Eberswalde University for Sustainable Development

Module catalogue

Forestry System Transformation (M.Sc.)

valid from WiSe 2021/2022

M Rethinking Environmental Economics I

Semester:	1
Module coordinator:	Prof. Dr. Carsten Mann (Carsten.mann@hnee.de)
Status:	Mandatory
Goal:	Students learn the basic economic concepts and underlying market rationales that are relevant for natural resources use and management. As an important part, they understand the dynamics of market systems and get to know the different reasons for market failures. This enables them to reflect on the development of market-based solutions for sustainable resource uses, and to distinguish solutions that range from new markets and incentive-based policy instruments to concepts that better link economic and ecological systems and processes.
Examination form	Oral exam (100%) (single exam)
ECTS-Credits:	6
SWH:	4

Module Component 1 Introduction to resource uses and economic concepts

Semester:	1
Coordinator:	Prof. Dr. Carsten Mann
Lecturer:	Prof. Dr. Carsten Mann
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (7 h), Seminar (8 h), Practical exercise (15 h), Self-study (45 h)
Max. study places	25
Language:	English
Module type	blocked

Examination form

Oral exam (50%)

Entry requirements

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Goal:

Students have a solid understanding of concepts and methods of environmental, ecological and natural resource economics. They are familiar with the dynamics of economic systems, functioning of markets, reasons for market failures and potential solutions. They are able to discuss the relevancy of these concepts for sustainable forest management and to optimise the use of forest resources, being aware of their respective chances and limitations.

Content:

- Introduction to neoclassical, environmental, and resource economics, their theoretical assumptions and fields of application, including the allocation of resources, the concept of perfect markets, dynamics of economic systems, growth orientation;
- Critically assessing the validity and limitations of the above economic theories, models and methodologies when dealing with different environmental problems;
- Deeping concepts of market failures for dealing with public goods/common-pool resources, externalities, the tragedy of the commons, and collective action;
- Elaboration of environmental economic solutions to market failures such as state interventions and private markets;
- Introduction to the foundation of ecological economics; underlying rationales and principles;
- Illustration of major environmental problems and economic trends based on case study examples with a focus on sustainable forest management and governance;
- Role game for negotiating tradeoffs and solutions.

Recommended related elective modules :

Competences :

Technical competence (50%), Methodological competence (30%), Social competence (10%), Personal competence (10%)

Literature:

- Bromley, D. W. (1991). Environment and Economy, Property Rights and Public Policy; Blackwell: Cambridge, MA, USA; Oxford, UK.
- Daly, H.E., Farley, J., 2011. Ecological Economics: Principles and Applications, 2nd ed. Island Press, Washington, DC. Chapter 10: Market Failures (pp. 165-191).
- Ehrlich, P.R., Ehrlich, A.H., Holdren, J.P., 1993 [1977]. Availability, Entropy, and the Laws of Thermodynamics, Chapter 2 in H. E. Daly and K. N. Townsend (Eds.) Valuing the earth : economics, ecology, ethics. MIT Press, Cambridge, Massachusetts, pp. 69-73.
- Gowdy, J.M., 2000. Terms and concepts in ecological economics. Wildlife Society Bulletin. 28 (1), 26-33.
- Jollands, N., 2006. Concepts of efficiency in ecological economics: Sisyphus and the decision maker. Ecological economics. 56 (3), 359-372.
- Røpke, I., 2004. The early history of modern ecological economics. Ecological Economics. 50 (3–4), 293-314.
- Spash, C.L., 2011. Social ecological economics: Understanding the past to see the future. The American Journal of Economics and Sociology. 70

(2), 340-375.
- Vatn, A., 2014. Markets in environmental governance — From theory to practice. Ecological Economics 105: 97–105.
- Wunder, S. 2015. Revisiting the concept of payments for environmental services. Ecological Economics doi:10.1016/j.ecolecon.2014.08.016.

Module Component 2 — Human wellbeing, ecosystem functions, services and valuation approaches

Semester:	1
Coordinator:	Prof. Dr. Carsten Mann
Lecturer:	Prof. Dr. Carsten Mann
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (7 h), Seminar (7 h), Practical exercise (16 h), Self-study (45 h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Oral exam (50%)
Entry requirements	-
Goal:	Students are enabled to understanding the ecosystem services (ES) concept, its rationales, and current state of its uptake in scientific research and policy mainstream. They are familiar with definitions, typologies, and frameworks that link ES to wellbeing, and recent socio-political and scientific debates for mapping, indicators & valuation. Based on case study examples, students are enabled to analyse chances and challenges of the ES concept and distinct valuation approaches for political and economic decision-making, know about the challenges to communicate to the science-policy/practice interface, and develop strategies for overcoming them.
Content:	- Understanding of the range of ecosystem functions, services, benefits, and need for trade-offs; - Knowledge of the ecosystem service concept, its history, drivers and discourses; - Distinguishing different kinds of ES costs and values; - Introduction to different kinds of valuation methods and their scope of application;

- Deepening debate on valuation and alternative approaches (multi-criteria/stakeholder);
- Discussion of Chances and challenges of the ES concept and the potential of nature-based solutions for mainstreaming;
- Introduction to governance of ES: status-quo and future implications;
- Examples of new market approaches and inventive-based policy instruments (carbon, PES, REDD+);
- Practice examples and exercises for ES assessment and valuation.

Recommended related elective modules :

Competences : Technical competence (50%), Methodological competence (30%), Social competence (10%), Personal competence (10%)

Literature:

- Ban, N.C., Mills, M., Tam, J., Hicks, C.C., Klain, S., Stoeckl, N., Bottrill, M.C., Levine, J., Pressey, R.L., Satterfield, T., Chan, K.M.A. 2013. A Social-Ecological Approach to Conservation Planning: Embedding Social Considerations. Frontiers in Ecology and the Environment 11(4): 194–202.
- Brockhaus, M. and Angelsen, A. 2012. Seeing REDD+ through 4Is: A political economy framework In: Analysing REDD+: Challenges and choices, edited by A. Angelsen, M. Brockhaus, W. D. Sunderlin and L. V. Verchot. Bogor, Indonesia: CIFOR, pp. 15-30.
- Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P., van den Belt, M. 1997. The value of the world's ecosystem services and natural capital. Nature 387: 253–260.
- Daily, G.C., 1997. Nature's Services: Societal Dependence on Natural Ecosystems. Island Press, Washington, DC.
- de Groot, R.S., Alkemade, R., Braat, L., Hein, L., Willemen, L. 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecological Complexity 7, 260-272.
- Elmquist, T., Maltby, E., Barker, T., Mortimer, M., Perrings, C., Aronson, J., De Groot, R., Fitter, A., Mace, G., Norberg, J., Pinto, I.S., Ring, I. 2010. Biodiversity, Ecosystems and Ecosystem Services. In: TEEB – The Economics of Ecosystem Services, Ecological and Economic Foundations, Edited by P. Kumar. Washington, D.C.: Island Press: 42-111.
- Engel, S., Pagiola, S., Wunder, S. 2008. Designing payments for environmental services in theory and practice: an overview of the issues. Ecological Economics 65(4):663–674.
- Farley, J. and Costanza, R. 2010. Payments for ecosystem services: from local to global. Ecological Economics 69(11): 2060–2068.
- Gómez-Baggethun, E., De Groot, R., Lomas, P.L., Montes, C. 2010. The history of ecosystem services in economic theory and practice: From early notions to markets and payment schemes. Ecological Economics 69(6): 1209–1218.
- Gómez-Baggethun, E. and Muradian, R. 2015. In markets we trust? Setting the boundaries of Market-Based Instruments in ecosystem

services governance, Ecol. Econ. http://dx.doi.org/10.1016/j.ecolecon.2015.03.016
- Haines-Young, R. and Potschin, M. 2010. The links between biodiversity, ecosystem services and human well-being. In: Raffaelli D, Frid C, editors. Ecosystem ecology. A new synthesis. Cambridge (UK): University Press. p. 110–140.
- Jax, K., Barton, D.N., Chan, K.M.A., de Groot, R.S., Doyle, U., Eser, U., Görg, C., Gómez-Baggethun, E., Griewald, Y., Haber, W., et al. (2013). Ecosystem services and ethics. Ecological Economics 93: 260-268.
- Millennium Ecosystem Assessment (MA). 2003. Ecosystems and Human Well-Being: A Framework for Assessment. Washington (DC): Island Press.
- Rival, L. and Muradian, R. 2013. Introduction: Governing the Provision of Ecosystem Services. Heidelberg, New York, London: Springer, pp. 1–17.
- Schomers, S. and Matzdorf, B. 2013. Payments for ecosystem services: A review and comparison of developing and industrialized countries. Ecosystem Services 6: 16–30.

