BOOK OF ABSTRACTS

I. SESSION DESCRIPTION

ID: T11

Interregional flows of ecosystem services / nature contributions to people

Hosts:

	Name	Organisation	E-mail
Host:	Thomas Koellner	University of Bayreuth	thomas.koellner@uni-bayreuth.de
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Abstract:

On this one planet a multitude of ecosystem services (ES) / nature contributions to people (NCP) are flowing from regions in which they are provided to regions in which they are utilized. Such ES/NCP flows happen from landscape to regional to global scale. Mechanisms include i) international trade of food, feed, and fibers, ii) biophysical flows of regulating services, iii) flows mediated through migrating or dispersing species, and iv) information flows related to cultural services. The recent pandemics and geopolitical conflicts show the vulnerability, but also the necessity of the sustainable management of such interregional telecoupling. The European Union`s Regulation on Deforestation-free products from 2023 is a step towards this. Still, regional and national studies still often neglect the dependence on distant ES/NCP and regularly disregard off-site effects in provision and use of ES/NCP. However, it is important to consider interregional flows of ES/NCP as they can cause telecouplings between regions. Through such telecouplings, a change in supplying ecosystems can affect ES/NCP beneficiaries in distant demand regions, but also the other way around ES/NCP demand can cause environmental problems in distant supply regions. For instance, inequalities originated in telecoupled systems could lead these systems to fall into maladaptive situations or socio-ecological traps. Ultimately,

policies aiming at enhancing ES/NCP in a region should not lead to ecosystem damage elsewhere. To cover this field the ESP thematic working group "Global Ecosystem Service Flows (TWG 11)" was installed during the World Conference in 2015 in South Africa.

This group invites contributions to this session. Submissions should address open research questions related to (i) quantitative assessments of interregional ES/NCP flows and telecouplings, incl. (spatial) and long-term modelling of sending and receiving regions, and accounting for ES/NCP and biodiversity embedded in these flows, (ii) quantification of drivers behind these different interregional flows (iii) the evaluation of such flows in terms of effects, i.e. benefits, damages, inequalities and sustainability both in sending and receiving regions, (iv) motivations and perceptions of different actors involved (v) options to better govern interregional conservation of biodiversity and management of ES/NCP. We welcome studies from both broad range of disciplines investigating effects of telecouplings from a biophysical as well as from a social/economic perspective in all types of habitats (i.e. marine, freshwater and terrestrial ecosystems). Specifically, linkages to the conference theme OneHealth are encouraged.

Goals and objectives of the session:

This session aims at exchange on methods and applications how to complement regional assessments of ES/NCPs with an interregional assessment of ecosystem flows to and from a specific region. This opens the possibility to present work relevant for ES/NCP on material flow analysis of trade, embodied water and land, environmental footprints as well as life cycle assessment. This session should also bring together researchers from different disciplines investigating inequality effects, valuation and sustainable managements of telecoupling from a social, economic and/or ecological perspective.

Planned output / Deliverables:

We will discuss the creation of a focus group working towards a joint position paper specifically on inequalities, power asymmetries, social-ecological-economic effects, etc. resulting from interregional ecosystem service flows.

II. SESSION PROGRAM

Room: Expert Street 8

Date of session: 20th of November 2024

Time of session: 11:00 – 12:30

Timetable speaker

Time	First name	Surname	Organization	Title of presentation
11:00	Alexandra	Marques	PBL Netherlands Environmental Assessment Agency, The Netherlands	The role of Nature's Contributions to People in sustaining international trade of agricultural products
11:12	Gabriela	Rabeschini	Senckenberg Biodiversity and Climate Research Center, Germany	Quantifying Nature's contributions to people embedded in international food trade
11:24	Anna	Mayer	Leuphana University of Lüneburg, Germany	Beyond boundaries: Identifying telecoupled flows of anthropogenic capitals in the co-production of nature's contributions to people
11:36	Davina	Vackarova	Charles University, Czech Republic	Conceptualizing ecosystem services footprint to unveil effects of consumption and international trade on ecosystem services
11:48	Charis	Chalkiadakis	University of Twente, The Netherlands	Large-scale fisheries of West Africa: A regional assessment of benefit flows using a spatiotemporal approach
12:00	Jakob	Bogenreuther	University of Bayreuth, Germany	Biodiversity impact of food waste: Quantification for supply chain stages and products in Germany
12:12	Evangelia	Drakou	Harokopio University of Athens, Greece	Transforming telecoupled supply chains through integrated modelling and participatory approaches

III.ABSTRACTS

The first author is the presenting author unless indicated otherwise.

