BOOK OF ABSTRACT

I. SESSION DESCRIPTION

ID: S1

Agroecology: Managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

	Title	Name	Organisation	E-mail
Host:	Dr.	Edmundo Barrios	Food and agriculture Organization of the United Nations (FAO), Italy	edmundo.barrios@fao.org
	Dr.	Miguel Cebrián-Piqueras	Leibniz Universität Hannover, Germany	cebrian@umwelt.unihannover.de
	Dr.	Bartosz Bartkowski	UFZ Helmholtz Centre for Environmental Research, Germany	cebrian@umwelt.unihannover.de
Co-host(s):	Dr.	Cristina Quintas	Universität Kassel, German	cristina.quintas@uni-kassel.de
	Dr.	Carsten Paul	Leibniz Centre for Agricultural Landscape Research (ZALF), Germany	Carsten.Paul@zalf.de
	Dr.	Katarina Hedlund	Lund University, Sweden	katarina.hedlund@biol.lu.se
	Dr.	Luisa Carvalheiro	Universidade Federal de Goiás, Brazil	lgcarvalheiro@gmail.com
	Dr.	Charles Midega	International Centre of Insect Physiology and Ecology (ICIPE), Kenya	cmidega@icipe.org

Abstract:

The growing global demand for agricultural products projected to double in the next few decades is putting tremendous pressure on agriculture to increase production. Agricultural intensification based on monocultures and heavy reliance on external inputs has led to land-use changes that encourage simplification of agricultural habitats, soil degradation, and loss

of the above- and below-ground biodiversity they sustain. In contrast, biodiversity-based intensification approaches – such as agroecology – encourage agricultural habitat diversification that enhances biodiversity, ecological functions and the provision of ecosystem services while taking into consideration the social aspects that need addressing for sustainable and fair food systems. Agroecology requires a deep understanding of ecological processes and socio-ecological interactions at site and landscape level, and the integration of interconnected socio-ecological processes and organization levels. This session will explore the potential of agroecology, and other forms of biodiversity-based agriculture, as adaptive management approaches to mediate between contrasting conservation models (e.g. Land-sparing and Land-sharing) based on the local social and ecological context and circumstances. Case studies contrasting the impacts of agroecological vs. conventional practices on the social-ecological resilience of agroecosystems including sustaining the multifunctionality of soils, or incorporating socio-cultural approaches to explore social values, are welcomed. Studies where co-creation and sharing of knowledge has integrated biodiversitybased knowledge and principles into tools supporting farmer's decisions, and contributed to guide agroecosystem redesign interventions to improve regulating ecosystem services (e.g. soil-mediated, pollination, and pest & disease control) and cultural ecosystem services are of special interest. Also, studies considering the analysis and design of policy and governance in the context of fostering agroecology and related approaches are welcomed. Specific questions to be addressed during the session are: How can biodiversity and ecosystem services be most effectively managed to facilitate agroecological transitions to sustainable food and agricultural systems? What methodological approaches have proven most adequate to elicit and systematically gather stakeholder and general public knowledge about landscape representations, beliefs and values and to explore the social acceptance, demand or perception for the connection between the management of biodiversity for the sustained provision of ecosystem services in agriculture? What types of innovative governance options and policy instruments are effective in facilitating agroecological transitions?.

Goals and objectives of the session:

1) Identifying examples of biodiversity management approaches and practices that enhance ecosystem services and/or reduce trade-offs between provisioning, regulating and cultural services in agriculture.
2) Learning from the methodological tools developed to facilitate cocreation and sharing of knowledge across agroecological transitions to sustainable food and agricultural systems.
3) Identifying entry points to write a synthesis paper about the main findings of the session.

Planned output / Deliverables:

1) Synthesis publication
2) Fostering an Agroecology community of practice in SWG1.

Related to ESP Working Group/National Network:

Sectoral working group: SWG 1 – ES in Agricultural production systems

II. SESSION PROGRAM

Date of session: Tuesday, 22 October 2019
Time of session: 10:30 – 18:00

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
10:30–10:45	Edmundo	Barrios	FAO	The 10 Elements of Agroecology: Guiding the transition to sustainable food and agricultural systems
10:45–11:00	Anoush Miriam	Ficiciyan	University of Goettingen	More than yield: Ecosystem services of traditional versus modern crop varieties revisited
11:00–11:15	Lena	Dempewolf	University of the West Indies, Trinidad And Tobago	Agriculture and the state of pollination services, policies and programmes in Caribbean Small Island Developing States – Current status, gaps and the way forward
11:15–11:30	Tanel	Vahter	University of Tartu	Agricultural practices in soil biodiversity management: multi-trophic feedback loops to ecosystem sustainability and functions.
11:30–11:45	Manon	Dardonville	Université de Lorraine / INRA	Quantifying ecosystem capacity, modulation by agricultural practices and actual use of ecosystem services by farmers
11:45–12:00	Bastian	Steinhoff-Knopp	Leibniz University Hannover	How to better address soils in the ecosystem service approach? – A meta-analysis of concepts, frameworks and classification schemes.
13:30–13:43	Katarina	Hedlund	Lund University	How can agricultural management improve soil carbon stocks – A global systematic review

