



BOOK OF ABSTRACT

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I. SESSION DESCRIPTION

ID: T11

Tele-coupling through flows of ES from regional to global scales

	Title	Name	Organisation	E-mail
Host:	Prof. Dr.	Thomas Koellner	University of Bayreuth, Germany	thomas.koellner@uni-bayreuth.de
	Dr.	Maria Felipe-Lucia	iDiv, Germany	maria.felipe-lucia@idiv.de
Co-host(s):		Felipe Benra	iDiv, Germany	felipe.benra@idiv.de
	Dr.	Nynke Schulp	VU University, The Netherlands	nynke.schulp@vu.nl
	Dr.	Matthias Schröter	UFZ, Germany	matthias.schroeter@ufz.de
	Prof. Dr.	Aletta Bonn	iDiv, Germany	aletta.bonn@idiv.de

Abstract:

A multitude of ecosystem services (ES) are flowing from regions in which they are provided to regions in which they are used. Such ES 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 recently published IPBES report for Europe and Central Asia has found a strong reliance of the region on ES provided elsewhere. It has also pointed to knowledge gaps with respect to regulating and cultural ES. Regional and national studies often neglect the dependence on distant ES and regularly disregard off-site effects in provision and use of ES. However, it is important to consider interregional flows of ES as they can cause telecouplings between regions. Through such telecouplings, a change in supplying ecosystems can affect ES beneficiaries in distant demand regions, but also the other way around ES 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



in a region should not lead to ecosystem damage elsewhere. To cover this field a new 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 flows and telecouplings, incl. (spatial) and long-term modelling of sending and receiving regions, and accounting for ES 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. We welcome studies from both the natural and social sciences 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).

Goals and objectives of the session:

This session aims at exchange on methods and applications how to complement regional assessments of ecosystem services with an interregional assessment of ecosystem flows to and from a specific region. This opens the possibility to present work relevant for ecosystem services 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 of telecouplings from a social and/or ecological perspective.

Planned output / Deliverables:

The output planned is to create 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.

Related to ESP Working Group/National Network:

[Thematic working group: TWG 11 – Global ES Flows](#)



II. SESSION PROGRAM

Date of session: Thursday, 24 October 2019

Time of session: 10:30 – 15:00

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
10:30–10:45	Nynke	Schulp	Vrije Universiteit Amsterdam	Distant trade offs of sustainable agriculture in the European Union
10:45–11:00	Giorgio	Bidoglio	Senckenberg Institute for Biodiversity and Climate Research (SBIK-F)	Does trade drive intensification of land use? Analyzing patterns of land system change in a tele-coupled world
11:00–11:15	Ervin	Kosatka	University of Bayreuth	Quantifying the flows of ecosystem services from USA to Israel based on the trade flows of wheat, maize, and soybean
11:15–11:30	Hendrik	Wolter	University of Oldenburg	Tele-coupling effects in fruit breeding and cultivation
11:30–11:45	Dava	Vackaru	Global Change Research Institute of the Czech Academy of Sciences	Quantifying embodied NPPpot of agricultural production in international trade and implications for ecosystem services
11:45–12:00	Uta	Schirpke	Eurac Research	Spatial mismatches, interactions and dependencies of ecosystem services from mountain regions
13:30–13:45	Caroline	Bosire	International Livestock Research Institute	The effect of changing meat and milk production and consumption on future water and land footprints in Kenya
13:45–14:00	Felipe	Benra	German Centre for Integrative Biodiversity Research	Ecosystem Services inequalities arising from non-native tree plantations telecouplings in southern Chile
14:00–14:15	Berta	Martín-López	Leuphana University	A novel telecoupling framework to assess social relations across spatial scales for ecosystem services research



14:15–14:30	María	Felipe-Lucia	Helmholtz Centre for Environmental Research & German Centre for Integrative Biodiversity Research	Inequalities derived from telecoupled effects of ecosystem services on health
14:30–14:45	María	Felipe-Lucia	see above	Discussion on TWG11 activities: methods and approaches to analyze inequalities derived from interregional ecosystem service flows, possibility of joint position paper.
14:45–15:00	Thomas	Koellner	University of Bayreuth	Discussion on TWG11 activities: future research need and collaboration

III. ABSTRACTS

The abstracts appear in alphabetic order based on the last name of the first author. The first author is the presenting author unless indicated otherwise.