1. Biodiversity impact of food waste: Quantification for supply chain stages and products in Germany

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Reducing food waste could lower pressures on land resources in supply regions and thereby contribute to the mitigation of global biodiversity loss. However, which supply chain stages and food products to target with policy measures is hardly known. Especially, a differentiation of the impact after taxa and finding the country of origin for single feed products is still missing and is therefore quantified in the present study. The food waste mass at supply chain stages and sub-stages in Germany was calculated and differentiated after 204 food products. All products were traced back to their countries of origin, using data on production and bilateral trade and converting animal products into their feed demand. Via the land cover of cropland and pastures, the impact on mammals, birds, amphibians, reptiles, and plants was quantified. Germany's avoidable food waste (food that was edible before its disposal) leads to 0.3 vertebrate and 1.5 plant species being potentially lost globally. Household-level waste is responsible for 47 % of this species loss, while food services show the largest impact per mass. The most influential products are obtained from pigs and cattle. The impact of beef consumed in Germany is twice as high as that of beef produced in Germany because the mix of countries for the feed is different. For meat from sheep, the impact is even more than ten times higher. 82 % of the impact on vertebrate taxa and 92 % of the impact on plants occur outside of Germany. Among vertebrate taxa, mainly amphibians are affected, occurring in the mainly affected country Brazil. The results can be used to formulate policies that inform consumers about the impact of food waste in supply regions or display the impact of animal products and their feed demand.

Keywords: species loss, food waste, environmental impact, value chain, animal products

2. Large-scale fisheries of West Africa: A regional assessment of benefit flows using a spatiotemporal approach

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This study investigates the impact of large-scale fisheries on the marine biodiversity and ecosystem services within the waters of West Africa. Over the past decade, increased Distant Water Fleet (DWF) presence and industrial growth in Mauritania, Senegal, Gambia and G. Bissau has led to the depletion of fish stocks, exacerbating food and job insecurity. These phenomena, coupled with a weak system of governance, illegal, unreported, and unregulated fishing (IUU) and low-value addition, has led to losses in market shares and income. It has also contributed to marine coastal pollution and to an extent decreased seawater quality caused by discharges from fish processing facilities along the coastline with a final impact on human well-being and quality of life. Our research extends current knowledge by assessing marine ecosystem service flows throughout the extent of different Exclusive Economic Zones (EEZs) within and across the scale of the marine ecosystems. We quantify and map interactions between domestic, regional, and DWF fishing activities and analyse how exports and trade impact the marine social-ecological system, considering environmental and societal costs and benefits across value chains. The study also examines the role of intermediaries such as actors or entire countries involved in the process of value addition across the supply chain. By integrating socioeconomic and environmental variables with proximity indicators, we analyse the magnitude of ecosystem service flows and model these contributions through an ecosystem service flow index based on a set of transfer mechanisms. The resulting maps illustrate the flow of marine ecosystem services to beneficiaries across ecosystems. Additionally, our maps show vulnerabilities among beneficiary groups and flow hotspots. This research provides crucial insights into the role of beneficiaries across the value chain, thereby aiding the decision-making process to preserve local and regional biodiversity and recommend interventions for informed management of marine ecosystems.

