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I. SESSION DESCRIPTION

ID: T12

Economic and non-economic impacts of natural hazards and climate change on ecosystems and ecosystem services

	Title	Name	Organisation	E-mail
Host:	Dr.	Zita Sebesvari	United Nations University	sebesvari@ehs.unu.edu
	Ir.	Anne Nobel	Hasselt University	anne.nobel@uhasselt.be
Co-host(s):	Dr.	Yvonne Walz	United Nations University	walz@ehs.unu.edu

Abstract:

Disasters and climate change represent a major threat to ecosystems and impede sustainable development. Thus, reducing disasters and climate change impacts on ecosystems and ecosystem services as well as the associated social, environmental, and economic impacts remains a global priority. Ecosystems exposed to natural hazards and climate change impacts may encounter disturbance or suffer losses and damage, which has implications for the progress of disaster risk reduction and climate change adaptation, but is seldom quantified and monitored. In this session, we aim to explore conceptual, methodological and practical opportunities to assess, quantify and better integrate the loss and damage of ecosystems and their services into the evaluation and monitoring of disaster and climate change impacts, with the overall aim to achieve progress in disaster risk reduction and climate change adaptation while also providing better opportunities for ecosystem and ecosystem service loss monitoring for other purposes such as conservation or restoration. In this session we welcome abstracts that report on: 1) How to quantify the economic or non-economic value of impacts on ecosystems or ecosystem services as a consequence of a natural hazards (e.g. droughts, floods, storms) or climate change (e.g. higher air temperatures, changing rainfall patterns and sea-level rise), given that a climate-induced change or extreme event occurs, OR 2) How disaster risk or climate risks have changed, taking into account the loss or damage of ecosystem and ecosystem services due to a hazard event or climate change.



Goals and objectives of the session:

The overall aim of this session is to increase the understanding for data needs as well as assessment methodologies for economic and non-economic loss and damage of ecosystems and ecosystem services in the context of disaster risk and climate change. More specifically, we aim to answer following guiding questions in a participatory approach: 1.) How can methods help to assess and/or quantify losses and damages of ecosystems and ecosystem services due to natural hazards and climate change? 2.) What are the experiences with monitoring ecosystem and ecosystem service losses after a disaster or in course of climate change? 3.) What are the implications for disaster risk reduction and climate change mitigation and adaptation at the local level?

Planned output / Deliverables:

- Boards illustrating the discussion of the groups related to guiding questions
- Documented summary and synthesis of answers to respective guiding questions

Related to ESP Working Group/National Network:

[Thematic working group: TWG 12 – ES & Disaster Risk reduction \(DRR\)](#)

II. SESSION PROGRAM

Date of session: Thursday, 24 October 2019

Time of session: 16:30 – 18:00

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
16:30– 16:45	Nils	Droste	Lund University	Soil biodiversity insures against climatic variability in crop production – evidence from the Swedish agricultural long-term experiments
16:45– 17:00	Judit	Lecina-Diaz	CREAF	Identifying wildfire forest vulnerability and ecosystem services at risk



Time	First name	Surname	Organization	Title of presentation
17:00– 17:15	Giovanni	Signorello	University of Catania	The impact of hypothetical eruption events on ecosystem services in Mount Etna volcano (Sicily): spatial distribution and monetary evaluation
17:15– 17:30	Sonja	Wanke	Deltares	Impacts of Shellfish Reef Management on the Provision of Ecosystem Services Resulting from Climate Change in the Dutch Wadden Sea
17:30– 18:00	All participants			Discussion of guiding questions

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: T12 Economic and non-economic impacts of natural hazards and climate change on ecosystems and ecosystem services

Soil biodiversity insures against climatic variability in crop production – evidence from the Swedish agricultural long-term experiments

First author: Nils Droste

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Two large-scale trends increasingly affect agricultural production: climate change and the degradation of soil biodiversity. Both have their own effects on food security. Climate change in the northern latitudes may extend the growing season but may also increase climate variability and the likelihood of extreme events. For northern climates, there may thus be both



beneficial and adverse effects of climate change. Biodiversity loss degrades soil fertility, water-holding capacity, and decreases overall resilience. There may also be interactive effects of the two trends that multiply the effects on agricultural production. We analyse 54 years of data (1962–2015) for 12 sites of the Swedish long-term agricultural field experiments with regard to impacts of changes in climatic and soil biodiversity variables on production. We confirm that average temperatures are rising and that soil organic carbon as an indicator of microbial biomass decreases over time. Statistically, we employ a Bayesian multi-level model to estimate production functions. Controlling for fertilizer applications and accounting for crop sensitivity to the timing of rainfall and temperature, we show that soil biodiversity buffers negative effects of extreme climate events and increases the benefits of favourable climatic conditions. We thereby provide evidence for the important insurance functions of soil biodiversity in a changing climate. We elaborate on the processes and structures that lead to these results such as water holding capacity and soil fertility, and discuss potential management practices to increase soil biodiversity such as integrating grass cover into crop rotations. Future steps in this line of research will include the extrapolation of the results along climate change scenarios, quantification of the impacts of biodiversity conserving practices, and evaluation of potential governance approaches to support such practices.

