration Module to assist/facilitate its application. Moreover, the idea is not necessarily to apply the methods mentioned above anew. It may already be insightful to review and scrutinize existing studies related to the case studies.

Organization of the Module

Learning objectives

By means of the Integration Module, students will carry out an applied interdisciplinary research project on sustainability trade-offs. They will become familiar with the thematic background, acquire the methodological skills in impact assessment, decision-support and governance analysis, and apply qualitative and quantitative methodologies. Further, the students will learn to defend and refine their preliminary results and to put them in perspective with those of other students' groups.

The integration module will:

- introduce students to the concept of trade-offs related to sustainability transitions in general as well as with respect to specific case studies
- enhance methodological skills for impact assessment, decision analysis and governance analysis
- provide knowledge about the technological, environmental, economic, social and political dimensions of sustainability transitions and related case studies
- foster multidisciplinary discourse and interdisciplinary group work among students;
- provide competencies in conducting a research project (project management, teamwork, conflict management), presenting and debating the project and its findings, as well as practicing scientific writing.

Main tasks

The assignments will be carried out in groups of three. Each group is expected to work jointly on every task and distribute the workload evenly among the group members.

Groups are expected to prepare a research paper, and present and discuss interim research steps during block seminars. For both presentations as well as the final paper, students will receive a grade upon the performance of their group – group members will not be graded individually.

Each group will approach the topic of sustainability trade-offs for a specific case study. Each group is free to choose and design the case study. The case study should represent a decision-making problem which needs to be addressed in the context of sustainability transitions and which exhibits significant sustainability trade-offs. The following table provides examples.

Field	Energy and water infrastructure	Transportation infrastructure	Agriculture and nature conservation
Examples of possible case studies	• Decentralization of energy supply • Spatial distribution of wind energy • Deployment of bioenergy • Coal phase-out • Construction of dams/reservoirs • …	• Deployment of e-mobility • Development of new roads • Development of bike lanes/highways • …	• Deployment of organic agriculture • Restriction of glyphosate use • Designation of protected areas • Wolf management • …

The case study should be designed as specific as necessary, e.g., it may be tailored to a specific national or regional context. A technical criterion for the selection of case studies is the availability of studies and data which can be evaluated for the purpose of this research project.

The following points are meant to provide a rough guideline on how the research project should be organized:

1. Analyze the basic need for a sustainability transition for the specific case study.
2. Introduce an evaluation framework (set of criteria or objectives under consideration) to guide your analysis of trade-offs. Identify and assess the relevant sustainability trade-offs. Highlight remaining uncertainties.
3. Identify, analyze and discuss different methods and tools of decision analysis that could be applied to take a decision in the presence of the identified trade-offs.
4. Discuss a governance framework that could be used to promote a sustainability transition for your specific case study while mitigating the relevant sustainability trade-offs. Derive your policy recommendations.
5. Discuss the transferability of your insights to other contexts as well as open research questions.

Module assessment

The module will be assessed as follows:

- 25% for the class participation and presentations
- 75% for the final paper (75 to 100 pages)

The assessment of the projects' contents will be based on the following criteria:

- Does the project contribute to the objective of understanding and solving sustainability trade-offs?
- Does the project address all of the tasks mentioned above?
- Are the different concepts and methods of impact assessment, decision analysis and governance analysis correctly introduced, discussed and reflected upon?
- Is the discussion of the case study throughout the project consistent? Are the subsequent evaluation steps (impact assessment, decision analysis, governance analysis) reasonably put in relation to each other?
- Does the project contain both qualitative (i.e. concepts, ideas, innovations) and quantitative (i.e. assessments based on real data or substantiated estimates) elements?
- Does the project meet basic scientific standards (citation, style etc., see separate document with layout instructions)?

The final paper must be submitted electronically to lehmann@wifa.uni-leipzig.de by February 20, 2021.