1. Type of submission: **Abstract**

T. Thematic Working Group sessions: T11 Tele-coupling through flows of ecosystem services from regional to global scales



Ecosystem Services inequalities arising from non-native tree plantations telecouplings in southern Chile

First author: Felipe Benra

Other author(s): Laura Nahuelhual, María Felipe-Lucía, Aletta Bonn

Affiliation: UFZ – Helmholtz Centre for Environmental Research, Department of Ecosystem Services, Leipzig, Germany

Contact: felipe.benra@idiv.de

Non-native tree plantations (NNTP) are an increasingly relevant global source of timber and subject to telecoupling because they form socio-ecological systems that connect long-distance local, regional and global socio-economic and environmental drivers. In this context, Chile is increasingly gaining the role of an export oriented and natural resource dependent economy, with NNTP forestry as a main pillar. As such, NNTP expansion may lead to tradeoffs with important local ecosystem services (ES) and trigger in social, ecological and economic inequalities, which need to be evaluated for a sound and sustainable landscape planning.

We assessed the inequality effects of Chile's NNTP exports using publicly available national forestry export records and socio-economic data. We evaluated if telecouplings are the underlying cause or consequence of inequalities by performing a spatial-temporal analysis of NNTP exports at the national, municipal and farm property level. We further assessed ES change by analyzing tradeoffs in ES supply. We hypothesize that telecoupled effects of NNTP reduce provision of other ES (e.g water supply; native forest timber), do not increase economic wealth of local populations and increase land tenure inequality.

Telecoupling may act as a reinforcing mechanism of inequalities, both as a cause and a consequence. If NNTP continue to expand at a high rate and under the current management (large scale monocultures intended for export), significant ES supply changes are inevitable. These results can inform landowners, landscape planners and governments of the telecoupled effects of NNTP to better anticipate and mitigate inequalities arising from afforestation.



Keywords: Chile, inequality, ES supply, export, non-native tree plantations, socio-environmental conflict

2. *Type of submission:* **Abstract**

T. Thematic Working Group sessions: T11 Tele-coupling through flows of ecosystem services from regional to global scales

Does trade drive intensification of land use? Analyzing patterns of land system change in a tele-coupled world

First author: Giorgio Bidoglio

Other author(s): Thomas Kastner

Affiliation: Senckenberg Biodiversity and Climate Research Centre (SBK-F), Frankfurt am Main, Germany

Contact: giorgio.bidoglio@senckenberg.de

In our globalized world, local impacts of agricultural production are increasingly driven by consumption in geographically distant places. Due to growing population, changing diets and increasing energy demand, the international trade of biomass products (i.e. food, feed, energy) is expected to surge in the next decades. Boosting agricultural production through intensification is expected to meet most of the increasing demand for biomass, especially through high-yield crops in developing countries. Historically, enhancing crop production has relied on the conversion of natural ecosystems into agricultural land, as well as on the intensification of land already in use by raising the output per unit area through e.g., tillage, improved irrigation, fertilizer application. Yet, land use intensification involves ecosystem degrading activities. Fertilizers, in particular, are linked to eutrophication of waterbodies, loss of biodiversity and changes in species composition.

Utilizing global spatially explicit data on crop and country specific fertilizers application rates, we develop a classification for land systems according to land-use intensity. We then link these data to a database on global trade and consumption of agricultural products. In this way, we characterize how the different land use intensity classes are distributed along imported and domestically sourced agricultural products. This allows us addressing questions relevant for sustainable management of food production systems and for analyzing trade-offs in land systems:



- How are different land use intensity levels distributed among produced, traded and consumed products?
- Does international trade drive land-use intensification in developing countries?
- Are trade-offs between different ecosystem services predictable along intensification paths?

Keywords: international trade, tele-coupling, land use intensity, agricultural production



3. *Type of submission: Abstract*

T. Thematic Working Group sessions: T11 Tele-coupling through flows of ecosystem services from regional to global scales

The effect of changing meat and milk production and consumption on future water and land footprints in Kenya.

