



BOOK OF ABSTRACT

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I. SESSION DESCRIPTION

ID: S1

Ecosystem service multifunctionality in agroecosystems: can we soften biophysical and social tradeoffs?

Hosts:

	Title	Name	Organisation
Host:	Dr.	Muriel Tichit	INRA
Co-host:	Dr.	Sandra Lavorel	CNRS

Abstract:

Transitions to sustainable agriculture require dealing with some key societal challenges, such as feeding the cities, contributing to climate change mitigation, reducing environmental and human health externalities from agriculture, and preserving biodiversity. To address these challenges, researchers and practitioners are developing management practices promoting essential ecosystem services such as soil fertility, nitrogen fixation, erosion control, pollination, and pest and disease regulation. But all management practices may not move in the same direction. Consequences of management practices on multiple ecosystem services involve complex trade-offs operating across multiple scales and among interdependent challenges. Furthermore, different stakeholders pursue different, sometimes antagonist, goals as they have different preferences, needs, values, norms towards ecosystem services. Tradeoffs are thus biophysical and social.

The issues to be discussed in the session include (i) the mutual dependence of food production and ecosystem services; (ii) the role of functional biodiversity for agroecosystem multifunctionality; (iii) the challenges of decision making in a context of social and ecological tradeoffs; (iv) data gaps and priority research needs that can guide the use of ecosystem service framework in agriculture.



Goals and objectives of the session:

We draw attention to potential conflicts to overcome for achieving multifunctionality in agroecosystems. Specific objectives are (i) to build on contributions from a large range of European agroecosystems. (ii) to discuss the analytical backbone of the ecosystem service assessment in agriculture (e.g. knowledge integration and comparability of results); (iii) to explore the potential of ecosystem service concept to connects different societal actors and different scientific disciplines

Planned output / Deliverables:

We hope to stimulate discussion on how to improve research and decision making on food, ecosystem services and biodiversity in the future. This includes raising awareness on the ecosystem service concept in farm business as well as in European policy-making and the wider public.

A special issue section in “People and Nature”

Related to ESP Working Group/National Network:

[Sectoral Working Groups: SWG 1 – ES in Agricultural production systems](#)

II. SESSION PROGRAM

Date of session: Tuesday, 16 October 2018

Time of session: 8:45 – 13:00

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
8:45–9:00	Muriel	Tichit	INRA	Ecosystem service multifunctionality in agroecosystems: can we soften biophysical and social trade-offs?
	Sandra	Lavorel	CNRS	
9:00–9:30	Francesco	Accatino	INRA	Exploring strategies for enhancing synergies and softening trade-offs between food production and other ecosystem services with a land use optimization model.



Time	First name	Surname	Organization	Title of presentation
9:30–9:45	Davide	Longato	University of Venice	Enhancing the provision of ecosystem services at landscape level in agroecosystems while reducing conflicts with food production by managing marginal agricultural lands.
9:45–10:00	Miguel	Cebrià-Piqueras	Leibniz University of Hanover	A functional approach to explain trade-offs and synergies between vegetation-mediated ecosystem services such as species conservation value, agricultural production and carbon sequestration in coastal grasslands.
10:00–10:15	Miren	Onaindia	University of the Basque Country	Land use efficiency through analysis of agroecological capacity and ecosystem services in an industrialized region (Biscay, Spain).
11:30–11:45	Corentin	Pinsard	INRA	Multifunctionality of ecosystem services and resilience attributes in a gradient of agroecosystems across Europe.
11:45–12:15	Ilse R.	Geijzendorffer	MNHN	Bundling the ecosystem services supplied by agroecosystems as part of the French Evaluation of Ecosystems and Ecosystem Services (EFESE).
12:15–12:30	Thomas	Poméon	INRA	Data engineering and management for an integrated assessment of agricultural ecosystem: a reflection based on the EFESE-EA French



Time	First name	Surname	Organization	Title of presentation
				experience
12:30–13:00	Sandra	Lavorel	CNRS	General discussion.
	Muriel	Tichit	INRA	

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**

S. Sectoral Working Group sessions: S1 Ecosystem service multifunctionality in agroecosystems can we soften biophysical and social tradeoffs

Exploring strategies for enhancing synergies and softening tradeoffs between food production and other ecosystem services with a land use optimization model

First author: Francesco Accatino

Other author(s): Muriel, Tichit

Affiliation: UMR SADAPT, INRA, AgroParisTech, University Paris Saclay, France, Italy