Keywords: soil biodiversity, climate change, insurance, resilience, soil carbon

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

[T. Thematic Working Group sessions: T12 Economic and non-economic impacts of natural hazards and climate change on ecosystems and ecosystem services](#)

Identifying wildfire forest vulnerability and ecosystem services at risk

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Forest ecosystems support a wide variety of ecosystem services that are essential for human-wellbeing. However, forests are increasingly being under pressure from global change, resulting in changes in natural hazards, mostly forest fires, drought and insect-outbreaks. In the case of forest fires, fire weather season frequency and length are expected to increase during the next few decades. Under these circumstances, we need to evaluate the vulnerability



of forests to wildfires as well as the risk of losing their ecosystem services. The main objective of this study is to determine the spatial patterns of vulnerability and risk of losing ecosystem services if wildfires occur. We define the main criteria and indicators to assess vulnerability and risk, including all their components (i.e., susceptibility and recovery capacity for vulnerability; hazard probability, exposure and vulnerability for risk). Then, we apply these concepts with real data using indicators from a Mediterranean region, i.e., Catalonia (NE Spain) to identify the most vulnerable forests and the areas at highest risk to lose their ecosystem services. We also identify which indicators have the highest influence in both vulnerability and risk. We believe this concepts and methodology could be applied to forest worldwide to reduce hazard impacts on ecosystems and ecosystem services.

Keywords: wildfires, vulnerability, risk, Mediterranean, forests

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

T. Thematic Working Group sessions: T12 Economic and non-economic impacts of natural hazards and climate change on ecosystems and ecosystem services

The impact of hypothetical eruption events on ecosystem services in Mount Etna volcano (Sicily): spatial distribution and monetary evaluation

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InVEST model and GIS spatial analysis were used to make a biophysical and economic assessment of three ecosystem services (ESS) – carbon storage, pollination and water yield – on the Mount Etna volcano (S.E. Sicily). The hazard map by lava flow inundation at Mt. Etna performed by the INGV Institute (2013, Catania Section) was used to hypothesize three future scenarios related with different hazard levels: low (scenario 1), medium (scenario 2), and high (scenario 3). The results, related to the current setting, indicates that (1) the Etna area stores about 16.4 million tonnes of carbon (€ 492 million). As it was expected, forests (conifer and oak woods) located on the Mt. Etna Natural Park show the highest carbon storage capacity per hectare. However, the orchards are the first source of carbon storage (equal to 42% of the total) due to their wide extension on Mt Etna territory. (2) The value of pollination service



attributable to wild insects (*Apis* spp. and *Bombus* spp.) is € 45 million, equal to 50% of the total value of pollinator-dependent crops. Mixed forests, interrupted by natural pastures and cultivated crops, supply the highest level of wild bee pollination services. (3) The volume of underground water, calculated as the difference between rainfall and the rate of evapotranspiration, is about 400 million m³ per year (€ 240 million). The comparison of the effects of lava flow inundation on the EES was made across the scenarios. The carbon storage and the pollination service will decrease in the future scenarios, due to the loss of woods and natural habitats. Instead, the water yield capacity will increase because the creation of new naked land surfaces characterized by high permeability levels. In detail, the ESS show a maximum loss of 18% and 10% for carbon storage and pollination respectively, and a maximum increase of about 10% for water yield.

Keywords: carbone storage, pollination, water yield, economic value, InVEST, lava flow

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

[T. Thematic Working Group sessions: T12 Economic and non-economic impacts of natural hazards and climate change on ecosystems and ecosystem services](#)

Impacts of Shellfish Reef Management on the Provision of Ecosystem Services Resulting from Climate Change in the Dutch Wadden Sea

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Ecosystem goods and services are the basis of all life on earth and through the interaction with natural systems and societies are the main contributor to human well-being. In recent years, the ecosystem service (ES) concept has been a growing tool in coastal and marine management. Management related to ESs, therefore, seeks to define and analyse the various service characteristics and potentials in relation to human activities in coastal zones such as in the Wadden Sea region. The Wadden Sea provides many ESs such as nutrients, materials and energy, or aesthetic value. Furthermore, shellfish reefs provide many benefits to humans, such as food, coastal protection, or aesthetic value. However, in recent years, their efficiency is surrounded by uncertainty as they are prone to climate change-related stressors. Identifying their vulnerabilities when exposed to changing water conditions is fundamental to determine



the best circumstances for an efficient application of these reefs to restore and sustain existing ESs.

An ecological modelling approach enabled the simulation of several future climate scenarios for the Dutch Wadden Sea. A broad review of the current shellfish management practices helped to develop and adapt four different management strategies which are commonly found in integrated coastal zone management (ICZM) when protecting the coastline: Do nothing, Hold the line, Advance the line, and Replace the line. These management alternatives were applied to the modelled climate scenarios and evaluated in terms of their potential effects on the provisioning of ESs by shellfish reefs. A multi-criteria analysis pointed out the multiple benefits that could be derived from actively preserving and maintaining shellfish reefs through advancing, replacing and holding the line with the highest scores assigned to advancing the line under all climate scenarios. Results also show how no intervention could cause irreversible damage to shellfish reefs and the ESs they provide.

Keywords: Reef management, shellfish, climate change, ecological modelling, integrated coastal zone management (ICZM)