Keywords: Multi-dimensional approach, Assessment, Composite indicator, Resources distribution, Origin-Destination maps

3. Transforming telecoupled supply chains through integrated modelling and participatory approaches

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The constantly declining condition of biodiversity and the ecosystem services, made it clear that there is a need for regional, national and local policy measures to substantially change, through transformation, from their design, up to the targets that are set. This becomes even more important yet challenging, under the prism of globalization, in which pressure on biodiversity and ecosystems is magnified through a continuous demand for local biodiversity outcomes, globally.

Within the BIOTRAILS Horizon Europe project, we focus on four telecoupled systems: fisheries and aquaculture outputs from Greece, cocoa from Peru, arts and crafts from Brazil and gold from Ghana. We analyzed the social parameters that could tentatively induce transformation along the supply chain. We conducted face to face interviews and surveys, with stakeholders from all parts of the supply chain. We used the Theory of Planned Behavior to explore how factors that describe individuals' Social Norms, Perceived Behavior Control and Attitude, shape their intention to adopt sustainable and biodiversity-friendly practices. The collected information was used to develop causal inference, through structural equation modelling. Our analysis revealed that across three supply chains trust in policies and the influence of social circles are shared and critical to shape individuals' decisions. Depending on the political and social context of the case studies, some parameters were more prevalent across case study. For instance lack of continuous training within all levels of employees within the aquaculture sector was identified as a critical point which might ensure transformation. Improvement of and transparency in the decision-making instruments was also highlighted in the gold case study. The produced outcomes are expected to feed into a larger system dynamics model, which takes into account the impact of these social norms in the entire supply chain system, from the point of supply up to the final consumption and use.

Keywords: Structural Equation Models, Participatory system dynamics models, cocoa, fisheries, gold

4. The role of Nature's Contributions to People in sustaining international trade of agricultural products

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Nature's Contributions to People (NCP) are essential for the production and trade of agricultural, forestry, and fishery commodities. Often, there is a spatial disconnect between consumers and the natural systems where the commodities are produced. Traded agricultural products are therefore dependent on nature and NCP in their region of origin. The dependencies of agricultural products on NCP are, however, insufficiently recognized by consumers and are rarely considered in global environmental governance and trade policies along value chains. Here, we synthesize studies highlighting dependencies of agricultural products on NCP in their origin locations to identify opportunities and challenges in quantifying their contribution in sustaining trade flows. We suggest three methodological steps for quantifying NCP dependencies in international agricultural trade: spatial mapping of NCP supply and demand, linking NCP to agricultural trade flows, and tracing trade flows. Each methodological step requires further development and harmonisation to enable a complete accounting of how international agricultural trade depends on NCP. Given the lack of knowledge and data on how NCP support agricultural trade, social and environmental trade-offs of natural resource management are currently hard to quantify. Quantifying the role of NCP dependencies of traded agricultural products can support their sustainable management, contribute to supply chain accountability, and serve as input to sustainable natural resource governance and foster responsibility and equity in supply chains.

Keywords: Nature's contributions to people (NCP), dependencies, telecoupling, international agricultural trade, supply chains

5. Beyond boundaries: Identifying telecoupled flows of anthropogenic capitals in the co-production of nature's contributions to people

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Telecoupling provides a lens to examine the interconnectedness of social-ecological systems (SES). Whilst considerable attention has been paid to the telecoupled flows of nature's contributions to people (NCP), little is known about the telecoupling of anthropogenic capitals - namely human, social, physical, and financial capital- that co-produce these NCP. We address this gap focusing on telecoupled flows of anthropogenic capitals in timber production, carbon storage in forests, and fodder production, pest control, and carbon storage in grasslands across three German case study sites. We understand these sites as receiving systems and identify the sending systems from which telecoupled flows of anthropogenic capitals originate. We conducted semi-structured interviews with forestry and agricultural stakeholders to explore how local and telecoupled capital flows underpin NCP co-production, and influence land use management. We use content analysis to formulate questions for a quantitative survey on telecoupling flows. The survey results will serve as a basis for creating degrees of telecoupling for each land management unit, such as a farm or a forest district, which will demonstrate the differences between anthropogenic capitals underpinning NCP co-production. For example, financial and physical capital may be telecoupled to a greater extent than social and human capital, given that resources such as agricultural machinery and subsidies frequently necessitate sourcing from distant systems. Consequently, the degree of telecoupling and reliance on telecoupled anthropogenic capitals will depend on land management approaches taken. Identifying patterns and dependencies in the telecoupling of anthropogenic capitals critical to NCP co-production highlights how reliance on telecoupled capitals can render land management units susceptible to global market fluctuations and geopolitical issues. By identifying these vulnerabilities in SES, strategies can be developed to enhance sustainability and resilience by diversifying capital sources or creating local alternatives, promoting sustainable NCP co-production and reducing dependence on globalised markets.