Seminar dates

The seminar meetings will be held in room SR 17 on the Mondays indicated below from 13.15 to 16.45

October 11	General introduction into the analysis of trade-offs, decision analysis and governance analysis (incl. an illustrative game)
October 25	Organizational introduction, thematic introduction, group formation & allocation of cases.
November 8	Presentation and discussion of the selected case study: Characteristics and suitability for the purpose of the research project (specificity, relevance of trade-offs, availability of data)
November 29	Presentation and discussion of preliminary impact assessment and decision analysis
January 10	Presentation of the final assessment including also governance analysis

Supervisors

All supervisors are based at the Ritterstr. 12 offices (1st floor). Consultation hours are upon appointment.

Name	Email	Room
Jun.-Prof. Dr. Paul Lehmann	lehmann@wifa.uni-leipzig.de	208
Charlotte Geiger	geiger@wifa.uni-leipzig.de	210
Jan-Niklas Meier	meier@wifa.uni-leipzig.de	210
Felix Reutter	reutter@wifa.uni-leipzig.de	211
Dr.-Ing. Philip Tafarte	tafarte@wifa.uni-leipzig.de	210
Elisabeth Wolfram	ewolfram@wifa.uni-leipzig.de	210

Literature

Impact assessment and trade-offs

BMWi (2018). Sixth Energy Transition Monitoring Report "The Energy of the Future" - Reporting Year 2016 – Summary. Bundesministerium für Wirtschaft und Energie (BMWi), Berlin.

Cavender-Bares, J., Polasky, S., King, E., Balvanera, P. (2015). "A sustainability framework for assessing trade-offs in ecosystem services". *Ecology and Society* 20(1): Article 17.

Cord, A. F., Bartkowski, B., Beckmann, M., Dittrich, A., Hermans-Neumann, K., Kaim, A., Lienhoop, N., Locher-Krause, K., Priess, J., Schröter-Schlaack, C., Schwarz, N., Seppelt, R., Strauch, M., Václavík, T., Volk, M. (2017). „Towards systematic analyses of ecosystem service trade-offs and synergies: Main concepts, methods and the road ahead." *Ecosystem Services* 28: 264-272.

Daw, T. M., Coulthard, S., Cheung, W. W. L., Brown, K., Abunge, C., Galafassia, D., Peterson, G. D., McClanahan, T. R., Omukotoi, J. O., Munyi, L. (2015). "Evaluating taboo trade-offs in ecosystems services and human well-being." *Proceedings of the National Academy of Sciences* 112(22): 6949-6954.

Fuso Nerini, F., Tomei, J., Seng To, L., Bisaga, I., Parikh, P., Black, M., Borrion, A., Spataru, C., Castán Broto, V., Anandarajah, G., Milligan, B., Mulugetta, Y. (2018). "Mapping synergies and trade-offs between energy and the Sustainable Development Goals." Nature Energy 3: 10-15.

King, E., Cavender-Bares, J., Balvanera, P., Mwampamba, T. H., Polasky, S. (2015). "Trade-offs in ecosystem services and varying stakeholder preferences: evaluating conflicts, obstacles, and opportunities." *Ecology and Society* 20(3): Article 25.

McShane, T. O., Hirsch, P. D., Trung, T. C., Songorwa, A. N., Kinzig, A., Monteferri, B., Mutekanga, D., Thang, H. V., Dammert, J. L., Pulgar-Vidal, M., Welch-Devine, M., Brosius, P., Coppolillo, P., O'Connor, S. (2011). "Hard choices: Making trade-offs between biodiversity conservation and human well-being." *Biological Conservation* 144: 966-972.

Meletiou, A., Grace, M., Darbi, M., Pham-Truffert, M., Locher-Krause, K., Rueff, H. (2019). "EU renewable energy policies, global biodiversity, and the UN SDGs." EKLIPSE Project Report, Centre for Ecology & Hydrology, Wallingford, United Kingdom.