One of the biggest challenges today is to satisfy an increasing demand of food while preserving other ecosystem services. It is thus important to find land use and land cover strategies aimed at softening the trade-offs and enhancing synergies between food production and other ecosystem services. We performed optimization scenarios to explore interactions between livestock production and other ecosystem services (namely, crop production, carbon sequestration, and timber growth) in France. We calibrated, at the resolution of 709 land units, ecological production functions, i.e., statistical models predicting the provision of ecosystem services from production factors (i.e., land cover, pesticide expense, and climate). We studied the extent to which livestock production could be increased without reducing other ecosystem services and without increasing total pesticide expense. We posed the constraints at the country level and at the level of Nomenclature of Territorial Units of Statistics 3 (NUTS3). We found that a 20% increase in livestock production could be achieved in France with constraints posed at the country level. Synergies were promoted by the expansion of grassland, which is a multi-functional land use, while trade-offs were softened through intensified use of cultivated land and spatial segregation of livestock production (with 45% of land units specialized in food production,



32% specialized in other ecosystem services, and 23% specialized in the mixed provision of food and other ecosystem services). The optimization scenario with constraints posed at the NUTS3 level showed a lower total increase in livestock production (7%), but a reduced spatial segregation of livestock production. Enhancing multi-functional land covers is a promising strategy for promoting ecosystem services multi-functionality. Instead, the strategy for softening tradeoffs by segregating ecosystem services tended to decrease local multi-functionality and might lead to trade-offs on the social level.

Keywords: Multi-level scenarios, multi-functionality, optimization, synergies and tradeoffs, ecological production functions.

2. *Type of submission: Abstract*

S. Sectoral Working Group sessions: S1 [Ecosystem service multifunctionality in agroecosystems can we soften biophysical and social tradeoffs](#)

A functional approach to explain trade-offs and synergies between vegetation-mediated ecosystem services such as species conservation value, agricultural production and carbon sequestration in coastal grasslands

First author: Miguel A. Cebrián-Piqueras

Other author(s): Juliane Trinogga, Anastasia Trenkamp, Vanessa Minden, Michael Kleyer

Affiliation: Leibniz University of Hanover, Germany

Recent empirical and theoretical approaches have called for an understanding of the processes underpinning ecosystem service provision. An increasing number of studies is showing how key plant functional traits respond to environmental gradients and subsequently explain ecosystem properties in several systems. However, little is known concerning how trade-offs and synergies between plant functional traits predict variation of ecosystem service associations. Furthermore, few studies have used independently-measured final ecosystem services, which represent socio-ecological values and endpoints in the ecosystem services provision cascade. Our goals were (1) to understand responses of plant functional traits to environmental gradients and (2) to detect how trade-offs and synergies between plant functional traits explain trade-offs and synergies between multiple ecosystem properties and services explaining species conservation value, agricultural production and carbon sequestration. Forty-four plots were studied in a coastal marsh landscape of the German North Sea Coast. We used a structural equation model approach to test the initially-hypothesized model. We found that (1) a trade-off exists between plant traits associated with plant size and traits explaining both plant growth (roots and stems)



and the leaf economic spectrum; (2) variation of the plant traits' trade-off responded significantly to the land use gradient and nutrient availability, which were both strongly driven by a groundwater gradient (co-variation of salinity and groundwater level); (3) the plant traits' trade-off explained an initial major trade-off between ecosystem properties and final services, indicating ecosystem carbon stocks at one extreme of the axis and both the plant's nature conservation value and forage production at the other extreme. However, a secondary trade-off was also found between the species conservation value and forage production, which was indicated by a trade-off between leaf economic spectrum and plant growth in response to the intensity gradient.

Keywords: plant functional traits, ecosystem service trade-offs, species conservation, coastal grasslands, agroecosystems

3. *Type of submission:* **Abstract**

S. Sectoral Working Group sessions: [S1 Ecosystem service multifunctionality in agroecosystems can we soften biophysical and social tradeoffs](#)

Enhancing the provision of ecosystem services at landscape level in agroecosystems while reducing conflicts with food production by managing marginal agricultural lands

First author: Davide Longato

Other author(s): Mattias Gaglio, Elena Gissi

Affiliation: Department of Design and Planning in Complex Environment, IUAV University of Venice, Venice, Italy