Keywords: Telecoupling, Anthropogenic capitals, Nature's contributions to people, Social-ecological systems, Land use management

6. Quantifying Nature's contributions to people embedded in international food trade

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In telecoupled agri-food systems, NCP embedded in agricultural products are traded from sending to receiving systems, which are ecologically connected. This interlinkage is however not fully accounted for along value chains. Here, we quantify a regulating (pollination) and a non-material (supporting identities) NCP supporting the coffee and soy trade from Brazil's municipalities to their importing countries. For both crops, we estimate the spatial match between pollination demand and supply and the proportion of overall production potentially resulting from pollination at municipality level. Based on literature review, we identify proxies for components of nature supporting identities of coffee and soy farmers in Brazil and build municipal typologies with four categories for coffee (farm size, coffee species, Geographical Indication of origin and natural habitat integration) and three for soy (farm size, natural habitat integration and seed type). In the municipalities analysed, there is a pollination deficit (low supply and high demand) in 76 municipalities responsible for 34% of coffee production, and in 365 municipalities responsible for 68% of soy production. Approximately 25% of coffee and 16% of soy production may be attributed to pollination, with highest percentages in municipalities at the west coast for coffee and at the south for soy. Most coffee production is in municipalities characterized by smallholders, arabica coffee, with Geographical Indication and above average nature integration. Most soy producing municipalities are characterized by smallholders, modified seeds, and above average nature integration; however, more than half of production is in municipalities characterized by not-smallholders, modified seeds, and below average nature integration. Following, coffee and soy trade flows from these municipalities to their importing countries will be linked to the results. Mapping and tracing these NCP through the supply-chain will help to shed light on how trade dynamics relate to natural and cultural resource use in telecoupled agri-food systems.

Keywords: agri-food systems, pollination, supporting identities, coffee, soy

7. Conceptualizing ecosystem services footprint to unveil effects of consumption and international trade on ecosystem services

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International trade has recently attracted attention as an important driver of ecosystem services loss. Several studies document the increasing impact of international trade on ecosystem services and their economic value. Consumption in wealthy countries displaces environmental impacts beyond their borders and creates global tele-connections. Therefore, consumption takes a toll on nature in regions serving as a source of ecosystem services. Distant impacts on ecosystem services abroad are not visible to consumers nor are they accounted for in the value of traded products. The burden on ecosystem services resulting from the appropriation and conversion of ecosystems has been overlooked in global telecoupling studies.

In this contribution, we present a concept of "ecosystem services footprint" within the framework of environmental footprint family indicators. Traditionally, environmental footprints such as the carbon footprint, water footprint, material footprint or ecological footprint have focused on quantifying the direct and indirect pressures human activities place on specific environmental assets. We illustrate the concept by the analysis of the economic value of ecosystem services lost due to land conversion and production of crops, which are either directly traded internationally or enter supply chains of international trade and are induced by final demand abroad. Within the Multi-regional input-output analysis framework, we report the ecosystem services loss footprint for 49 countries and world regions based on EXIOBASE and FAOSTAT data. We discuss future outlook and policy implications, including ecosystem services accounting.

Ecosystem service footprint analysis can further contribute to studies on the role of consumer behaviour, dietary transitions and values in reducing our environmental impact on ecosystem services.

Keywords: Environmental footprint, Ecosystem services, Multi-regional input-output analysis, International trade, Final consumption