13:43-13:56	Sabine	Bicking	Kiel University	Intensive agriculture and the ecosystem service "nutrient regulation".
13:56-14:09	Raquel	Luján Soto	Spanish National Research Council	Identifying local and technical indicators of soil quality for participatory monitoring the impacts of regenerative agriculture: A methodological framework.
14:09-14:22	Violeta	Hevia	Universidad Autónoma de Madrid	Exploring the effect of a green infrastructure on wild bee abundance and diversity in agroecosystems.
14:22-14:35	Inés	Gutiérrez-Briceño	Swedish University of Agricultural Sciences / Autonomous University of Madrid	Articulating agroecological transitions through apiresilient practices at farming systems in Madrid.
14:35-14:48	Sara	Palomo-Campesino	IMIDRA	Ecosystem services supply in agroecological and conventional horticultural farms in South Madrid. An assessment of agricultural practices sustainability.
14:48 -15:00	Lea	Kliem	University of Oldenburg	Seeds of resilience: The contribution of commons-based plant breeding and seed production to social-ecological resilience of the agricultural sector.
16:30-16:43	Hendrik	Wolter	University of Oldenburg	Improving the resilience of fruit cultivation with commons-based organic fruit breeding.
16:43-16:56	Vincent	De Leijster	Utrecht University	Economical farm-level costs and benefits of agroecological practices in almond plantation in southern Spain
16:56-17:09	Elke	Plaas	Georg August University Goettingen	Why earthworms are worth gold – the valuation of soil biodiversity in real farm management.
17:09-17:22	Linda	Blättler	Charles University	Integrated assessment of ecosystem services provided by permaculture and its possible

				contribution to sustainable agriculture
17:22-17:35	Johannes	Carolus	Thuenen Institute	Understanding and improving the sustainability of agro-ecological farming systems in the EU.
17:35-18:00				Discussion

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: Invited speaker* ***abstract***

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

The 10 Elements of Agroecology: Guiding the transition to sustainable food and agricultural systems

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Agroecology is an integrated approach that simultaneously applies ecological and social concepts and principles to the design and management of food and agricultural systems. It seeks to optimize the interactions between plants, animals, humans and the environment while taking into consideration the social aspects that need to be addressed for a sustainable and fair food system. Agroecological innovations are based on the co-creation of knowledge, combining science with traditional, practical and local knowledge of producers in a particular context. Agroecology seeks to bring transformative change to agriculture by addressing the root causes of problems in an integrated way and providing holistic and long term solutions. The 10 Elements of Agroecology emanated from a FAO consultative process, expert reviews and regional seminars, and include: diversity, co-creation and sharing of knowledge, synergies, efficiency, resilience, recycling, human and social values, culture and food traditions, responsible governance, circular and solidarity economy. As an analytical tool, the

10 Elements can help countries to operationalize agroecology and promote agroforestry. By identifying important properties of agroecological systems and approaches, as well as key enabling environment conditions, the 10 Elements constitute a guide for policy makers, practitioners and stakeholders in planning and evaluating agroecological transitions aiming at sustainable food and agricultural systems.

Keywords: Agricultural systems, agroecology, biodiversity, co-creation, ecosystem services

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

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

Intensive agriculture and the ecosystem service “nutrient regulation”

First author: Sabine Bicking
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Intensive agriculture, which aims to increase one single ecosystem service, crop production, produces significant pressures on the environment. The practices, which come along with intensive agricultural production, degrade the environment and decrease ecological integrity and thereby the potential supply of other ecosystem services. Accessorily, these circumstances also decrease the future potential of an ecosystem to provide the ecosystem service crop production itself. Thus, even though one single ecosystem service is optimized in the short-run, the long-term provision of multiple ecosystem services is diminished. In this context, (over)fertilization plays a very important role as a pressure that strongly affects the condition of an ecosystem. In order to sustain the multi-functionality of soils and to guarantee long-term food security and related human health benefits, it is of great importance to ensure sustainable nutrient situations, where in- and outputs of nutrients are in balance. Within the presentation, insights on mapping and assessments of the ecosystem service nutrient regulation are given. The focus lies on the calculation of nitrogen budgets as indicators of the demand for nutrient regulation. Thereby, also the methodological background of the assessments is outlined and the possibility of an integration into a vulnerability evaluation is discussed. Besides, it is shown how the findings can serve as a foundation for the development

of land management policies and agricultural practice plans aiming to decrease excess nitrogen budgets and thereby reduce the future demand for the ecosystem service nutrient regulation.