M Future Management Systems I

Semester:	1
Module coordinator:	Prof. Dr. Martin Guericke (martin.guericke@hnee.de)
Status:	Mandatory
Goal:	Students get an overview of important silvicultural basics, site / ecological conditions and silvicultural methods. Building on this, students gain knowledge of different, property-dependent forest management strategies for the provision of multifunctional ecosystem services. Basic knowledge and theoretical background of forest growth modelling are acquired. Practical examples of application are developed and evaluated with the help of growth simulations. Results and strategy recommendations will be discussed and evaluated in a forest management and society context.
Examination form	Project report (100%) (single exam)
ECTS-Credits:	6
SWH:	4

Module Component 1 Forest Management Systems for Ecosystem Services – silvicultural fundamentals

Semester:	1
Coordinator:	Prof. Dr. Martin Guericke
Lecturer:	Prof. Dr. Tobias Cremer, Prof. Dr. Peter Spathelf et al.
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (10h), practical exercises (10h), project (10h), self-study (45h)
Max. study places	25
Language:	English
Module type	blocked

Examination form	Project report (50 %) (part of exam)
Entry requirements	FST reader recommended for silviculture, forest growth and management.
Goal:	Students acquire or refresh the knowledge of basic silvicultural principles and management strategies for forest management and forest regeneration, which is available at different levels. They will have knowledge of different forest management systems and the respective, property-dependent objectives. They know existing and potential future social demands on forest systems and understand how these can change over time. They are able to analyse organisational, procedural and institutional structures and derive adaptation requirements and potentials.
Content:	Repetition and deepening of silvicultural and forest yield and forest growth fundamentals. Explanation of the geographical, organisational and social framework conditions and interactions in connection with the approach multifunctional forest management. Introduction to public forest administration and management structures and silvicultural guidelines based on case studies. Presentation of the interplay between ecological and economic, especially wood market specific conditions.
Recommended related elective modules :	
Competences :	Technical competence (50%), Methodological competence (50%)
Literature:	- v. Gadow, K. u. Hui, G.Y. (1999): Modelling Forest Development. Kluwer Academic Publishers, Dordrecht: 212 p. - Bravo, F. et al. (2017): Managing Forest Ecosystems: The Challenge of Climate Change, Managing Forest Ecosystems 34, Springer International Publishing Switzerland. - Pretzsch, H. (2009): Forest Dynamics, Growth and Yield - From Measurement to Model. Springer-Verlag Berlin Heidelberg. - Jan Hansen, J.; Nagel, J. (2014): Waldwachstumskundliche Softwaresysteme auf Basis von TreeGrOSS - Anwendung und theoretische Grundlagen. Beiträge aus der Nordwestdeutschen Forstlichen Versuchsanstalt Band 11, Universitäts-drucke Göttingen. - v. Gadow. K. (2005): Forsteinrichtung – Analyse und Entwurf der Waldent-wicklung, Universitätsdrucke im Universitätsverlag Göttingen. - v. Gadow, K. (2006): Forsteinrichtung – Adaptive Steuerung und Mehrpfad-prinzip, Universitätsdrucke im Universitätsverlag Göttingen.

Module Component 2 — Silvicultural management based on growth modelling for decision support

Semester:	1
Coordinator:	Prof. Dr. Martin Guericke
Lecturer:	Prof. Dr. Martin Guericke
ECTS-Credits:	3

SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (10h), practical exercises (10h), project (10h), self-study (45h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Project report (50 %) (part of exam)
Entry requirements	FST reader recommended for silviculture, forest growth and management.
Goal:	Students are enabled to guide structured goal-setting processes and to define operational realizable and measurable goals. By means of selected case studies (forestry enterprises of different types of ownership) and self-defined target hierarchies the influence of different silvicultural strategies and management decisions can be quantified on the basis of forest growth model calculations. The students are able to apply growth models and to evaluate and map the results of different mid-term scenario simulations. Students are enabled to weight the results of different target and management strategies by applying decision support systems. They are able to identify potentials and processes for the optimization of target hierarchies and to implement silvicultural control processes in the sense of adaptive management.
Content:	Data collection and processing of a case study based on own or provided empirical data (forest inventory data). Development and definition of different, individual forest management scenarios and implementation of growth simulations with the single tree simulator BWin Pro. Comparison and evaluation of results of different silvicultural scenarios, development and justification of best case recommendations. Development and description of concrete implementation examples for adapted management scenarios, in particular taking into account the increasing influence of climate change.
Recommended related elective modules :	
Competences :	Technical competence (50%), Methodological competence (50%)
Literature:	- v. Gadow, K. u. Hui, G.Y. (1999): Modelling Forest Development. Kluwer Academic Publishers, Dordrecht: 212 p. - Bravo, F. et al. (2017): Managing Forest Ecosystems: The Challenge of Climate Change, Managing Forest Ecosystems 34, Springer International Publishing Switzerland. - Pretzsch, H. (2009): Forest Dynamics, Growth and Yield - From Measurement to Model. Springer-Verlag Berlin Heidelberg. - Jan Hansen, J.; Nagel, J. (2014): Waldwachstumskundliche Softwaresysteme auf Basis von TreeGrOSS - Anwendung und theoretische Grundlagen. Beiträge aus der Nordwestdeutschen Forstlichen Versuchsanstalt Band 11, Universitäts-drucke Göttingen.

- v. Gadow. K. (2005): Forsteinrichtung – Analyse und Entwurf der Waldent-wicklung, Universitätsdrucke im Universitätsverlag Göttingen.
- v. Gadow, K. (2006): Forsteinrichtung – Adaptive Steuerung und Mehrpfad-prinzip, Universitätsdrucke im Universitätsverlag Göttingen.

M Forest governance and policy I

Semester:	1
Module coordinator:	Prof. Dr. Carsten Mann (Carsten.mann@hnee.de)
Status:	Mandatory
Goal:	Students get to know social and political sciences theories and concepts of environmental-/forest governance and policy. They learn about social structures, institutions and actors as a basis for elaborating and reflecting on topics such as collaboration, protest behaviour and policy action. Students become familiar with examples from environmental protection, forest management, biodiversity and nature conservation, to improve their understanding of policy and social systems and their specific functioning and interactions.
Examination form	Project presentation (50%), Project report (50%)
ECTS-Credits:	6
SWH:	4

Module Component 1 Concepts, institutions and actors

Semester:	1
Coordinator:	Prof. Dr. Carsten Mann
Lecturer:	Prof. Dr. Carsten Mann, Prof. Dr. Heike Walk
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (7 h), Seminar (7 h), Project (16 h), Self-study (45h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Project presentation (25%), Project report (25%)

Entry requirements	FST reader recommended for silviculture, forest growth and management.
Goal:	Students understand, can explain and analyse environmental and forest governance systems. Rooted in a new institutional economics and political sciences understanding, students can distinguish between governance structures, institutions, actors and organisations. In particular they are familiar with key political sciences concepts for natural resources governance and policy. This enables students to understand institutional stability and change over time, policy choice and actor coalitions in order to handle multiple realities for collaboration, integrated and adaptive approaches, and sustainable resource management.
Content:	- Introduction to the conceptual foundation of (environmental) governance and different schools of thought: structures, institutions, actors; - Exploration of a paradigm shift from central government steering to collaborative approaches in natural resource management; - Introduction to concepts of system dynamics, phases of institutional stability and change - Introduction to the concepts of robustness, resilience and adaptive capacity; - Deepening of key policy concepts such as policy cycle, rational choice and advocacy coalitions; as well as integrated and community-based governance; - Deepening of dedicated governance systems: Forest and environmental governance; biodiversity governance, and governance of protected areas; - Handling multiple realities: inter-disciplinary and transdisciplinary research approaches.
Recommended related elective modules :	
Competences :	Technical competence (45%), Methodological competence (35%), Personal competence (10%), Media competence (10%)
Literature:	- Cox, M., Arnold, G., & Villamayor Tomás, S. 2010. A Review of Design Principles for Community-Based Natural Resource Management. Ecology and Society 15(4):38. - Hodge, I. 2007. The Governance of Rural Land in a Liberalised World. Journal of Agricultural Economics 58(3):409–32. - Jordan, A. J. & Turnpenny, J. R. 2015. The Tools of Policy Formulation: Actors, Capacities, Venues and Effects. Northampton, MA: Edward Elgar Publishing Ltd. - Kemp, R., Parto, S., & Gibson, R. B. 2005. Governance for Sustainable Development: Moving from Theory to Practice. International Journal of Sustainable Development 8(1):12–30. - Loft, L.; Mann, C.; and Hansjürgens, B. (2015): Challenges in Ecosystem Services Governance: Multi-levels, multi-actors, multi-rationalities. In: L. Loft; C. Mann & B. Hansjürgens “Governance of Ecosystem Services – Challenges for sustainable development”, Journal of Ecosystem Services, Special Issue 16, pp. 150 – 157, DOI: 10.1016/j.ecoser.2015.11.002.

- Paavola, J., Gouldson, A., & Kluvánková, T. 2009. Interplay of Actors, Scales, Frameworks and Regimes in the Governance of Biodiversity. Environmental Policy and Governance 19(3):148–58.
- Pierson, P (2000). Increasing returns, path dependence, and the study of politics. American Political Science Review, 94, pp. 251-267.
- Scott, W. R. 2008. Institutions and Organizations: Ideas and Interests. Thousand Oaks, Calif.: Sage.
- Stoker, G. 1998. Governance as Theory: Five Propositions. International Social Science Journal 50(155):17–28.
- Stone, D. 2012. Policy Paradox: The Art of Political Decision Making. Auflage: 3. New York: Norton & Company.