As the world's largest and most managed terrestrial ecosystem, covering nearly 40 percent of the global landmass, agroecosystems provide a large opportunity to address sustainable development through ecosystem services-based approaches. Agroecosystems have been always considered primarily as sources of provisioning services, such as food, forage, fibre, bioenergy, etc. Recently their contribution to other types of services (i.e. regulating and cultural) have been recognized. One of the biggest challenges of today and of the future regarding agroecosystems is then to ensure food security while providing other services, meaning both other provisioning, regulating and cultural ones. In this framework, the use of marginal agricultural lands to enhance the provision of other ecosystem services at landscape level can be an effective strategy to reduce trade-offs with food production. The scope of this study is i) to identify marginal agricultural lands through remote sensing data, and ii) to analyse the spatial distribution of such areas in relation to other ecosystem services provided at landscape level, in order to suggest appropriate land use strategies



aimed at enhancing the provision of a set of ecosystem services in agroecosystems while reducing trade-offs among them. The method is applied for the Province of Rovigo, located in the Veneto region (Northern Italy). Using a GIS-based environmental modelling, after the identification of marginal agricultural lands through remote sensing data, meaning croplands not involved or poorly involved in food production, their spatial distribution is analysed in relation to ecosystem services maps carried out in previous studies (Gissi et al., 2016; 2017), as well as additional spatial and biophysical data driving the provision of certain services. Results are discussed in relation to potential land use strategies aimed at enhancing the provision of a set of ecosystem services in marginal agricultural lands identified without affecting other services provided at landscape level.

Keywords: marginal agricultural lands, remote sensing, ecosystem services trade-offs, food production

4. *Type of submission: Abstract*

S. Sectoral Working Group sessions: [S1 Ecosystem service multifunctionality in agroecosystems can we soften biophysical and social tradeoffs](#)

Bundling the ecosystem services supplied by agro-ecosystems as part of the French Evaluation of Ecosystems and Ecosystem Services (EFESE).

First author: Maud Mouchet

Other author(s): Ilse R. Geijzendorffer, Anne Meillet, Thomas Poméon, Anaïs Tibi, Muriel Tichit, Olivier Therond

Affiliation: Museum National d'Histoire Naturelle, France

Presenting author: Ilse R. Geijzendorffer

In line with the European program “Mapping and Assessment of Ecosystem and their Services”, the French Ministry for the Environment implemented its National Ecosystem assessment (i.e. French Evaluation of Ecosystems and Ecosystem Services, EFESE) in 2012. Here, we present the analysis of the associations among ecosystem services (ES) supplied by agro-ecosystems and quantitatively estimated by a group of experts coordinated by the French National Institute for Agricultural Research. Ten ES were represented by fourteen indicators relevant in the context of field crops, which were quantified at the Small Agricultural Region (SAR) level. We first identified associations among ES using a correlation network. Our results highlighted three broad nodes of ES: a first node combines ES related to water and nitrogen cycles, a second node combines ES sensitive to semi-natural habitats or intensity of agricultural practices and, a third node combines ES related to carbon fluxes and



stocks. In a second step, we differentiated ES bundles corresponding to two beneficiary groups: society and farmers. For each beneficiary-oriented bundle, we identified spatial clusters of SARs based on their similarity in ES supply using self-organizing maps and the Silhouette index. We then explored the spatial congruence of the clusters of SARs between the two beneficiary-oriented bundles. The analysis of congruence between the different types of ES bundles to society and farmers allowed characterising SARs according to their multifunctional character. Finally, we investigated the relationships between bundles of ES and several management parameters related to measures for the degree of intensification (e.g. the relative area of croplands, agricultural inputs) and naturalness. We further discuss the relationships between the level of the supply of multi-ES with intensification and, in particular, the weak relationship with agricultural inputs.

Keywords: Agricultural areas, ES bundles, National ES assessment, France

5. *Type of submission:* **Abstract**

S. Sectoral Working Group sessions: [S1 Ecosystem service multifunctionality in agroecosystems can we soften biophysical and social tradeoffs](#)

Land use efficiency through analysis of agrological capacity and ecosystem services in an industrialized region (Biscay, Spain)

First author: Miren Onaindia

Other author(s): Lorena Peña, Beatriz Fernández de Manuel, Gloria Rodríguez-Loinaz, Iosu Madariaga, Igone Palacios-Agúndez, Ibone Ametzaga-Arregi

Affiliation: University of the Basque Country (UP/EHU), Spain

New solutions are necessary for the reconciliation of food production and environmental conservation. This study focuses on determining the synergies and trade-offs between agrological capacity and ecosystem services (ES) in an industrialized region in northern Iberian Peninsula in order to improve the efficiency use of soils. The methodology provided here allows the mapping of the best areas for equilibrating both, agrological capacity and provision of ES. We determine specifically the most suitable areas to develop new agricultural activities with the greatest efficacy. Results highlight the synergies between agrological capacity, habitat maintenance, pollination, and aesthetic values. Moreover, the creation of new grasslands and croplands in productive soils occupied by forest plantations would enhance agriculture, some ES, and landscape multi-functionality. However, decreasing the area of forest plantations in favour of agricultural lands would create trade-offs with carbon storage. These trade-offs could be relativized if actual environmental and economical



situations are taken into account. Based on the results obtained applying the proposed methodology, policy-makers have the opportunity to manage a transition towards more sustainable land use through specific actions while increasing local food security.