First author: Caroline Bosire

Affiliation: International Livestock Research Institute, Kenya

Contact: kerubo.bosire@gmail.com

Population growth and rising affluence increase the demand for agricultural commodities, while urbanization and globalization enlarge consumer–producer distances. The associated growth in trade in agricultural products results in increasing dependence on natural resources in the producing regions. This study assesses the impact of changing meat and milk consumption on natural resources use in Kenya, considering two socio-economic development scenarios, namely the Business As Usual (BAU) and Kenya Vision 2030 (S2030) scenarios. Two resource use indicators, water footprint and land footprint, are used to represent human appropriation of water and land resources for meat and milk production, trade and consumption in 2030. Overall meat and milk production and consumption are projected to be higher in the S2030 than in the BAU scenario. The fraction of imported meat in total meat consumption is expected to grow between 2009 and 2030 from 37% to 45% in both scenarios. The fraction of imported milk in total milk consumption will remain at 13% in the S2030 scenario but grow towards 20% in the BAU scenario. From 2009 to 2030, the water and land footprints of meat production will grow by 93% and 91% in BAU and by 45% and 23% in S2030. The water and land footprints of milk production will both grow by 59% in BAU and by 18% and 14% in S2030. The use of water and land for producing meat and milk in Kenya will thus grow under both scenarios, but less in S2030 than in BAU, despite the stronger growth of meat and milk consumption per capita in S2030, which can be explained by the smaller population growth in the S2030 scenario and the greater improvements in water and land productivities. Reducing the dependency on foreign land and water resources would require a yet more ambitious policy.

Keywords: livestock, consumption, water and land footprint, virtual water and land trade, water and land dependence



4. *Type of submission: Invited speaker abstract*

T. Thematic Working Group sessions: T11 Tele-coupling through flows of ecosystem services from regional to global scales

Inequalities derived from telecoupled effects of ecosystem services on health

First author: María Felipe-Lucía

Other author(s): Aletta, Bonn

Affiliation: aUFZ – Helmholtz Centre for Environmental Research / German Centre for Integrative Biodiversity Research (iDiv), Germany

Contact: maria.felipe-lucia@idiv.de

Flows of ecosystem services connect people and nature across regions. However, the consequences of such flows for health only start to be identified. For example, there is increasing evidence of the effects of ecosystem service flows through trade, migratory species, passive biophysical flows and information flows on health (telecoupled effects). In this context, we need to understand the characteristics of both sending and receiving systems to foster desired and prevent undesired effects on health. In particular, it is key to identify the mechanisms by which ecosystem service flows have an effect on health, the different social actors involved in each flow, and the ability of these actors to use and manage these services. In this way, we can identify potential imbalances and prevent inequalities derived from the effects of telecoupled ecosystem services on health. In this talk, I will present a review of the existing evidence regarding the linkages between ecosystem service telecouplings and health and how that relates to inequalities. Based on this information, I will show how to operationalize the telecoupling framework to identify social inequalities and some examples of its application with regards to health.

Keywords: ecosystem service flows, teleconnections, health and wellbeing, inequity, trade-offs and synergies



5. *Type of submission: Abstract*

T. Thematic Working Group sessions: T11 Tele-coupling through flows of ecosystem services from regional to global scales

Quantifying the flows of ecosystem services from USA to Israel based on the trade flows of wheat, maize, and soybean

First author: Ervin Kosatica

Affiliation: University of Bayreuth, Professorship of Ecological Services, Germany

Contact: erwin.kosatica@uni-bayreuth.de

This presentation shows the research from the MedWater project and is a part of a more comprehensive assessment of the flows of ecosystem services (ES) to and from Israel. The study offers a detailed investigation of ES in the sending systems, i.e. watersheds in Kansas and Iowa in the USA, with regards to the receiving system in Israel (Koellner et al., 2018). The ES are assessed using the Soil and Water Assessment Tool (SWAT). The study looks at the telecoupling between Israel and USA based on flows of traded goods and impacts on other ES. Specifically, the focus is on the staple crops that are traded worldwide (wheat, maize, soybean), where Israel is almost completely dependent on imports. Due to data availability the study examines the time period 2000–2010 where the majority of wheat, maize, and soybean imports to Israel come from the USA, Brazil, and Ukraine. The USA watersheds are focused on two distinct systems, a semi-arid climate with wheat, maize, and soybean production in Kansas, and production of soybean and maize in a more humid climate in Iowa. The trade data used to identify the major sending systems are national scale. Therefore, without knowing the exact watersheds producing crops for Israel, we model the variety of watersheds that are producing these crops. Both watersheds are relatively large, around 6000km², produce similar crops, and are distinctly agricultural regions. Although SWAT is primarily a hydrological model, its complex hydrological as well as crop growth components have been successfully used in ecosystem services research (Francesconi et al., 2016). SWAT is able to provide indicators for a variety of ES, including food and feed provisioning, regulation of freshwater, and many others. The resulting ES assessment provides an indication of Israel's dependence on ecosystems in the USA, showing the flow of ES to Israel.