Module Component 2 — Environmental Policy and Nature Conservation

Semester:	1
Coordinator:	Prof. Dr. Heike Walk
Lecturer:	Prof. Dr. Heike Walk, Prof. Dr. Pierre Ibisch, Prof. Dr. Carsten Mann
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (7 h), Seminar (7 h), Project (16 h), Self-study (45h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Project presentation (25%), Project report (25%)
Entry requirements	FST reader recommended for silviculture, forest growth and management.
Goal:	Students are familiar with the general objectives, tools and current debates of environmental-, nature- and biodiversity conservation policy on different levels. They know the basic environmental governance structures, and the different policy instruments at stake to manage environmental problems. They are able to discuss the chances and limitations of these policy approaches in a nuanced way. For dedicated environmental policy arenas, students can analyse central actors, inherent problem perceptions and ideas for policy solutions. They are able to analyze participatory governance in different policy fields.
Content:	- Introduction to central environmental policy fields, strategies, instruments and actors;

- Environmental philosophy & ethics: The bedrock of sustainable development;
- Science-policy interface and requirements for post-normal science concepts & solutions;
- Ecosystem-based adaptation & the participatory approach to sustainability.
- Citizen Competence, Empowerment, and Capacity Building
- A partnership approach to forest ecosystem management
- Field trip

Recommended related elective modules :

Competences : Technical competence (45%), Methodological competence (35%), Personal competence (10%), Media competence (10%)

Literature:

- Agrawal, A. and Redford, K. (2006) Poverty, Development, and Biodiversity Conservation: Shooting in the Dark? Wildlife Conservation Society ISSN 1534-7389.
- Arts, B.; Buizer, M. (2009): Forests, discourses, institutions. A discursive-institutional analysis of global forest governance. Forest Policy and Economics: 11 (5-6), 340-347.
- Dimitrov, R. S. (2005): Hostage to Norms: States, Institutions, and Global Forest Politics. Global Environmental Politics 5 (4): 1-24.
- Fath, B.D, Jørgensen, S.E., Patten, B.C. and Straškraba, M. (2004) Ecosystem Growth and Development. BioSystems 77 (2004) 213–228
- Filotas, E., L. Parrott, P. J. Burton, R. L. Chazdon, K. D. Coates, L. Coll, S. Haeussler, K. Martin, S. Nocentini, K. J. Puettmann, F. E. Putz, S. W. Simard, and C. Messier. 2014. Viewing forests through the lens of complex systems science. Ecosphere 5(1):1.
- Kläy, A.; Zimmermann, A. B.; Schneider, F. (2016): Rethinking science for sustainable development: Reflexive interaction for a paradigm transformation. Futures, 65: 72-85.
- Lang, D. J., Wiek, A., Bergmann, M. and M. Stauffacher. 2012. Transdisciplinary research in Sustainability Science. Practice, Principles and Challenges. Sustainability Science 7: 25–43.
- Mann, C.; Plieninger, T.; Raymond, C. M.; Garcia Martin, M.; and Shaw, B. (in preparation). Integrated landscape management as an operational bridge for implementing the Sustainable Development Goals (SDGs) in Europe. Landscape and Urban Planning.
- Pascual, M. and Guichard, F. (2005) Criticality and disturbance in spatial ecological systems. TRENDS in Ecology and Evolution Vol.20 No.2
- Rayner, J., Buck, A., Katila, P. (2010), Embracing complexity: Meeting the challenges of international forest governance. A global assessment report. Prepared by the Global Forest Expert Panel on the International Forest Regime. IUFRO World Series Volume 28. Vienna.
- Rosa, H.D (2004) The bioethics of biodiversity. Human Ecology Special Issue No. 12: 161-175

- Walk, H. and Müller, M. 2014. Democratizing the climate negotiations system through improved opportunities for participation. In: Dietz, M. und Garrelts, H. (Eds.): Handbook of the climate change movement. Routledge International Handbooks, S. 31-43.
- Winkel, G., Kaphengst, T., Herbert, S., Robaey, Z.; Rosenkranz, L., Sotirov, M. (2009): EU policy options for the protection of European forests against harmful impacts. Final Report to the tender: ENV.B.1/ETU/2008/0049: OJ 2008/S 112 - 149606.
- Winkel, G. & Sotirov, M. (2013): Whose integration is this? European forest policy between the gospel of coordination, institutional competition, and new spirits of integration. Environment and Planning C: Government and Policy.

M Fundamentals of Measurements and Modelling

Semester:	1
Module coordinator:	Prof. Dr. Luis Miranda (luis.miranda@hnee.de)
Status:	Mandatory module
Goal:	The students get to know different automated measurement methods in the environmental sector. They are able to identify and discuss the data origins and to assess the data quality of a measurement. They process data in environmental modelling and apply the building methodology behind mathematical models in environmental science, forestry and ecology.
Examination form	Technical discussion (50%), Term paper (50%)
ECTS-Credits:	6
SWH:	4

Module Component 1 Sensors for automated measurements

Semester:	1
Coordinator:	Prof. Dr. Luis Miranda
Lecturer:	Prof. Dr. Luis Miranda
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (12h), Practical exercise (18h), Self-study (45h)
Max. study places	
Language:	English
Module type	blocked
Examination form	Technical discussion (50%)

Entry requirements	-
Goal:	The students identify and describe the measuring principles behind sensor technologies used as data sources for environmental modelling. They know the principles of data quality assessment and further data processing procedures that guarantee a meaningful re-use of the measured data.
Content:	The course focuses on field data acquisition to support the construction and tuning of ecosystem and environmental models. The knowledge of different measuring principles is important for the processing, analysis and evaluation of sensory recorded environmental data and helps with the interpretation of ecosystem phenomena. The most important sensors for automatic field measurements are presented alongside their physical measuring principles and technical usage constrains. The parts of an automatic measuring system are presented and discussed, as well as the concepts of sensor resolution and accuracy. The concepts of analog to digital conversion, signal conditioning, interfaces and noise are reviewed. Practical exercises show the sensor construction and their installation and calibration, particularly sensors for temperature, relative humidity, solar radiation and soil water content. Practical troubleshooting and testing techniques are presented to assess the state of the sensors.
Recommended related elective modules :	
Competences :	Technical competence (50%) Methodological competence (40%) Personal competence (10%)
Literature:	Fritschen, L. J., & Gay, L. W. (2012). Environmental instrumentation. Springer Science & Business Media. Pearcy, R. W., Ehleringer, J. R., Mooney, H., & Rundel, P. W. (Eds.). (2012). Plant physiological ecology: field methods and instrumentation. Springer Science & Business Media.

Module Component 2 — Process modelling methodology

Semester:	1
Coordinator:	Dr. Evelyn Wallor
Lecturer:	Dr. Evelyn Wallor
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (15 h), Practical exercise (15 h), Self-study (45 h)
Max. study places	

Language:	English
Module type	blocked
Examination form	Term paper (50%)
Entry requirements	-
Goal:	The students know about application areas of ecosystem models and are able to distinguish between different modelling concepts. They have a broad overview of different models and tools related to different focuses on environmental processes, e.g. carbon dynamics, water- and nutrient cycling, and biomass growth. Students learn the principles of modelling practice in terms of parameter estimation, model set-up, and model validation. They conceptualize and design mathematical models to be used in environmental science, forestry and ecology. The students define input and output variables as well as protocols for modelling exercises.
Content:	The course refreshes fundamental knowledge about ecosystems with respect to definitions, terms, and processes (e.g. element cycling, mass balance), and introduces the role and purpose of model applications in environmental science (e.g. large scale scenarios, retrospective evaluation). Based on relevant scientific findings from the field of modelling different models and modelling approaches are explored (e.g. quantitative vs. dynamic, point vs. terrain model). Building on this, students set up various ordinary differential equations to simulate exemplarily forest biomass growth (e.g. logistic growth, Gompertz growth). They extend the growth models with terms for carbon accounting depending on tree age and tree species. Furthermore, they conduct parameterisation and model curve fitting by applying the least squares method on selected process equations. Finally, measures for model validation to assess models' outcome are introduced and trained (e.g. RMSE, IA, MAE). All methods are trained and practiced in connection with the module component "Sensors for automated measurements" using the software R and RStudio.
Recommended related elective modules :	Information & mathematical models (2nd term) Principles of landscape ecology (2nd term)
Competences :	Technical competence (50%) Media competence (10%) Methodological competence (30%) Personal competence (10%)
Literature:	Ahuja, Laj R., Ma, L. (Eds.) (2011). Methods of Introducing System Models into Agricultural Research. ASA-CSSA-SSSA Book. DOI:10.2134/advagricsystmodel2 Teh, C. (2006). Introduction to mathematical modeling of crop growthhow the equations are derived and assembled into a computer model. Brown Walker Press. Wendroth, O., Lascano, R.J., Ma, L. (Eds.) (2019). Bridging Among Disciplines by Synthesizing Soil and Plant Processes. ASA-CSSA-SSSA Book. DOI:10.2134/advagricsystmodel8 additional relevant literature and current scientific resources will be provided by the lecturer

E Carbon Sequestration and accounting[1]

Semester:	1
Module coordinator:	Prof. Dr. Martin Guericke (Martin.Guericke@hnee.de)
Status:	Elective
Goal:	Students understand the carbon cycle with special reference to forests, soils and forest products. They are qualified to develop and critically reflect forest growth scenarios and have acquired basic knowledge of the purpose and the implementation of life cycle analysis (LCA), product carbon footprints (PCF) and corporate carbon footprints (CCF).
Examination form	Work report (100%)
ECTS-Credits:	6
SWH:	4

Module Component 1 Carbon Sequestration and accounting

Semester:	1
Coordinator:	Prof. Dr. Martin Guericke
Lecturer:	Prof. Dr. Martin Guericke, Prof. Dr. Tobias Cremer, Prof. Dr. Winfried Riek
ECTS-Credits:	6
SWH:	4
Workload:	150 h / Semester
Teaching form	Lecture (30h), Project (30h), self-study (90h)
Max. study places	8 (+ 8 GCM + 8 FIT)
Language:	English
Module type	blocked
Examination form	Work report

Entry requirements

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Goal:

Students understand the carbon cycle with special reference to forests, soils and forest products. They are qualified to develop and critically reflect forest growth scenarios and have acquired basic knowledge of the purpose and the implementation of life cycle analysis (LCA), product carbon footprints (PCF) and corporate carbon footprints (CCF).