Keywords: agriculture regeneration; efficient use of soils; local agriculture; integrative land management; multifunctional landscape

6. *Type of submission:* **Abstract**

S. Sectoral Working Group sessions: [S1 Ecosystem service multifunctionality in agroecosystems can we soften biophysical and social tradeoffs](#)

Multifunctionality of ecosystem services and resilience attributes in a gradient of agroecosystems across Europe

First author: Corentin Pinsard

Other author(s): Francesco Accatino, Muriel Tichit

Affiliation: UMR SADAPT, INRA, AgroParisTech, University Paris Saclay, Paris, France

Ecosystem services (ES) are essential to maintain agriculture's essential functions but their supply is threatened by human activities and climate change. Resilience is the capacity of a system to experience shocks while retaining the same function, structure, feedbacks, and identity. It is an important property for agroecosystem in a changing climate. We hypothesized that agroecosystems sustained by and providing multiple ES exhibit higher resilience potential. The objective of this study was to explore the spatial congruence in Europe between multifunctionality of 14 ES, classified as private (food production) or public goods (regulating and cultural ES), and four resilience attributes: Human appropriation of net primary productivity (HANPP), Energy Returned on Energy Invested (ERoEI), Water Exploitation Index (WEI) and gross nutrients balance (GNB). We measured multifunctionality with the Simpson index and the total value of ecosystem services. These indicators were computed for 48292 land units across Europe and analysed with spatially explicit multivariate methods. We found that 14% of land units with the highest values of multifunctionality of public goods exhibited the lowest harvested crop production, and the highest timber removal. These land units matched with the highest values of three resilience attributes (HANPP, WEI & GNB). In addition, 17% of land units with the highest harvested crop production presented in average lower values for all resilience attributes. We conclude that promoting multifunctionality of ecosystem services is one important step to build resilient agroecosystems in Europe. As resilience is a multi-dimensional concept, next step should account for new indicators to assess the resilience potential.



Keywords: Multifunctionality, Ecosystem services, Spatial congruence, Resilience

7. *Type of submission:* **Abstract**

S. Sectoral Working Group sessions: S1 Ecosystem service multifunctionality in agroecosystems can we soften biophysical and social tradeoffs

Data engineering and management for an integrated assessment of agricultural ecosystem: a reflection based on the EFESE–EA French experience

First author: Thomas Pomeon

Other author(s): Eric Cahuzac, Anne Meillet

Affiliation: US ODR, INRA, 31326, Auzeville, France

The French National Institute for Agricultural Research (INRA) led a collective scientific assessments of agricultural ecosystems, involving 60 scientific experts and contributors from a large panel of disciplines and organizations. One major goal of this study, designated by the acronym EFESE–EA, was to compute biophysical and economic indicators on Ecosystem Services (ES) provided by agricultural ecosystems, and to map them for the French territory at the finest scale possible. This required in particular to develop and apply a set of procedures to select and implement the appropriated methods, and then to compile and diffuse the indicators produced during this study. The literature is quite replete with insights and recommendations on how to deal with mapping and assessment of ES. However, some points may be very general and quite vague concerning data management component. Finally this crucial part of ecosystems assessments remains in some way under-informed, under-formalized and under-structured, comparing with other components. Our proposal is to contribute in a better understanding of the whys and the wherefores of such a data engineering. We first synthetize main recommendations and findings existing on data management for ES assessment, especially those provided by the MAES working group. Thus, based on our experience in EFESE–EA, we focus on main issues for ES assessment, especially for agricultural ecosystem: anticipation and time constraint, translation of concepts inapplicable method, expertise and integration of a large panel of data sources, reproducibility and validation, dissemination (for research, public decision,...). We propose several ways in which data management could be improved, notably in term of traceability and transparency: data management plan, workflows, methodological notes, platform. While a diversity of context, focus and data availability leads to diverse methods, we stress the necessity for more anticipated, formalized and transparent processes. This will help to address relevant challenges for ES assessment practitioners, in relation with the validity, the comparability and the take-up of the results, and the gradual improvement of methods.



Keywords: ecosystem assessment, agricultural ecosystem, data management