Rösch, C., Bräutigam, K.-R., Kopfmüller, J., Stelzer, V., Fricke, A. (2018). „Sustainability assessment of the German energy transition". *Energy, Sustainability and Society* 8:12

Decision analysis

Brondízio, E.S., Gatzweiler, F.W., Zografos, C., Kumar, M. (2010). „Socio-cultural context of ecosystem and biodiversity valuation (Chapter 4)". In: TEEB, *The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations*. Edited by Pushpam Kumar. Earthscan, London and Washington.

Daw, T. M., Coulthard, S., Cheung, W. W. L., Brown, K., Abunge, C., Galafassia, D., Peterson, G. D., McClanahan, T. R., Omukotoi, J. O., Munyi, L. (2015). "Evaluating taboo trade-offs in ecosystems services and human well-being." *Proceedings of the National Academy of Sciences* 112(22): 6949-6954.

Klauer, B., Bartkowski, B., Manstetten, R., Petersen, T. (2017). „Sustainability as a Fair Bequest: An Evaluation Challenge." *Ecological Economics* 141: 136-143.

O'Neill, J., Spash, C. L. (2000). "Conceptions of Value in Environmental Decision-Making". Policy Research Brief Number 4, Cambridge Research for the Environment.

Orchard-Webb, J., Kenter, J. O., Bryce, R., Church, A. (2016). "Deliberative Democratic Monetary Valuation to implement the Ecosystem Approach." *Ecosystem Services* 21: 308-318.

Pascual, U., Muradian, R., Brander, L., Gómez-Baggethun, E., Martín-López, B., Verma, M. (2010). "The economics of valuing ecosystem services and biodiversity (Chapter 5)". In: TEEB, *The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations*. Edited by Pushpam Kumar. Earthscan, London and Washington.

Saarikoski, H., Mustajoki, J., Barton, D. A., Geneletti, D., Langemeyer, J., Gomez-Baggethun, E., Marttunen, M., Antunes, P., Keune, H., Santos, R. (2016). "Multi-Criteria Decision Analysis and Cost-Benefit Analysis: Comparing alternative frameworks for integrated valuation of ecosystem services". *Ecosystem Services* 22: 238-249.

Weitzman, M. (2011). "Fat-Tailed Uncertainty in the Economics of Catastrophic Climate Change". *Review of Environmental Economics and Policy* 5(2): 275–292.

Governance analysis

Gunningham, N., Sinclair, D. (1999). “Instrument Mixes for Environmental Policy: How Many Stones Should be Used to Kill a Bird?”. Law and Policy 21(1): 49-67.

Lehmann, P. (2012). “Justifying a Policy Mix for Pollution Control: A Review of Economic Literature”, *Journal of Economic Surveys* 26(1), 71-97.

Lehmann, P., Gawel, E., Strunz, S. (2019). „EU Climate and Energy Policy Beyond 2020: Are Additional Targets and Instruments for Renewables Economically Reasonable?”. In: Gawel, E., Strunz, S., Lehmann, P., Purkus, A. (eds.), *The European Dimension of Germany’s Energy Transition Opportunities and Conflicts*, Heidelberg: Springer, pp. 11-26.

Oates, W. E. (1999). “An Essay on Fiscal Federalism.” *Journal of Economic Literature* 37: 1120-1149.

OECD (2007). “Instrument Mixes for Environmental Policy”. OECD, Paris.

Strunz, S., Gawel, E., Lehmann, P. (2014). „On the Alleged Need to Strictly Europeanise the German Energiewende.” *Intereconomics* 49(5): 244-250.

Strunz, S., Gawel, E., Lehmann, P. (2015). “Towards a general "Europeanization" of EU Member States' energy policies?” *Economics of Energy & Environmental Policy* 4(2), 143-159.

van Zeijl-Rozema, A., Cörvers, R., Kemp, R., Martens, P. (2008). „Governance for Sustainable Development: A Framework“. *Sustainable Development* 16: 410-421.