Content:

The interactions among vegetation, climate and soil properties as main factors influencing soil carbon storage will be explained. In terms of carbon sequestration the current EU-wide programs for observing and monitoring the element budget in forest ecosystems are presented. An overview of global threats to soils in particular by loss of humus and measures for soil protection will be given.

Finally, forest yield and growth is modelled according to common, traditional approaches as well as to new tools like statistical computer growth models (BWinPro). In this context current trends and available tools in forest growth modelling are presented. Students carry out self-selected and self-defined case studies focused on carbon sequestration. Additionally the participants learn about the problems and challenges to include the dynamic change of management strategies, effects of climate change and the general change of site conditions in growth modelling and to evaluate the results of growth scenarios.

Secondly rules for the development of LCA (life cycle analysis), layout, structure and boundaries of LCA; PCF (product carbon footprints) and CCF (corporate carbon footprints) will be presented. Basic knowledge of the purpose and the implementation of life cycle analysis (LCA), product carbon footprints (PCF) and corporate carbon footprints (CCF) will be given. Moreover it will be discussed which data are needed to develop a LCA, how such data are collected and how the calculation is done. In this context important tools and software for the calculation of LCA will be explained.

Recommended related elective modules :

Competences :

Technical competence (50%), Methodological competence (20%), Social competence (10%), Personnel competence (20%)

Literature:

- V. Gadow, K., Pukkala, T. A., Tome, M., 2000. Sustainable Forest Management. Kluwer Academic Publishers.
- Jandl, R., Rodeghiero, M., Olsson, M. 2011. Soil carbon in Sensitive European Ecosystems: From Science to Land Management, John Wiley & Sons. Ltd. Olsthoorn et al. 1999. Management of mixed-species forest: silviculture and economics. IBN Scientific Contributions 15, Wageningen.
- Pommerening, A. a. Murphy, S.T., 2004. A review of the history, definitions and methods of continuous cover forestry with special attention to afforestation and restocking. Forestry, Vol. 77, No. 1, 27-44

E Assessment tools and methods: Forest 4.0 / Parametrization and spatial assessment of biomass[II]

Semester:	1
Module coordinator:	Prof. Dr. Jan-Peter Mund (jan-peter.mund@hnee.de)
Status:	Elective
Goal:	Students are aware of the principal methods and innovative technical tools for estimating, quantifying, calculating and mapping the baseline of different carbon pools and to monitor carbon stock changes related to various forest and land management measures. After the course, students have a solid foundation of principal concepts of biomass and carbon quantification and their specific cycles. Students know about the advantages applying remote sensing and modelling techniques for the spatial assessment and modelling of forest biomass at different scales. Students will learn about different carbon parametrization, quantification or simulation models for forest biomass on a landscape level and discuss methods to quantify forest biomass and estimate the forest carbon stock and their uncertainty.
Examination form	Project presentation (50%), Project report (50%)
ECTS-Credits:	6
SWH:	4

Module Component 1 Assessment tools and methods: Forest 4.0 / Parametrization and spatial assessment of biomass

Semester:	1
Coordinator:	Prof. Dr. Jan-Peter Mund
Lecturer:	Prof. Dr. Jan-Peter Mund
ECTS-Credits:	6
SWH:	4
Workload:	150 h / Semester
Teaching form	Lecture (12h), seminar (18h), practical exercise (30h), self-study (90 h).

Max. study places	25
Language:	English
Module type	Blocked
Examination form	Project presentation (50%), Project report (50%)
Entry requirements	
Goal:	Students are aware of the principal methods and innovative technical tools for estimating, quantifying, calculating and mapping the baseline of different carbon pools and to monitor carbon stock changes related to various forest and land management measures. After the course, students have a solid foundation of principal concepts of biomass and carbon quantification and their specific cycles. Students know about the advantages applying remote sensing and modelling techniques for the spatial assessment and modelling of forest biomass at different scales. Students will learn about different carbon parametrization, quantification or simulation models for forest biomass on a landscape level and discuss methods to quantify forest biomass and estimate the forest carbon stock and their uncertainty.
Content:	This module offers an introduction to selected monitoring methods of global phenomena and recent trends in earth observation of the environment. The module focuses on standardized remote sensing products and sensor networks for earth observation. Global monitoring and standardized earth observation products will be discussed and students will critically evaluate existing NASA and ESA–Copernicus and Sentinel products and discuss recent trends and challenges in multi-temporal earth observation especially land cover land-use topics. In addition students will learn about typical earth observation services like Marine services, Soil and Water services; Crop monitoring, Atmosphere services or Emergency response and Security services.
Recommended related elective modules :	Transformation and innovation II
Competences :	Technical competence (50%), Methodological competence (35%), Personal competence (5%), Media competence (10%)

- **Literature:**

- Aschbacher; J & Pilar Milagro-Pérez; M. (2012): The European Earth monitoring (GMES) programme: Status and perspectives. In: Remote Sensing of Environment 120 (2012) 3–8.
- De Mey, Stefaan (2015): The Future of Satellite Applications: The End-User Perspective. In: Yearbook on Space Policy 2015, pp 175-191.
- Donlon, C. et al (2012): The Global Monitoring for Environment and Security (GMES) Sentinel-3 mission. In: Remote Sensing of Environment 120 (2012) 37– 57.
- Elsharkawy, A., Et Al. (2012). Improvement in the Detection of Land Cover Classes Using the Worldview-2 Imagery ASPRS Sacramento, CA.
- Houghton, R.A.; Nassikas, A.A.(2017): Global and regional fluxes of carbon from land use and land cover change 1850–2015, DOI: 10.1002/2016GB005546
- Jensen(2006): Remote Sensing of the Environment: An Earth Resource Perspective (2nd Edition)

- Jones & Vaughan (2010): Remote Sensing of Vegetation: Principles, Techniques, and Applications
- Vuolo, F., Wai-Tim, Ng, Atzberger, C. (2016): Smoothing and gap-filling of high resolution multi-spectral time series: Example of Landsat data. In: International Journal of Applied Earth Observation and Geoinformation, Volume 57, May 2017, Pages 202–213
- Wulder, M.A., S.E. Franklin (2003): Remote Sensing of Forest Environments. Kluwer Academic Publishers.

Further and more recent literature will be presented during the lectures and in the literature review of the seminar.

M Rethinking Environmental Economics II

Semester:	2
Module coordinator:	Prof. Dr. Carsten Mann (Carsten.mann@hnee.de)
Status:	Mandatory
Goal:	The students are enabled to describe, analyse and evaluate linkages between economic and environmental systems understood as coupled social-ecological systems and system interactions. They become familiar with frameworks for system analysis to apply in concrete action situations. Students will gain a deepened understanding, and debate alternative economic concepts, for natural resource uses and management, and in particular debate the new trends in bioeconomy.
Examination form	Project presentation (100%) (singe exam)
ECTS-Credits:	6
SWH:	4

Module Component 1 Economy – Ecology Systems Interactions

Semester:	2
Coordinator:	Prof. Dr. Carsten Mann
Lecturer:	Prof. Dr. Carsten Mann
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (8h), Seminar (12h), Project (20h), Self-study (45 h)
Max. study places	25
Language:	English
Module type	blocked

Examination form

Project presentation (50%)

Entry requirements

Goal:

Students acquire knowledge on economy - ecology system interactions conceptualized as 'social-ecological systems' (SES). They gain a system-based understanding of economy as an integral part of the environment that needs to be understood in its uncertainties and limitations. Students are introduced to the IAD and SES analysis frameworks, and will be enabled to apply them. The crucial role of institutions that mediate system interactions is highlighted. Limits to growth are critically reflected and alternative concepts for economic development and human well-being are debated including issues such as ethics, fairness and equity.

Content:

- Understanding of socio-ecological systems and economy – ecology interdependencies;
- Identification and debate of socio-economic and political trends that influence natural resource uses, overuse and degradation;
- Introduction to system analysis frameworks IAD and SES
- Carrying out system analysis in dedicated action situations;
- Debate of the growth orientation and `limits of growth´;
- Introduction to alternative economic theories and models regarding environmental and natural resource uses, i.e. circular economy, Degrowth and welfare economics;
- Elaboration of crucial issues of ethics, fairness and equity;
- Stakeholder discussions on related module topics.