Keywords: Quantification and mapping, ecosystem service demand, fertilization, nitrogen budget, farming practices

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

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

Integrated assessment of ecosystem services provided by permaculture and its possible contribution to sustainable agriculture

First author: Linda Blättler
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Even though sustainable agriculture has received increasing attention in the last decades, the so-called permaculture movement remains underresearched. Permaculture movement uses an agroecological design system for creating sustainable human settlements in general and a framework of mimicking natural ecosystems in particular. In our research we tested the possibility of an integrated assessment of permaculture ecosystems with the concept of ecosystem services. Ecosystem services framework seems to be suitable in answering two key questions; first, what kind of ecosystems is permaculture creating and whether they are closer to natural ecosystems (i.e. woodlands) or conventional agriculture, and second, with which services exactly do they provide us with? To answer these questions, we first developed a method how to easily measure the regulating, provisioning and cultural services. We studied 9 permaculture farms and interviewed their owners. In our research we decided to combine quantitative methods (for measuring the regulating services, e.g. water flow regulation, carbon stock) with qualitative methods (to estimate cultural services as sense of place, heritage and others). To estimate the provisioning services, we devised a specialized questionnaire. Our findings confirm the traditional belief that permaculture is a system that indeed mimics natural ecosystems, at least in the realm of regulating services. The amount of provisioning services, on the other hand, varies a lot depending on the motivation for growing food. Cultural services

provided by permaculture ecosystems are very unique and seem to be filling the gap of a deeper sense of connectedness with natural laws. In the time of the Anthropocene and degradation of most of the ecosystems permaculture methods should be explored and applied more frequently because they are a promising way of how to restore and regenerate the regulating and cultural services provided by agriculture that have been overlooked in the last century.

Keywords: Ecosystem services in agriculture, permaculture, agroecology, sustainable agriculture, integrated assessment of ecosystem services, regulating services in agriculture

4. *Type of submission:* ***Abstract***

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

Understanding and improving the sustainability of agro-ecological farming systems in the EU

First author: Johannes Carolus
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Producing sufficient food and biomass while preserving soil, water and biodiversity cannot be achieved by the currently dominating types of conventional agriculture. Agroecological approaches and eco-functional intensification are fundamental for a sustainable food production in the future. However, despite efforts at national and international levels, the joint provision of public and market goods is frequently unbalanced at the farm and farm systems levels, and typically constrained by knowledge and economical concerns.

To enhance the understanding of socio-economic and policy drivers for, and barriers to, agroecological transitions in EU farming systems, a novel, holistic farm sustainability assessment across farms in Europe is conducted. To address the key dilemma of providing public goods without compromising the economic and social sustainability of farms, the assessment includes the application of three decision support tools on agroecological and conventional

farms covering a broad range of key production systems of European agriculture. The first tool, the SMART Farm Tool, is a multi-criteria approach which enables a broad overview of the sustainability of a farm, based on the SAFA Guidelines of the FAO. The second tool, the Cool Farm Tool, enables a deeper understanding of farms' impacts on public goods, namely climate, water quality and biodiversity. The third tool, COMPAS, delivers detailed data on the farms' economic performance. Based on first results of the farm assessment, we present how the three tools allow comparing agroecological with conventional farming systems. Further-more, we demonstrate how the results can be utilised to (a) foster peer-to-peer learning be-tween farmers, other key actors of the value chain and scientists, and (b) co-create market and policy incentives promoting the transition to agro-ecological farming systems and the provision of ecosystem services in the EU.

The abstract is based on the UNISECO project (www.uniseco-project.eu) funded by the EU's Horizon 2020 programme (grant agreement N° 773901).

Keywords: agroecology, decision-support tools, agroecological transitions, farm sustainability assess-ment, participatory approach

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

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

Quantifying ecosystem capacity, modulation by agricultural practices and actual use of ecosystem services by farmers

First author: Manon Dardonville
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Ecosystem services (ES) provided to farmers are now well-considered as natural-capital-based production factors. Developing them is a way to reduce use of anthropic inputs and so to develop a more sustainable agriculture. However, it is still a scientific challenge to evaluate quantitatively part of ES relatively of anthropic inputs in agricultural production.