Keywords: Ecosystem services flows, Telecoupling, Israel, USA



6. *Type of submission: Abstract*

T. Thematic Working Group sessions: T11 Tele-coupling through flows of ecosystem services from regional to global scales

Spatial mismatches, interactions and dependencies of ecosystem services from mountain regions

First author: Uta Schirpke

Other author(s): Erich Tasser, Ulrike Tappeiner

Affiliation: Institute for Alpine Environment, Eurac Research, Italy

Contact: uta.schirpke@eurac.edu

Mountain environments provide many ecosystem services (ES) to local populations as well as to beneficiaries living in the lowlands. Spatial relationships are complex due to spatial mismatches between areas of provision and those that benefit from provided goods and services. To support the development of policies and a sustainable landscape management, assessments on ES that account for supply, demand and actual use of ES can contribute to an enhanced understanding of the interactions between these components. This contribution therefore examined spatial relationships, interactions and dependencies among supply, demand, and actual use of eight key ES in the European Alps and surrounding lowlands. Our results reveal important supply–use–demand mismatches across landscapes, i.e. more natural mountain regions are hotspots of supply, whereas high demand for ES is mostly associated with highly urbanised areas or intensively used agricultural areas in the lowlands. The results from overlap analysis indicate that the level of supply or demand, or a combination of both, often determines the actual use, but other drivers, such as infrastructure or marketing, play an important role. Moreover, we found that spatial flows of ES from mountain regions range from local to global interactions and mostly go far beyond the regional level. Our findings contribute to an enhanced understanding of ES of mountain regions and inform decision-making in order to support the development of sustainable management strategies. This is particularly important at the regional and cross-national level to assure the ES delivery to the benefitting lowland areas and to adopt a sustainable use of natural resources in service-providing mountain areas.

Keywords: ES mapping, supply–demand mismatches, spatial analysis, mountains, socio-ecological systems



7. *Type of submission: Invited speaker abstract*

T. Thematic Working Group sessions: T11 Tele-coupling through flows of ecosystem services from regional to global scales

Distant trade offs of sustainable agriculture in the European Union

First author: Nynke Schulp

Other author(s): Perrine Laroche, Anna Liza Bais-Moleman

Affiliation: Nynke Schulp, Netherlands

Contact: nynke.schulp@vu.nl

Over the past CAP reforms, the European Union has been shifting away funding from supporting production to supporting sustainable agricultural practices. This shift has been driven by an increasing demand of European consumers by more sustainable agricultural products, as well as more sustainable agricultural landscapes. Existing policies set baselines for permanent pasture for carbon sequestration, setting aside land as ecological focus area, the national scale definition of good agri- environmental practices, as well as the support of rural development. While such measures can contribute fulfilling local demands for public goods from agricultural land, such as flood regulation, opportunities for recreation, and climate regulation, previous research on ecosystem service trade-offs almost consistently shows a risk of trade-offs against agricultural production. In an increasingly telecoupled world, trade-offs that do not need to be solved locally can leak to other parts of the world and impact ecosystem service supply elsewhere through indirect land use change.

In a case study of the European Union, we analyze recent changes and potential future changes in the level of implementation of measures that contribute to improving the environmental sustainability of European agriculture through analysis of farm and landscape data and scenarios. We evaluate how more sustainable agricultural practices can result in indirect land use change and how these indirect land use changes cascade into changes in ecosystem services. We adopt a combination of empirical analysis of farm level data and land use scenario analysis, complemented with spatially explicit indicators for ecosystem services.