Recommended related elective modules :

Competences :

Technical competence (40%), Methodological competence (40%), Social competence (10%), Personal competence (10%)

- **Literature:**

- Berkes, Fikret, Carl Folke, and Johan Colding. 2000. Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience. Cambridge, New York: Cambridge University Press.
- Costanza, R., Daly, L., Fioramonti, L., Giovannini, E., Kubiszewski, I., Mortensen, L.F., Pickett, K.E., Ragnarsdottir, K.V., De Vogli, R., Wilkinson, R., 2016. Modelling and measuring sustainable wellbeing in connection with the UN Sustainable Development Goals. Ecological Economics. 130, 350-355..
- Hagedorn, Konrad. 2008. "Particular Requirements for Institutional Analysis in Nature-Related Sectors" European Review of Agricultural Economics 35(4): 357-384.
- Janssen, Marco A., John M. Anderies, and Elinor Ostrom. 2007. "Robustness of Social-Ecological Systems to Spatial and Temporal Variability." Society and Natural Resources 20(4): 307–22.
- Liu, J., Dietz, T., Carpenter, S.R., Alberti, M., Folke, C., Moran, E., Pell, A.N., Deadman, P., Kratz, T., Lubchenco, J., Ostrom, E., Ouyang, Z., Provencher, W., Redman, C.L., Schneider, S.H., Taylor, W.W. (2007). Complexity of Coupled Human and Natural Systems. Science 314: 1513-1516.

- Ostrom, E. 2011. Background on the Institutional Analysis and Development Framework. Policy Studies Journal 39(1): 7–27.
- Ostrom, E. 2009. Social-Ecological Systems A General Framework for Analyzing Sustainability of Social-Ecological Systems. Science 325:419-422.
- Ostrom, E., Burger, J., Field, C.B., Norgaard, R.B., Policansky, D. 1999. Revisiting the commons: local lessons, global challenges. Science. 284 (5412): 278–282.
- Schlager, Edella and Elinor Ostrom. 1992. Property-Rights Regimes and Natural Resources: A Conceptual Analysis. Land Economics 68(3):249–62.
- Williamson, O. E. 2004. Transaction Cost Economics and Agriculture: An Excursion. The Role of Institutions in Rural Policies and Agricultural Markets. Amsterdam: Elsevier 19–39.
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Module Component 2 Bioeconomy strategies

Semester:	2
Coordinator:	Prof. Dr. Tobias Cremer
Lecturer:	Prof. Dr. Tobias Cremer
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (10h), Seminar (10h), Project (10 h), self-study (45 h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Project presentation (50%)
Entry requirements	
Goal:	Students have a good understanding of the Bioeconomy concept in general. They understand the aims of different concepts and strategies related to Bioeconomy and how an efficient and resource-friendly use of natural resources such as plants, animals, and microorganisms shall be achieved. They can identify bioeconomy potentials of a range of various institutional, economic and biophysical settings with a special focus on forestry and analyze in how far these play a crucial role for shaping the countries bioeconomy strategies. Further, students are able to derive implications for a sustainable forest resource management.
Content:	Bioeconomy aims to achieve an efficient and resource-friendly use of natural

resources. It concerns a wide variety of sectors, including especially forestry, agriculture and plant breeding. In forestry, this new global trend has the potential to significantly change demand for wood and other resources. By that, traditional markets and market participants will be influenced, and forest management strategies might have to be adapted, according to new stakeholders in the market. It is therefore crucial to understand this new megatrend, to be able to derive first assumptions of how to react and how to handle the upcoming challenges and changes.
In this module, students are therefore introduced to a range of country perspectives on bioeconomy. Based on cross-country comparisons, socio-economic insights into this emerging policy and business field are presented: strategies, actors, risks and promises. Differences in institutional, economic and biophysical settings are identified and analyzed in how far these play a crucial role for shaping the countries' bioeconomy strategies and how forestry is affected. Potentials for a European way are debated, and implications for resource management are thematised.

Recommended related elective modules :

Competences :

Technical competence (40%), Methodological competence (40%), Social competence (10%), Personal competence (10%)

- **Literature:**

- Cristóbal, J., Matos, C. T., Aurambout, J. P., Manfredi, S., & Kavalov, B. (2016). Environmental sustainability assessment of bioeconomy value chains. Biomass and Bioenergy, 89, 159-171.
- Hetemäki, L. (2014). Future of European Forest Based Sector. Structural Changes Towards Bioeconomy. What Science Can Tell Us 6, European Forest Institute. http://www.efi.int/files/attachments/publications/efi_wsctu_6_2014.pdf
- Lewandowski, I. et al. (2018): Bioeconomy. Shaping the Transition to a Sustainable Biobased Economy. Springer, 358 S.
- Philippidis, G, M'barek, R., & Ferrari, E. (2016): Drivers of the European Bioeconomy in Transition (BioEconomy2030): An exploratory, model-based assessment. Joint Research Center by the European Commission, EUR 27563 EN; doi:10.2791/529794. http://citarea.cita-aragon.es/citarea/bitstream/10532/3282/1/2016_100.pdf
- Scarlat, N., Dallemand, J. F., Monforti-Ferrario, F., & Nita, V. (2015). The role of biomass and bioenergy in a future bioeconomy: policies and facts. Environmental Development, 15, 3-34.
- Wolfslehner, B., Linser, S., Pülzl, H., Bastrup-Birk, A., Camia, A., & Marchetti, M. (2016). Forest bioeconomy-a new scope for sustainability indicators. From Science to Policy 4, European Forest Institute.

M Future Management Systems II

Semester:	2
Module coordinator:	Prof. Dr. Ute Sass-Klaassen (ute.sass-klaassen@hnee.de)
Status:	Mandatory
Goal:	In this module basic and new concepts of forest ecology, management and restoration in a changing world are presented and discussed. Implication for multiple forest functions are evaluated with special emphasis to the resource wood. Students gain basic knowledge on actual approaches and tools to assess forest-area changes, forest productivity, and availability of forest resources (tree growth, dendrochronology, wood quality, sustainable biomass production, forest restoration, climate-smart forestry).
Examination form	Written exam 120 min (70%), Project report (30%)
ECTS-Credits:	6
SWH:	4

Module Component 1 Strategic silvicultural planning and management

Semester:	2
Coordinator:	Prof. Dr. Ute Sass-Klaassen
Lecturer:	Prof. Dr. Ute Sass-Klaassen, Prof. Dr. Peter Spathelf, Markus Höhl, Prof. Dr. Gert-Jan Nabuurs
ECTS-Credits:	6
SWH:	4
Workload:	150 h / Semester
Teaching form	Lecture (30h), Seminar (10 hours) Practical exercise (10 h), excursion (10 h) self-study (90 h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Written exam (70%), Project report (30%)

Entry requirements

Goal:

Students gain knowledge, experience and practical skills on the forest ecology and forest management strategies in different climate areas and under changing climate conditions. They are able to discuss and evaluate suitable tools for forest restoration and climate-smart forestry.
Specifically they learn:

(1) recall relevant numbers, facts, and background information on forest ecosystems and forest resources worldwide;
(2) classify silvicultural systems and techniques for wood production;
(3) assess the applicability of sustainable forest-management techniques in forest systems worldwide;
(4) explain how tree growth and wood anatomy translate to technological properties and hence wood quality;
(5) analyse data from international databases with respect to sustainable resource extraction and forest-area changes;
(6) critically judge the role of various ecological and social aspects relevant for sustainable forest resource management and forest restoration in forest ecosystems worldwide.

Content:

The course provides a general introduction into ecology and management of forests and forest resources worldwide. In the second part special emphasis is given on mitigating climate change impacts (climate-smart forestry) as well as forest and landscape restoration. The following topics are addressed:

(1) ecology and functioning of different forest ecosystems in different climate zones (temperate, boreal, tropic);
(2) sustainable forest-management systems: background, development, and application of certification systems;
(3) silvicultural systems and techniques for forest-resource management, their history and application;
(4) silvicultural measures to mitigate climate-change impact (climate-smart forestry);
(5) inclusion of silvicultural strategies into land-use decisions (e.g. development of forest and landscape restoration concepts);
(6) the type and characteristics of forest resources, with special emphasis on wood;
(7) wood formation, and anatomical, mechanical, and technological properties of wood.

Recommended related elective modules :

Forest Management Strategies for ecosystem service provision II

Competences:

Technical competence (40%), Methodological competence (40%), Social competence (10%), Personal competence (10%)

Literature:

Barreto, P., Amaral, P., Vidal, E. & Uhl, C. (1998): Costs and benefits of forest management for timber production in eastern Amazonia. Forest Ecology and Management 108. S. 9-26.