Based on literature review, we develop a generic assessment method based on operational indicators to describe ES bundles provided to farmer according to field, farm and landscape characteristics. Application of this method in 30 contrasted farms in terms of agricultural practices enable to assess their relationships with 4-ES dimensions, their role and relative weight in the production of agricultural goods.

According to the spatiotemporal configuration of cropping systems (rotations, cover crops, semi-natural habitats etc.) and landscape complexity in which they are embedded, we assessed the level of (i) ES capacity (potential) available to farmer. Further, we evaluate to which extent ES capacity is (ii) modulated due to beneficial or detrimental agricultural practices and forward the impact on sustainability of (iii) the natural capital. Then, we determine (iv) how much farmer use actually ES capacity instead of relying on anthropic inputs (for example, use of biological regulation instead of pesticides) to produce.

Based on this first diagnostic, we identified (i) the main ESs limiting agricultural production, and (ii) the ways to enhance their furniture both using current ecosystem capacity and through its development and assessed (iii) the weight of ES (vs. exogenous inputs) in the agricultural production.

In conclusion, this ES assessment method enable user to categorize farms in a new way according to the level of ES and their role in agricultural production process. It allows to finely determine the biotechnical functioning of farming systems and overcome coarse classification like conventional vs. organic farming.

Keywords: ecosystem services, ecosystem capacity, natural capital, farming system, landscape

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

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

Economical farm-level costs and benefits of agroecological practices in almond plantation in southern Spain

First author: Vincent De Leijster

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In Mediterranean woody crop systems, the agroecological practices of tillage abatement, green manure and organic soil amendments have been proven to be effective in rehabilitating ecosystem services. However, a large scale implementation is hindered by uncertainties about their impact on farm profitability. In this study we investigated the farm-level economical costs and benefits, including the Net Present Value (NPV) of farms, of no tillage (NT), green manure (GM), compost (CM) and conventional tillage (CT) as a control in Spanish almond plantations. We estimated long-term profitability based on costs and benefits using a stochastic cash flow model. We tested to what extent price premiums, resilience to climate change, and including erosion costs affect farm profitability. CM improves NPV with 37% compared to CT. However, for NT and GM the NPV was reduced by 71% and 65% respectively. Price premiums for agroecologically produced products can improve the profitability of NT, GM and CM. The break-even point of NT and GM with CT was found at 22% and 18% higher premium values. NT was most resilient to increased frequency of dry years due to climate change, which results in a higher long-term NPV. This was observed at increased frequency of dry years, i.e., at 12 years and more of dry years during a 30 year simulation. This corresponded to a 2.6 times higher dry year frequency than projected by IPCC scenarios. The on-site costs of erosion in both CT and CM were found to be €253 ha-1 y-1, which is 83% higher than NT and 103% higher than GM. These erosion cost values are not changing; NT and GM always had lower NPV values than CT. To conclude, vegetation cover reduce almond farm profitability, while compost improves this compared to conventional tillage.

Keywords: Agroecology – Mediterranean woody crop systems – costs and benefits – resilience – trade-offs

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

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

Agriculture and the State of Pollination Services, Policies and Programmes in Caribbean Small Island Developing States – Current Status, Gaps and the Way Forward

First author: Lena Dempewolf
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Caribbean Small Island Developing States (SIDS) are highly data deficient with respect to pollination services and their management, particularly in an agricultural context. Furthermore, very limited farmer and public knowledge of pollination related issues and ecosystem services, in addition to a poor understanding of the link between unsustainable farming practices and the direct impact on food production and their livelihoods further underscore the need for improved regional and national policies and interventions. The near complete lack of the mention of pollination services in Caribbean environment, biodiversity, agriculture and related national and regional policies underscores the extent of the current knowledge and management gap.

SIDS face unique challenges in managing pollination services, both ecological and socio-political in nature, which in turn impact food security. High rates of endemism and extinction, high vulnerability to habitat changes and drastic impacts of invasive species and human activities consistent with small islands underscore the urgency for an increased focus on redesigning agricultural landscapes for improved pollination services management. While the vast majority of farmers within the region consists of smallholders, current regional agricultural practices are unsustainable for maintaining effective pollinator abundance and diversities due to high and inappropriate pesticide use, widespread and unmanaged slash-and-burn agriculture and poor knowledge of beneficial insects in agricultural landscapes, among others. The additional increased and disproportionate susceptibility of SIDS to the

effects of climate change and natural disasters along with a limited capacity of these islands to mitigate the impacts of these complex issues further stresses this need.