Keywords: Trade-offs, sustainable agriculture, climate-smart agriculture, telecoupling



8. *Type of submission: Abstract*

T. Thematic Working Group sessions: T11 Tele-coupling through flows of ecosystem services from regional to global scales

Quantifying embodied NPPpot of agricultural production in international trade and implications for ecosystem services

First author: Dava Vackaru

Other author(s): Jan Weinzettel

Affiliation: Global Change Research Institute of the Czech Academy of Sciences, Czech Republic

Contact: vackar.d@czechglobe.cz

Natural ecosystems provide valuable ecosystem services to human society and preserve original biodiversity. However, in several world regions, natural environment has been replaced by agricultural systems, i.e. cropland and pastures. This transformation of ecosystems led to enhancement of provisioning services (agricultural produce, biofuels and meat) at the cost of loss of many valuable regulating and cultural services.

Net primary production (NPP) has been used as a measure of ecological performance of ecosystems. People appropriate significant amounts of NPP by land conversion and harvest which has been quantified using a concept of human appropriation of net primary production (HANPP). Transformation of natural ecosystems usually leads also to the loss of potential productivity (NPPpot) and extensive HANPP on agricultural land.

While agricultural production serves mainly domestic markets, several recent studies suggest increasing share of international trade on the ecosystem and biodiversity impacts. Mainly wealthy countries increasingly draw resources from abroad. This has been described as footprint displacement. Footprint concept recognizes responsibility of consumers in generating environmental impacts.

We present results from the global analysis of NPPpot agricultural footprint, which quantifies the amount of potential (natural) net primary production embodied in final consumption. Using Multi-regional input-output analysis (MRIO), we determine the contribution of consumers in individual states to the footprint, especially from the perspective of international trade.



Our results confirm some patterns common for land, water and carbon footprints. We present also patterns of NPPot appropriation and footprint in biodiversity hotspots and discuss implications for ecosystem services. Countries with high share of imports on total footprint (high consumer responsibility) should identify policies supporting ecosystem services and biodiversity in exporting countries (usually biodiversity-rich) and with lower contribution to the international trade. This should go hand in hand with sustainable producing practices and ecosystem protection in countries of origin.

Keywords: HANPP, ecosystem services, international trade, MRIO, agriculture footprint

9. *Type of submission: Abstract*

T. Thematic Working Group sessions: T11 Tele-coupling through flows of ecosystem services from regional to global scales

Tele-coupling effects in fruit breeding and cultivation

First author: Hendrik Wolter

Affiliation: Department of Economics and Law, Working Group Ecological Economics, University of Oldenburg, Germany

Contact: hendrik.wolter@uol.de

General discussions about agricultural and food systems often neglect the fruit sector. In this sector, fruit breeding and fruit cultivation mark the foundation of the value-added process. Both systems exist as separate place-based social-ecological systems on a local scale. However, resulting ecosystem services and disservices as well as activities of actors in these systems affect each other: Breeding influences cultivation and vice versa. This takes place through distinct flows of resources and information on a regional, national, and even global scale. Fruit varieties developed by breeders in New Zealand can be cultivated in Europe. Hence, the classically separated systems overlap in certain aspects, making them an interesting case to study tele-coupling effects.

Building on literature about social-ecological systems, food and agricultural systems, as well as tele-coupling, the conducted research identifies links and flows between fruit breeding and cultivation on a multilevel scale as integrated parts of food systems. This lays the conceptual groundwork to understand tele-coupling effects between both systems, leading to insights



about building resilience in breeding and cultivation of fruits and for agricultural crop production in general.

The conceptualization shows that agrobiodiversity is the key connecting ecosystem service that works as a common resource base for both fruit breeding and cultivation. Besides direct interlinkages, e.g. when farmers also engage in breeding activities, influences take place through distinct flows. These occur in different shapes (a) between both multilevel systems and (b) inside them. Flows can be, e.g., cultural (norms of organic farming across nested agricultural systems) or economical (business models of farmers affect breeding goals). Fruit breeding and cultivation are embedded in complex multilevel food systems, which additionally influence both systems. Effects of tele-coupling are latent and only emerge or become visible in specific contexts. Identifying and analyzing these flows gives some insights which flows should be strengthened, where negative effects of flows should be mitigated, and where currently distant flows should be transformed into direct interlinkages.

Keywords: plant breeding, agriculture, agrobiodiversity, tele-coupling, social-ecological system