Bussotti, Filippo & Pollastrini, Martina & Holland, Vera & Brüggemann, Wolfgang. (2014). Functional traits and adaptive capacity of European forests to climate change. Environmental and Experimental Botany. 111: 91-113. (https://www.sciencedirect.com/science/article/pii/S0098847214002585)

FAO (2018): State of the world's forests. FAO, Rome. http://www.fao.org/state-of-forests/en/

Günter, S., Weber, M., Stimm, B., Mosandl, R. (Eds) (2012): Silviculture in the tropics. Series Tropical Forestry, Vol. 8. Springer, Dordrecht. 560 p.
Jandl, R., Spathelf, P., Bolte, A. et al. (2019). Forest adaptation to climate change—is non-management an option?. Annals of Forest Science 76, 48, https://doi.org/10.1007/s13595-019-0827-x
Louah,L., Visser, M., Blaimont, A., de Cannière, C. (2017): Barriers to the development of temperate agroforestry as an example of agroecological innovation: Mainly a matter of cognitive lock-in?,Land Use Policy 67:86-97. https://www.sciencedirect.com/science/article/pii/S0264837717305367
Macdicken, K. (2015). Global Forest Resources Assessment 2015: What, why and how?. Forest Ecology and Management. 352: 3–8.
Mansourian, S., Vallauri, D. & Dudley, N. (2005): Forest Restoration in Landscapes: Beyond Planting Trees. Springer. 437 p.
Nabuurs G.J., Delacote, P., Ellison, D., Hanewinkel, M., Hetemäki, L. & Lindner, M. (2017). By 2050 the mitigation effects of EU forests could nearly double through climate smart forestry. Forests 8 (12):484.
Nambiar, E.K.S. 1999. Pursuit of Sustainable Plantation Forestry. Southern African Forestry Journal, No 184. p. 45-62.
Nutto, L., Spathelf, P. & Seling, I. (2002): Plantagenwälder – eine Option für Brasilien. Holz-Zentralblatt 109. S. 1287.
Pearce, D., Putz, F.E. & Vanclay, J.K. (2003): Sustainable forestry in the tropics: panacea or folly? Forest Ecology and Management 172 / 2-3. S. 229-247. https://www.sciencedirect.com/science/article/pii/S0378112701007988
Reed, J., Van Vianen, J., Foli, S, Clendenning, J.,Yang, K., MacDonald, M., Petrokofsky, G., Padoch, C.& Sunderland, T. (2017). Trees for life: The ecosystem service contribution of trees to food production and livelihoods in the tropics. Forest Policy and Economics. 84: 62-71. https://www.sciencedirect.com/science/article/pii/S1389934117300345
Sass-Klaassen, U.G.W.; Fonti, P.; Cherubini, P.; Gricar, J.; Robert, E. M.R.; Steppe, K.; Bräuning, A.(2016): A Tree-Centered Approach to Assess Impacts of Extreme Climatic Events on Forests. Frontiers in Plant Science 7. https://www.frontiersin.org/articles/10.3389/fpls.2016.01069/full
Smith, D.M. 1962. The practice of silviculture. John Wiley & Sons, New York. 578 p.
Spathelf, P., Schneider, P.R., Finger, C.A., 2001. Zur nachhaltigen Bewirtschaftung von Araukarien-Mischwäldern in Südbrasilien. Forstarchiv 72, 92-100.
Steppe. K, von der Crone, J., de Paauw, DJW. (2016): TreeWatch.net: a tree water and carbon monitoring network to assess instant tree hydraulic functioning and stem growth. Front Plant Sci 7:Article 993.
Vanclay, J.K. (2005). Deforestation: correlations, possible causes and some implications. International Forestry Review 7:278-293.

M Forest governance and Policy II

Semester:	2
Module coordinator:	Prof. Dr. Carsten Mann (Carsten.mann@hnee.de)
Status:	Mandatory
Goal:	Students become familiar with the conceptual foundations to analyse land-use conflicts, conflict types, conflict reasons and conflict resolutions. They will learn about the range of land-use conflict based on various conflict examples. Further, students develop a deeper understanding of social sciences methods for conflict analysis, are enabled to carry out conflict analysis, and develop suitable management recommendations.
Examination form	Project presentation (100%)
ECTS-Credits:	6
SWH:	4

Module Component 1 Conflicts, cases and conflict management

Semester:	2
Coordinator:	Prof. Dr. Carsten Mann
Lecturer:	Prof. Dr. Carsten Mann
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (10 h), Seminar (10 h), Project (10 h), Self-study (45 h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Project presentation (50%)
Entry requirements	

Goal:

Students have a basic theoretical and practice-oriented understanding of conflicts in the realm of natural resource use and management for analysis and application. They are familiar with different types of (land-use) conflicts, conflict theory, and sets of conflict resolution strategies. They can analyse related conflict cases and derive suitable management solutions in a sound scientific and practice-oriented way.

Content:

This module contains following thematic blocks, each one consisting of theoretical insights, practice examples and exercises:

- Land-use transitions: Dynamic socio-ecological systems in relation to changing policy agendas and societal demands;
- Conceptual orientation: Conflict types, patterns, reasons; conflict management strategies;
- Exploration and debate of challenges and implications for sustainable natural resource use for dealing with heterogeneous stakeholders and land-use interests;
- Exploration of (international) land-use conflict and management examples;

  Group work and role game for developing own conflict solutions for sustainable resource uses and management.

Recommended related elective modules :

Competences:

Technical competence (50%), Methodological competence (20%), Social competence (20%), Personal competence (10%)

Literature:

- Food and Agriculture Organisation of the United Nations (FAO) 2005. Negotiation and mediation techniques for natural resource management. ROME: FAO/UN [URL document] ftp://ftp.fao.org/docrep/fao/008/a0032e/a0032e00.pdf.
- Foley, J.A., et al. (2005). Global consequences of land use. Science 309(5734): 570-574.
- Henle, K., et al. (2008). Identifying and managing the conflicts between agriculture and biodiversity conservation in Europe – A review. Agriculture, Ecosystems and Environment 124: 60-71.
- Hesselink, F. (2004). How to manage change? How to manage people? Skills and knowledge for effectiveness in communicating protected areas and biodiversity values. In: D. Hamú et al. (eds.), Communicating Protected Areas, IUCN, pp. 9-12.
- Lockwood, M., et al. (2009). Managing protected areas - A global guide. London: Earthscan.
- Torre, A., et al. (2014). Identifying and measuring land-use and proximity conflicts: methods and identification. SpringerPlus 3: 85.
- USDA Forest Service (2001). Defining, Managing, and Monitoring Wilderness Visitor Experiences. General Technical Report RMRS-GTR-79. Rocky Mountain Research Station, Fort Collins, CO.
- Von der Dunk, A., et al. (2011). Defining a typology of peri-urban land-use conflicts – A case study from Switzerland. Landscape and Urban Planning 101: 149-156.

Module Component Social Science Analysis of Conflict Cases

2

Semester:	2
Coordinator:	Prof. Dr. Heike Walk
Lecturer:	Prof. Dr. Heike Walk
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (10 h), Seminar (10 h), Project (10 h), self-study (45 h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Project presentation (50%)
Entry requirements	
Goal:	Students know about political institutions, actors and decision-making processes of climate policy. They are able to work on questions such as why do some interests groups have more influence in political processes than others? Students know about main empirical social science methods, types of data, and techniques for collecting social science data. They can decide for and apply different methods for different kinds of research questions (policy analysis, constellation analysis, network analysis). In addition, they can develop and discuss a variety of governance concepts.
Content:	Students gain a comprehensive knowledge about different social science research methods: - Selection of methods, types of data, and techniques for collecting social science data; - Learning about differences between research using qualitative and quantitative methods - Analyzing data sets, and correctly interpreting questionnaires, in-depth semi-structured interviews, focus groups, case studies - Formulating relevant and precise research questions and hypotheses - Selecting appropriate research strategies and methods fitting the research questions - Active Learning Exercises for Research Methods in Social Sciences
Recommended related elective modules :	
Competences:	Technical competence (30%), Methodological competence (50%), Social competence (10%), Personal competence (10%)

Literature:

- Babbie, E. (2010). The Practice of Social Research. Wadsworth Cengage Learning. International Edition.
- Buckles, D. & Rusnak, G. (1999). Cultivating Peace: Conflict and Collaboration in Natural Resource Management. Washington: World Bank Institute.
- Griggs, S., et al. (2014). Practices of freedom. Decentred governance, conflict and democratic participation. Cambridge: Cambridge University Press.
- Kvale, S. (2007). Doing interviews. Los Angeles: SAGE Publications.
- Krueger, R. A. (1994). Focus groups: a practical guide for applied research. Thousand Oaks, Cal.: Sage

M Socio-technical system transformation

Semester:	2
Module coordinator:	Prof. Dr. Heike Walk (heike.walk@hnee.de)
Status:	Mandatory
Goal:	Students are enabled to practically apply theories and concepts of transformation and gain a comprehensive understanding of-, and insights into, different innovation types as part of broader transformation strategies. They learn about actors, strategies and governance of transformation processes. As such, students gain a wide spectrum of conceptual and practice knowledge ranging from socio-technical system transformation up to cooperative forms of organisation.
Examination form	Oral report (100%) (single exam)
ECTS-Credits:	6
SWH:	4

Module Component 1 Transformation governance

Semester:	2
Coordinator:	Prof. Dr. Heike Walk
Lecturer:	Prof. Dr. Heike Walk, Prof. Dr. Benjamin Nölting
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (10 h), Seminar (10 h), Project (10 h), Self-study (45 h)
Max. study places	25
Language:	English
Module type	blocked

Examination form

Oral report (50%)

Entry requirements

Goal:

Students become acquainted with theories and concepts of transformation. They learn about actors, strategies and governance of transformation processes. Of special interest are civil society organizations and social movements. Students learn what a social movement is and about their part in transforming societies and stimulating rapid periods of cultural evolution. Students are enabled to reflect upon the role of civic, private and public sector institutions in transformation processes towards sustainable development.