We discuss the scope of available data for the Caribbean region, experiences in the use of citizen science to engage the regional population, farmer perceptions of their impact on and control over beneficial insects, pollination services education and management options specific to Caribbean farmers, and lastly, regional research and policy needs.

Keywords: pollination, agriculture, Caribbean, Small Island Developing States, biodiversity

8. *Type of submission:* ***Abstract***

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

More than Yield: Ecosystem Services of Traditional versus Modern Crop Varieties Revisited

First author: Anoush Miriam Ficiciyan
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Agricultural intensification with modern plant breeding focuses on few high-yielding crops and varieties. The loss of traditional crop species and variety diversity contributes to the current decline of provisioning, regulating, and cultural ecosystem services, as reported in the Millennium Ecosystem Assessment. Access to local and adapted varieties is pivotal for resilient agroecosystems, in particular under current global change. We reviewed the scientific literature to understand the role of different crop varieties for ecosystem services, comparing the performance and perception of traditional landraces versus modern varieties and ask the following questions: 1. Do landraces and modern varieties differ in terms of provisioning and regulating ecosystem services? 2. When and why do farmers prefer cultural ecosystem services of landraces over high-yielding varieties? Based on 41 publications, our results document that modern varieties are preferred over landraces because of their typically higher provisioning services such as crop yield. However, landraces often guarantee higher provisioning services under non-optimal farming conditions. Landraces can show high resilience under harsh environmental conditions and are a trusted source achieving stable crop yield (e.g., under

droughts stress). Regulating services such as resistance against pests and diseases appear to often become lost during breeding for high-yielding, modern varieties. Furthermore, small-scale farmers typically prefer local landraces due to regional cultural features such as family traditions and cooking characteristics for special dishes. In conclusion, both landraces and modern varieties have merit depending on the farmers' priorities and the social-ecological context. In any case, maintaining and restoring the huge diversity of landrace varieties is necessary for sustaining current and future needs.

Keywords: agrobiodiversity, food sovereignty, seed commons, variety diversity, protection laws

9. *Type of submission:* ***Abstract***

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

Articulating agroecological transitions throught apiresilient practices at farming systems in Madrid

First author: Inés Gutérrez-Briceño
Other author(s): Marina García-Llorente, Violeta Hevia Martín, Jorge Ortega Marcos
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Farms and its different management practices can have susbstantial effects on biodiversity which will turn into the supply of ecosystem services. Wild bees provide pollination services in small scale farming, which is key element to determine and improve farm production but also to the maintenance of ecosystem diversity. Wild bee diversity and abundance is influenced by social and ecological factors. In this study we aim to identify and quantify which agroecological practices and characteristics of the landscape influence the presence of wild bee pollinators. We have selected a total of 20 horticultural farms in a rural area in North Madrid. In order to identify wild bees, we will use pan-trapping method during the flowering period of the horticultural plants. We will also interview each farmer to identify the management of each farm, their perception towards pollination service and their influence on it. Social factors that influence farmer's decisions will be also analyse through the interview. In addition, we will also analyse the surrounding landscape composition specifying some indicators as the land use, distant from natural habitat and the proximity to bee hives. This study will allow us to have a

better understanding of which local apiresilient practices at farming systems can be effective to promote wild pollinators services. These apiresilient practices that will be found with the combination of ecological and human factors can contribute to articulate an agroecological transition in Madrid.

Keywords: Wild bees, small scale farming, ecosystem services, apiresilient practices, agroecological transition

10. Type of submission: ***Abstract***

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

How can agricultural management improve soil carbon stocks – A global systematic review

First author: Katarina Hedlund
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Loss of soil organic carbon (SOC) from agricultural land is a major threat to soils, as it both influences fertility and further exacerbates climate change. By examining existing evidence from agricultural field experiments we can identify effective mitigation measures that can substantially increase soil carbon and mitigate future climate change. We conducted a systematic review of long-term agricultural experiments using time series data. The systematic review is based on studies reporting time series data (more than 30 years) collated in a recently completed systematic map and a meta-analysis of tillage examining soil carbon across boreal and temperate climate zones. The metanalyses of rates of change of soil carbon in time series experiments compared experiments with different levels of tillage, organic amendments, crop rotations and fertiliser rates that are the most common drivers of soil carbon in agriculture. The results show that soil carbon generally decline across the long-term sites, but reducing tillage, adding organic amendments and using crop rotations with grasses or fallows can reduce the losses ranging from 0.5 % to 0.1 % of the current carbon stocks per year. In isolation, however, this cannot turn losses into a net increase. To increase soil carbon, multiple interventions are needed, and in this review we found that all four interventions together can increase soil carbon by 0.6 % per year. Current agricultural practices seeking to

increase carbon storage in temperate and boreal soils should apply multiple, diverse agricultural interventions in order to be able to mitigate carbon losses in future agriculture.

Keywords: Soil carbon, agriculture, long term experiments

11. Type of submission: ***Abstract***

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

Exploring the effect of a green infrastructure on wild bee abundance and diversity in agroecosystems

First author: Violeta Hevia

Other author(s): Jorge Ortega, Francisco M. Azcárate, César A. López-Santiago, Paloma Alcorlo, José A. González

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Agricultural intensification and its associated effects have been negatively affecting species richness and abundance of pollinators. Sunflower is one of the crops potentially affected by this pollinator crisis, as it is highly dependent on pollination by bees.

Among other measures to mitigate this situation, the European Union has proposed the installation of green infrastructures, GI (seminatural areas designed and managed to improve ecosystem services). We analyze the effect of a green infrastructure (composed of a 12-species floral mixture and nest boxes) on the presence of bees and sunflower seed set in adjacent fields. Twenty-two sunflower fields were sampled during the summer of 2017 in three municipalities of Cuenca (Spain): 11 fields with green infrastructures installed and 11 fields located close to semi-natural habitats (used as control). We used pan-traps to collect bees, and performed visual counts to estimate bee visitation rates at different distances from the green infrastructures and semi-natural habitats. Further, we estimated seed set in all sunflower crops. Our results show that the abundance of wild bees was higher in GI, while there were no significant differences in species richness and diversity of bees between GI and semi-natural habitats. Visitation rate to sunflower heads was higher in the fields adjacent to

green infrastructures than in those adjacent to semi-natural habitats. Furthermore, seed set was higher in sunflower crops adjacent to GI.

Keywords: Honeybees, pollinators, semi-natural habitats, wild bees

12. Type of submission: ***Abstract***

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

Identifying local and technical indicators of soil quality for participatory monitoring the impacts of regenerative agriculture: A methodological framework

First author: Raquel Luján Soto
Other author(s): Mamen Cuellar Padilla, Joris de Vente
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Soil quality monitoring systems integrating farmers´ and researchers´ knowledge are necessary to improve the understanding and foster the adoption of sustainable land management practices. This is especially relevant in semi-arid areas prone to land degradation that typically show a slow response of soils to changes in management. We developed a methodological framework for participatory identification and selection of local and technical indicators of soil quality and the development and validation of a visual soil assessment tool, for collaborative monitoring the impacts of regenerative agriculture (RA) by farmers and researchers. This framework is applied in a large-scale restoration project in southeast Spain together with almond farmers implementing RA practices. Farmers selected local indicators that focused mostly on assessing water regulation and soil erosion control, improvement of soil fertility, crop performance, and other key ecosystem services. Technical indicators selected by researchers focused mostly on soil physicochemical and biochemical properties including bulk density, aggregate stability, total and available nutrients, microbial biomass and activity, and leaf nutrients as proxy indicators of crop performance. The combination of local and technical indicators of soil quality provided complementary information that can improve the relevance, coverage and feasibility of RA impact assessment. Monitoring systems of soil quality that integrate local and technical indicators offer the opportunity for farmers

and researchers to jointly embark on a monitoring process, enhancing knowledge exchange and mutual learning, to help implementing RA for optimizing the provisioning of ecosystem services.

Keywords: ecosystem services, land degradation, almond production, agroecology, southeast Spain

13. Type of submission: ***Abstract***

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

Ecosystem services supply in agroecological and conventional horticultural farms in South Madrid. An assessment of agricultural practices sustainability

First author: Sara Palomo-Campesino
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Feeding the increasing world population while preserving the correct functioning of ecosystems has become a challenge under the current patterns of global change. Agroecology emerged as a transformative approach to address this challenge, fostering the application of sustainable agricultural practices and considering every element of the agri-food chain to promote an ecologically sustainable and socially fair agriculture worldwide. Our study in progress aims to assess the differences in the supply of agrarian ecosystem services between agroecological and conventional farming systems from a social-ecological perspective. In doing so, we selected a total of 13 agroecological and 12 conventional horticultural farms in two rural and two peri-urban areas in South Madrid. We started performing several biophysical samplings on each farm that will last until September of 2019 to assess soil quality (fertility, biological activity and erosion control), pollination service, pest control and tomato production. Concurrently, we will interview each farmer to reveal the specific agricultural practices applied at each farm as well as their perceptions towards agriculture and their willing to adopt new practices that may contribute to an agroecological transition in Madrid. Once we get all the results, we expect to find in the agroecological farms a significant higher supply of most of the ecosystem services analysed than in the conventional ones. This study will allow

us to begin to explore the possibilities of the spread of an agroecological transition in Madrid, as well as to elaborate an inventory of good practices to start this transition.