Content:

Students learn about different concepts and models of transformation and apply them to case studies of UNESCO Biosphere Reserves:

- A social contract for sustainability
- Transformation theories and approaches
- Multi-level perspective
- Transition management
- Coping with dilemmas of resource-oriented management

Students learn about the role of social movements and about their part in transforming societies and stimulating rapid periods of cultural evolution.

- Reflection about civic, private and public sector institutions
- Examples of social movements
- Main characteristics
- Cooperatives and civil society organizations

Recommended related elective modules :

Transformation and Innovation I + II

Competences:

Technical competence (30%), Methodological competence (20%), Social competence (30%), Personal competence (20%)

Literature:

- Beck, G. and Kropp, C. 2012. Die Gesellschaft wird innovativ – und die Wissenschaft von ihr? Zur Einleitung. In Gesellschaft innovativ. Wer sind die Akteure?, eds. G. Beck and C. Kropp, pp. 11-28, Wiesbaden, VS Verlag.
- Borrás, S. and J. Edler. 2012. “The Governance of Change in Sociotechnical and Innovation Systems: Some Pillars for Theory-Building.” Pp. 1–2 in Governance of Innovation and Socio-Technical Systems in Europe: New Trends, New Challenges conference.
- Brand, Ulrich (2016). “Transformation” as a New Critical Orthodoxy. The Strategic Use of the Term “Transformation” Does Not Prevent Multiple Crises. In: GAIA 25/1(2016): 23–27
- Braun-Thürmann, H. 2005. Innovation, Bielefeld: transcript.
- Della Porta, Donatella (ed.). 2014. Methodological practices in social movement research. Oxford: Oxford University Press
- Edquist, C. (ed.) 1997. Systems of Innovation - Technologies, Institutions and Organizations. London, Washington: Pinter Publishers/Cassell Academic.
- Fagerberg, J. and Verspagen, B. 2009. Innovation studies - the emerging structure of a new scientific field. Research Policy 38, pp. 218-233
- Geels, F.W. 2002. Technological transitions as evolutionary reconfiguration processes - A multi-level perspective and a case-study. Research Policy 31, pp. 1257-1274.

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Module Component 2 Innovation types, patterns and processes

Semester: 2

Coordinator: Prof. Dr. Carsten Mann

Lecturer: Prof. Dr. Carsten Mann

ECTS-Credits: 3

SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (10 h), Seminar (10 h), Project (10 h), Self-study (45 h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Oral report (50%)
Entry requirements	
Goal:	Students gain a comprehensive understanding of-, and insights into, different innovation types as part of broader transformation strategies. Guided by a socio-ecological-technical system-based innovation understanding, they are able to differentiate between technology innovations, social innovations, governance and policy innovations as well as innovative forms of organisations related to natural resources provision and use. As such students gain a wide spectrum of conceptual and practice knowledge ranging from technical-production processes such as for bioenergy up to cooperative forms of organisation.
Content:	Central themes/topics of this module component are: - Introduction to concepts and criteria of innovation systems and patterns of change; - Introduction to concepts of different innovation types, -patterns and innovation journeys; - Insights into different approaches for innovation testing, assessment, management, and transfer; - Elaboration of ideas of responsible innovation; - Presentations and experience of examples of innovation types and assessment methods
Recommended related elective modules :	Transformation and Innovation I + II
Competences:	Technical competence (40%), Methodological competence (20%), Social competence (20%), Personal competence (20%)
Literature:	- Borrás, S. and J. Edler. 2012. “The Governance of Change in Sociotechnical and Innovation Systems: Some Pillars for Theory-Building.” Pp. 1–2 in Governance of Innovation and Socio-Technical Systems in Europe: New Trends, New Challenges conference. - Braun-Thürmann, H. 2005. Innovation, Bielefeld: transcript. - Edquist, C. (ed.) 1997. Systems of Innovation - Technologies, Institutions and Organizations. London, Washington: Pinter Publishers/Cassell Academic. - Fagerberg, J. and Verspagen, B. 2009. Innovation studies - the emerging structure of a new scientific field. Research Policy 38, pp. 218-233

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E Water- and Nutrientmanagement[I]

Semester:	2
Module coordinator:	Prof. Dr. Jens Schröder (jens.schröder@hnee.de)
Status:	Elective
Goal:	Students gain a comprehensive understanding of the fundamentals and the relevance for society of water and nutrient sustainability in forest ecosystems, leading to applicable knowledge on the opportunities of forest management to actively support the delivery of various ecosystem services.
Examination form	Project Presentation (100%) (single exam)
ECTS-Credits:	6
SWH:	4

Module Component 1 Water Management

Semester:	2
Coordinator:	Prof. Dr. Jens Schröder
Lecturer:	Prof. Dr. Jens Schröder et al.
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (10 h), Seminar (10 h), Project (10 h), Self-study (45 h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Project Presentation (50%)
Entry requirements	
Goal:	Students are able to explore the close interrelations between forests and water. They can build on insights from forest site classification systems as well as

forestry-related hydrological-meteorological findings, and understand the relevancy of forest management for water regulation in the light of global change problems. They can examine and debate the particular role of forests and its water regulation and adaptation abilities, its influence on water and heat systems, buffer functions and risks. The fundamental importance of water availability for ecosystem services will be highlighted together with management options for forests supporting their adaptive capacity. Students can recognise various context conditions, institutional frameworks and social demands for the use of water resources and elaborate sustainable water management strategies.

Content:

The module will cover the two sub-topics in a closely connected approach. The scientific basis will be revisited and expanded, and the opportunities and challenges for forest management in a wider context of societal needs under different conditions will be explored Main focal points comprise

- Differences between managed forests and natural forests in terms of water and nutrient cycles
- Relevance of forest management for water regulation in the light of local to global change problems
- Water and nutrients as key elements in maintaining sustainability of forest land use and of provision of other services
- Reflection of forest and other land-use history as constraints of future strategies Context conditions and the role of social and political frameworks
- Opportunities of decision support via models and scenario studies
- Adaptation and resilience as central concepts of forest management for water and nutrients sustainability

Recommended related elective modules :

Competences:

Technical competence (40%), Methodological competence (40%), Social competence (10%), Personal competence (10%)

Literature:

- Buckles, D. & Rusnak, G. (1999). Cultivating Peace: Conflict and Collaboration in Natural Resource Management. Washington: World Bank Institute.
- Fujimori, T. (2001). Ecological and Silvicultural Strategies for Sustainable Forest Management. Elsevier, Amsterdam, New York, Tokyo.
- Kimmins, J. P. (2003). Forest Ecology. Third Edition; Prentice Hall, Oxford
- Pretzsch, H. (2009). Forest dynamics, growth and yield: From measurement to model. Springer Verlag, Berlin.
- vanDijk, A. I:; Keenan, R. J.(eds.) (2007). Planted Forests and Water. Forest Ecology and Management 251 (Special Issue), 128 pp.

Module Component 2 Nutrient Management

Semester:

2

Coordinator:	Prof. Dr. Jens Schröder
Lecturer:	Prof. Dr. Jens Schröder et al.
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (10 h), Seminar (10 h), Project (10 h), Self-study (45 h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Project Presentation (50%)
Entry requirements	
Goal:	Students get to know relevant nutrient cycles, their importance for functioning forest ecosystems stability, robustness and resilience, and possibilities of influencing them as part of forest and water management strategies.
Content:	The module will cover the two sub-topics in a closely connected approach. The scientific basis will be revisited and expanded, and the opportunities and challenges for forest management in a wider context of societal needs under different conditions will be explored Main focal points comprise - Differences between managed forests and natural forests in terms of water and nutrient cycles - Relevance of forest management for water regulation in the light of local to global change problems - Water and nutrients as key elements in maintaining sustainability of forest land use and of provision of other services - Reflection of forest and other land-use history as constraints of future strategies Context conditions and the role of social and political frameworks - Opportunities of decision support via models and scenario studies - Adaptation and resilience as central concepts of forest management for water and nutrients sustainability
Recommended related elective modules :	
Competences:	Technical competence (50%), Methodological competence (20%), Social competence (10%), Personal competence (20%)

Literature:

- Bolte, A. et al. (2009). Adaptive forest management in central Europe: Climate change impacts, strategies and integrative concept. Scandinavian Journal of Forest Research 24 (6): 473-482, doi: 10.1080/02827580903418224
- Lamprecht, H. (1989). Silviculture in the Tropics. Paul Parey, Hamburg & Berlin.
- Kimmins, J. P. (2003). Forest Ecology. Third Edition; Prentice Hall, Oxford
- Role of tree size in moist tropical forest carbon cycling and water deficit responses. New Phytologist, doi: 10.1111/nph.14633.Pretzsch, H. (2009). Forest dynamics, growth and yield: From measurement to model. Springer Verlag, Berlin.
- vanDijk, A. I:; Keenan, R. J.(eds.) (2007). Planted Forests and Water. Forest Ecology and Management 251 (Special Issue), 128 pp.