Keywords: Agroecology, conventional farming, ecosystem services supply, horticulture

14. Type of submission: ***Abstract***

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

Why earthworms are worth gold – the valuation of soil biodiversity in real farm management

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The on-going intensification of agriculture, climate change and food production supporting measures of the European Common Agricultural Policy (CAP) has let to declining soil biodiversity. Ecosystem services (ES) from soil are mostly driven by soil biota and contribute to food security, climate change mitigation, water retention and plant biomass. For preventing erosion, desertification, and landslides and to stabilise crop yields healthy soils are necessary requirements. The provision of ES by soil biota is a result of their impact on soil processes in interaction with soil conditions and soil management practices of the farmers like tillage or crop rotations, and the frequency and intensity of management actions. Earthworms are particularly keys in regulating soil processes, as all soil ecologists know. However, earthworm (or soil biota) related processes, functions and services are often overseen apart from an ecological perspective. Mostly, on-farm decisions, farming system evaluations and agricultural policy (eg. CAP) do not account for soil biota related services. A deeper understanding and a wider transformation of soil biological impacts is needed in the development of sustainable farming systems. Based on activities and results of the European Biodiversa-SoilMan-project we will show how to value earthworm activities in a more social-economical dimension. For example: With respect to biocontrol of soil-borne pests, the earthworm species Lumbricus terrestris is known to play an important role in repressing toxigenic phytopathogens, like

Fusarium culmorum and its mycotoxin deoxynivalenol (DON). We use the importance of earthworms for pest control to conceptualise and highlight how farmers' management practices influence soil ecosystem services in a socio-ecological context. For a better understanding we present a concrete example of an economical evaluation of ES provided by earthworms.

Keywords: Ecosystem services, soil biodiversity, economic value, soil management practices, sustainability

15. Type of submission: ***Abstract***

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Seeds of resilience: The contribution of commons-based plant breeding and seed production to social-ecological resilience of the agricultural sector

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Building resilience is a future priority for food systems to meet challenges like climate change. However, there has been little systematic research on the role of the seed sector in fostering social-ecological resilience of agroecosystems. The ongoing privatization and concentration in the seed industry result in a small number of high-yielding varieties. As an alternative, (new) organizational approaches in plant breeding and seed production build upon common ownership and collective management, including participation of smallholder farmers in variety development. The aim of this study is to analyze, conceptually and empirically, how a commons-orientation in the seed sector promotes or impedes the resilience of crop systems in comparison to private-property-based structures.

Building on Cabell and Oelofse (2012), this paper applies an indicator-based framework to assess the contribution of the two types of governance systems (conventional- and commons-based) to the resilience of crop systems. To derive qualitative data, we carry out a document

analysis of publications from breeding and seed producing organizations. Subsequently, we comparatively assess the impact of the two types of organizational structures on agro-ecological resilience.

The paper shows that the conventional seed sector has advantages in terms of production efficiency under controlled cultivation conditions as well as greater financial viability. However, commons structures in the seed sector promote agro-ecological resilience in several aspects. They focus on the development of open-pollinated, naturally reproducible varieties, advance plant robustness without chemical inputs, and further varieties adopted to specific regions and agro-ecological conditions. In addition, commons-based breeding approaches foster diversity at genetic, crop species and landscape level, create redundancy of different seed supply channels, and increase autonomy from external resource inputs and international markets. The resilience of governance structures are also strengthened through a high degree of self-organization of farmers along the value chain, participatory breeding approaches and increased access rights to seeds.

Keywords: Agroecosystems, Commons, Resilience, Seeds, Agriculture

16. Type of submission: ***Abstract***

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How to better address soils in the ecosystem service approach? – A meta-analysis of concepts, frameworks and classification schemes

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The importance of soils for ecosystem functioning and the supply of ecosystem services (ES) is emphasised by a huge body of literature. Soils are a core part for the potential supply of many provisioning ES in terrestrial ecosystems (e.g. food, fibre and timber). Also multiple regulating ES are strongly related to soils, such as nutrient and water regulation or soil retention.