E Transformation Pioneers II

Semester:	2
Module coordinator:	Prof. Dr. Heike Walk (heike.walk@hnee.de)
Status:	Elective
Goal:	Students are able to apply competences in interdisciplinary scientific work and self-management in order to plan their own transformation project of moderate scope. The orientation of the project corresponds to the goals of the study programme and leads to an entrepreneurship that supports sustainability transformation.
Examination form	Project report (100 %)
ECTS-Credits:	6
SWH:	4

Module Component 1 Transformation Pioneers

Semester:	2
Coordinator:	Prof. Dr. Heike Walk
Lecturer:	Prof. Dr. Heike Walk
ECTS-Credits:	6
SWH:	4
Workload:	150 h / Semester
Teaching form	Lecture (10h), Seminar (20h), Project (30h), Self-study (90h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Project report (100 %)
Entry requirements	

Goal:	Students are able to apply competences in interdisciplinary scientific work and self-management in order to plan their own transformation project of moderate scope. The orientation of the project corresponds to the goals of the study programme and leads to an entrepreneurship that supports sustainability transformation.
Content:	The module component deals with all relevant aspects of planning a project: defining aims and target groups; developing the strategy; planning the implementation of the project in terms of tasks, costs, team and time; and developing a fundraising strategy. We will reflect on the things we are concerned about with regards to the way our society is organized. We will gather these topics and talk about the obvious key aspects of an unsustainable growth. We look at the role of social movements in modern societies and assess why they are important for certain phases. Based on this, we plan our own transformation project.
Recommended related elective modules :	
Competences:	Technical competence (30%), Methodological competence (30%), Social competence (20%), Personnel competence (20%)
Literature:	German Advisory Council on Global Change (WBGU), 2011: World in Transition - A Social Contract for Sustainability German Advisory Council on Global Change (WBGU), 2014: Climate Protection as a World Citizen Movement, Berlin Hamann, A., Zea-Schmidt, C., Leinfelder, R. (eds.) 2014: The Great Transformation. Climate - Can We Beat the Heat? Berlin Mc Call, B./ von den Dool, J. , 2013: Hosting Transformation" - Pioneers of Change, Melk, Donau, Austria

M Project management and communication

Semester:	3
Module coordinator:	Prof. Dr. Carsten Mann (carsten.mann@hnee.de)
Status:	Mandatory
Goal:	This module enables students to plan and successfully carry out their own transformation project. It introduces the conceptual foundation, necessary management tools as well as the communication and dissemination strategies to students providing them with a set of means for successfully carrying out and communicating their project in the 3rd FST semester.
Examination form	Project report (100 %) (single exam)
ECTS-Credits:	6
SWH:	4

Module Component 1 Project design and management

Semester:	3
Coordinator:	Prof. Dr. Carsten Mann et al.
Lecturer:	Prof. Dr. Carsten Mann et al.
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Seminar (15h), project (15h), Self-study (45h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Project report (50 %) (part of exam)

Entry requirements	
Goal:	The module component helps students to plan their own transformation project of moderate size related to the study program's content. It takes them step by step from the first idea to a detailed project concept. Students acquire further skills in interdisciplinary scientific work and self-management.
Content:	The module component deals with all relevant aspects of planning a project: defining aims and target groups; developing the strategy; planning the implementation of the project in terms of tasks, costs, team and time; and developing a fundraising strategy. We will reflect on the things we are concerned about with regards to the way our society is organized. We will gather these topics and talk about the obvious key aspects of an unsustainable growth. We look at the role of social movements in modern societies and assess why they are important for certain phases. Based on this, we plan our own transformation project.
Recommended related elective modules :	
Competences:	Technical competence (30%), Methodological competence (50%), Social competence (20%), Personal competence (30%)
Literature:	- German Advisory Council on Global Change (WBGU), 2011: World in Transition - A Social Contract for Sustainability - German Advisory Council on Global Change (WBGU), 2014: Climate Protection as a World Citizen Movement, Berlin - Hamann, A., Zea-Schmidt, C., Leinfelder, R. (eds.) 2014: The Great Transformation. Climate - Can We Beat the Heat? Berlin - Mc Call, B./ von den Dool, J. , 2013: Hosting Transformation" - Pioneers of Change, Melk, Donau, Austria

Module Component 2 — Communication and dissemination

Semester:	3
Coordinator:	Prof. Dr. Carsten Mann
Lecturer:	Prof. Dr. Carsten Mann
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Seminar (15h), project (15h), Self-study (45h)
Max. study places	25
Language:	English

Module type	blocked
Examination form	Project report (50 %) (part of exam)
Entry requirements	
Goal:	Students get to know strategies for scientific communication, moderation and marketing. They are able to communicate results to expert and lay audience and get to know a range of dissemination strategies and media.
Content:	The module component deals with: - Objectives and fundamentals for science Communication and Public Engagement - Identifying the target audience - Social media channels for science communication and dissemination and debate - Challenges in science communication - An orientation for successful science communication - Students will present their project in a five-minute slot. Each presentation is followed by group discussion analysing the effective and ineffective points.
Recommended related elective modules :	
Competences:	Technical competence (30%), Methodological competence (50%), media competences (20) Social
Literature:	Literature will be announced at the beginning of the course.

M Research Project

Semester:	3
Module coordinator:	Prof. Dr. Carsten Mann (carsten.mann@hnee.de)
Status:	Mandatory
Goal:	The students accomplish a research project of moderate size related to the study programme's content. With the selected thematic orientation of the project, students can fullfill, in addition to the two complementary elective modules, their study orientation.
Examination form	Project report (100%) : Exam not graded (evaluated as "passed" / "not passed")
ECTS-Credits:	24
SWH:	20

Module Component 1 Research Project

Semester:	3
Coordinator:	Prof. Dr. Carsten Mann
Lecturer:	Prof. Dr. Carsten Mann, Prof. Dr. Tobias Cremer et al.
ECTS-Credits:	24
SWH:	20
Workload:	600 h / Semester
Teaching form	Project (300 h), Self-study (300 h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Project report (100 %) (not graded)
Entry requirements	
Goal:	The students accomplish a research project of moderate size related to the study programme's content. With the selected thematic orientation of the project,

	students can full fill, in addition to the two complementary elective modules, their study orientation.
Content:	The students accomplish a research project of moderate size related to the study programme's content. With the selected thematic orientation of the project, students can full fill, in addition to the two complementary elective modules, their study orientation.
Recommended related elective modules :	
Competences:	Technical competence (25%), Methodological competence (25%), Social competence (20%), Personal competence (30%)
Literature:	

M Master thesis colloquium

Semester:	4
Module coordinator:	Prof. Dr. Carsten Mann (carsten.mann@hnee.de)
Status:	Mandatory
Goal:	Students learn and improve their abilities to discuss and present their Master thesis topics, their thesis design, their conceptual orientation, the expected results and challenges in small groups and in plenum for generating thematic, methodological and didactic feedback.
Examination form	Project presentation (100%)
ECTS-Credits:	4
SWH:	2

Module Component 1 Master thesis colloquium

Semester:	4
Coordinator:	Prof. Dr. Carsten Mann
Lecturer:	Prof. Dr. Carsten Mann et al.
ECTS-Credits:	4
SWH:	2
Workload:	100 h / Semester
Teaching form	Seminar (30 h), Self-study (70 h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Project presentation (100%)
Entry requirements	

Goal:	Students have to discuss and present their Master thesis topics, thesis design, conceptual orientation and expected results and challenges (in small groups and in plenum).
Content:	Students have to discuss and present their Master thesis topics, thesis design, conceptual orientation and expected results and challenges (in small groups and in plenum).
Recommended related elective modules :	
Competences:	Technical competence (20%), Methodological competence (40%), Social competence (10%), Personal competence (30%)
Literature:	

M Master thesis and defence

Semester:	4
Module coordinator:	Prof. Dr. Carsten Mann (carsten.mann@hnee.de)
Status:	Mandatory
Goal:	Students obtain own research results while solving and discussing a scientific problem. Students present the research results of their master thesis and are able to defend its underlying assumptions, methodologies, and robustness of the key findings.
Examination form	Project report (70%), Project presentation (30%)
ECTS-Credits:	26
SWH:	20

Module Component 1 Master thesis and defence

Semester:	4
Coordinator:	Prof. Dr. Carsten Mann
Lecturer:	Prof. Dr. Carsten Mann et al.
ECTS-Credits:	26
SWH:	20
Workload:	650 h / Semester
Teaching form	Project (350 h), Self-study (300 h)
Max. study places	25
Language:	English/ German (tbd)
Module type	Blocked
Examination form	Project presentation (100%)
Entry requirements	
Goal:	Students obtain own research results while solving and discussing a scientific problem. Students present the research results of their master thesis and are

	able to defend its underlying assumptions, methodologies, and robustness of the key findings.
Content:	Students obtain own research results while solving and discussing a scientific problem. Students present the research results of their master thesis and are able to defend its underlying assumptions, methodologies, and robustness of the key findings.
Recommended related elective modules :	
Competences:	Technical competence (30%), Methodological competence (30%), Social competence (10%), Personal competence (30%)
Literature:	

From the first semester onwards, students may specialise by choosing compulsory elective modules from one of the following two **fields of specialisation:**

I= Forest Management Strategies for Ecosystem Service Provision (FMS)

II= Transformation and Innovation (T&I)