The ES approach is based on the concept that ecosystems provide benefits. Soils are an integral part of (terrestrial) ecosystems, as they define several ecosystem functions by their properties. Therefore, soils are significantly important and functionally required for the supply of many ES of different categories. These ES, whose supply is mainly defined by soils and their properties, can be defined as soil-related ES.

Agriculture depends on fertile soils and is a main beneficiary of soil-related ES, for instance regulating ES such as nutrient regulation, water supply or soil retention. In addition, agricultural land uses are providing multiple ES: foremost provisioning ES, but also cultural ES such as landscape aesthetics or cultural heritage. Therefore, ES assessments addressing agricultural land uses should consider the numerous links between soils and ES supply. The methods for the quantification of soil-related ES must include soil properties and condition.

This linkage of soils and ES is addressed in many frameworks and applied in several case studies. In addition, numerous reviews compile the current knowledge on the importance of soils in the ES approach.

The talk will present a meta-analysis of frameworks and classification schemes demonstrating the current status of concepts for the integration of soils in the ES approach. Based on the results of the meta-analysis, recommendations for the incorporation of soil properties and condition into the assessment of soil-related ES will be discussed and demonstrated in an agricultural case study in Northern Germany.

Keywords: soil-related ecosystem services, soil, assessment, agriculture, framework

17. Type of submission: ***Abstract***

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

Agricultural practices in soil biodiversity management: multitrophic feedback loops to ecosystem sustainability and functions

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The direct impact of agricultural land use practices on soil organisms has been extensively studied by both experimental and descriptive research. Although science is in continuous development and constantly offers possibilities to employ new research methods and consider aspects previously unknown, there is an urgent need to translate these kinds of studies into a perspective of soil ecosystem functioning. Getting to know how soil management practices influence soil dwelling organisms has been the first difficult step. Now, multitrophic interaction studies of the main players in agricultural soil ecosystems have to follow, while also taking into account the realm of economy.

In the biodiversa project SoilMan, our aim was to quantify soil ecosystem functions and multiple ecosystem services based on biodiversity parameters in different European regions. To accomplish this, a pan-European network of field trials and farm networks was established and the effects of tillage regimes and crop diversity on soil dwelling organisms determined. We use the resulting diversity data of fungi, bacteria, enchytraeids, earthworms, collembola, mites and gastropods to elucidate their roles and interactions in soil functioning and resulting ecosystem processes. Multitrophic feedback loops to soil functions and economically relevant variables are highlighted, giving an insight into the possible bottlenecks of current agroecological understanding.

Keywords: soil biodiversity, soil function, multitrophic interactions

18. Type of submission: ***Abstract***

S. Sectoral Working Group sessions: S1 Agroecology: managing biodiversity and soil health for the sustained provision of ecosystem services in agriculture

Improving the resilience of fruit cultivation with commons-based organic fruit breeding

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Plant breeding and agriculture take place in different social-ecological systems that influence each other on certain scales. A special case hereby is the fruit sector, where breeding and cultivation face several sustainability challenges such as genetic erosion and an accompanied intensive use of external inputs. For example, many widely grown commercial apple cultivars have a low robustness against pests and diseases, leading to a high use of (chemical) pesticides and consequently to ecosystem disservices. Low genetic diversity impedes the adaptation to changing environmental conditions, especially in the face of climate change. Overall, these developments reduce the resilience of fruit breeding and cultivation.

As an alternative, the approach of commons-based organic fruit breeding aims to develop new robust fruit cultivars with an agrobiodiversity-based and socio-cultural breeding approach. Here, breeding is carried out on-farm in a collaboration of farmers and breeders, using underutilized and heirloom varieties, and treating knowledge and certain material resources as common goods. By conducting a case study of the German fruit breeding initiative Apfel:gut, impacts and potentials of this approach for improving the resilience of fruit breeding and cultivation are assessed. For data generation, two focus groups with the Apfel:gut community and a qualitative interviews with the initiative's leaders took place.

Results show that, in comparison to conventional breeding and cultivation practices, commons-based organic fruit breeding potentially improves the future quality of provisioning and regulating ecosystem services through more genetically diverse and hence robust cultivars. Ecosystem disservices through the overuse of pesticides can be reduced. Further, this approach fosters distinct cultural ecosystem services because it broadens participation of

diverse actors, encourages learning and experimentation, and enables the realization of ethical values and norms of organic farming in breeding. These insights help to shape and build management approaches for resilient fruit breeding and cultivation systems, but also for agricultural and food systems in general.

Keywords: plant breeding, social-ecological system, resilience, agrobiodiversity, community