

Catastrophic shifts in drylands: how can we prevent ecosystem degradation? Special Session on how to overcome the difficulties of successful engagement of non-scientific stakeholders

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ABSTRACT: We already know quite a bit about the coexistence and interdependencies of human communities, animals, and plants, but we must learn more about the thresholds that determine whether or not ecological communities can survive in drylands in the future. Are some types of ecosystem more resilient to change than others? How easily can degraded land be restored? A series of experiments in different sites across European drylands will seek to provide some answers.

The aims and objectives of the large EU-FP7 funded CASCADE (Catastrophic shifts in drylands: how can we prevent ecosystem degradation?) project (www.cascade-project.eu, 2012-2017) are to obtain a better understanding of sudden shifts in drylands that may lead to major losses in biodiversity and concomitant ecosystem services. By focusing on drylands in Europe, CASCADE will build on existing knowledge regarding shifts in these vulnerable ecosystems and further improve the current understanding of the biogeochemical mechanisms underlying sudden and catastrophic shifts. CASCADE aims to further develop instruments and tools to predict the proximity of dryland ecosystems to thresholds in such a way that these predictions can be used by policy makers and land users, for more sustainable management of drylands worldwide.

A particular challenge for the CASCADE project is to convey complex concepts to non-scientific stakeholders in order to engage with stakeholders. In this special session we hope to offer the audience an insight into processes to think about concerning stakeholder engagement while generating ideas about land management measures to avoid catastrophic shifts and ways forward for the project to achieve maximum impact.

Keywords: Stakeholder engagement, Catastrophic shifts, Sustainable land management, Drylands, Ecosystem services

1. BACKGROUND

Changes in the well-known forest, shrub or grassland landscapes of Mediterranean dryland ecosystems, as they respond to environmental changes, are not always easy to understand or predict. When external conditions or pressures (such as climate or human land use) change, some ecosystems may respond in a gradual way. For example, an increase in grazing pressure by herbivores may lead to a decrease in vegetation cover in drylands. Other ecosystems, however, seem to remain inert to increasing pressures, until a threshold is passed. At this point the ecosystem suddenly shifts to a new state, characterized by a different structure, species composition and/or functioning (Kéfi et al., 2007). This phenomenon is referred to as a “catastrophic shift” (Fig. 1). A catastrophic shift, according to the mathematician René Thom’s catastrophe theory, is an abrupt change in the state of a system, which suddenly shifts from one stable state to another. Such shifts to a degraded state that occur in drylands can lead to dramatic economic as well as ecological consequences. Current understanding of the causes and characteristics of catastrophic ecosystem shifts in Mediterranean drylands is limited, so that it continues to be difficult to predict if or when a shift is going to occur, and whether action can be taken to prevent it from happening. The CASCADE Project will address the following key questions:

- Why do ecosystem catastrophic shifts occur?
- Why are some ecosystems more resilient than others?
- What can be done to prevent catastrophic shifts?
- Can degraded ecosystems be restored to a former state?



Fig. 1: Adjacent areas in Spain (El planeron, Belchite, Northeast of Spain) at the same time of year. What causes the vegetation community seen on the left to shift to a degraded landscape (on the right)? (Photos by S. Kéfi, 2009)

CASCADE will investigate a range of dryland ecosystems in southern Europe to study a range of physical and socio-economical drivers. Research will focus on 6 study sites in the Mediterranean region, ranging from Portugal to Cyprus (Fig. 2).



Fig. 2: CASCADE logo and field sites. 1 = Caramulo mountains, Portugal; 2 = Albutera range, Alicante, Spain; 3 = Ayora and Mariola ranges, Spain; 4 = Castelsaraceno, Italy; 5 = Messara valley, Crete; 6 = Pegia aquifer, Paphos, Cyprus

1.1 Session rationale

The CASCADE project faces a real and, we believe, not unique challenge in ensuring from the start, that relevant non-scientific stakeholders can engage with the concepts being studied, and – of crucial importance – that the management implications the project will produce are clear, effective, and appropriate for decision makers and land managers in order to guarantee the sustainability, both in economic and ecological terms, of land management strategies in the CASCADE study sites, and drylands in general.

Specific objectives of the session are to:

- obtain a better understanding of how complex concepts such as ecosystem shifts, thresholds, and tipping points may be more effectively conveyed to non-scientific stakeholders in order to engage with local land users;
- generate ideas from a (hopefully!) diverse audience about the type of preventive and restorative measures for sustainable management of dryland ecosystems that would address potential catastrophic shifts;
- develop a set of criteria to be used by potential stakeholders to assess the value of different SLM measures, in order to develop sound dissemination outputs for reporting to national and international policy-makers, as well as identify entry points for policy changes to ensure maximum policy output;
- offer the audience an insight into processes to think about concerning stakeholder engagement, and impact creation from a large interdisciplinary SLM research project.

1.2 Session structure

Participants will receive a short questionnaire regarding the topics to be discussed in the ensuing discussion round.

We will divide the session into two equal parts, the first dedicated to a series of short presentations, the second to interactive discussion and concluding remarks.

In the first part of the session, the following presentations will be made (3 x 12 minutes):

1. Introduction of the CASCADE Project and ways in which we plan to involve non-scientific stakeholders, including analyses of local land users' adaptation strategies and multi-scale evaluation of scenario analyses with land managers and policy makers. Presenter: Prof. Coen Ritsema, Wageningen University and Research Centre
2. Can we really determine the state of soil degradation in a way that it can be linked to political issues? Presenter: Dr. Violette Geissen, Wageningen University and Research Centre
3. Economic assessment of the financial effects of (not) adopting land management measures. Presenter: Dr. Luuk Fleskens, University of Leeds

Subsequently, in the second part the discussion will be structured around the following topics:

1. SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis of the CASCADE setup for stakeholder engagement;
2. Themes and terminology for stakeholder engagement;
3. Inventory and assessment criteria for SLM strategies addressing potential catastrophic shifts

2. THE CASCADE PATHWAYS TO IMPACT

2.1 Involving non-scientific stakeholders

Creating an understanding of ecosystem catastrophic shifts is one thing, but ensuring that that knowledge subsequently finds its way to better land management practices and policies is another. To achieve this ultimate aim, in CASCADE we will, simultaneously to ecological experiments and model development, identify ecosystem management practices and evaluate them according to their resilience to change and their sustainability over time and spatial scale. This assessment will be done in a participatory way with the help of stakeholders, including land users and local policy makers (Schwilch et al., 2012). Guidelines will be prepared on best practices for ecosystem management. Stakeholders will also be involved in scenario analyses and recommendations for up-scaling preventive and restorative measures. This will be done through an analysis of local land users' adaptation strategies across a spectrum of degradation states, providing insight into how people have responded to past shifts, and how they are responding as a result of current changes, to potentially avoid such shifts. Looking into the future, scenario analyses will be made of promising sustainable land management strategies that increase resilience and move away from a catastrophic shift, scaling-up in time and space. These scenarios will be evaluated at multiple scales with policy makers to finally formulate policy recommendations for preventive and restorative dryland management and identify entry points to inform policy change.

2.2 Economic assessment of the financial effects of (not) adopting land management measures

Information on the costs of ecosystem degradation and the benefits of preventive or restorative land management is crucial for stakeholder decision-making. Assessing such costs is not an easy task due to various uncertainties and feedback mechanisms. Among the most difficult aspects are the timing of costs and benefits and their attribution to stakeholders. An overview will be given about economic assessment methods, with special reference to complexities in drylands at risk of catastrophic shifts. The economic assessment will be framed along three dimensions (costs and benefits, on- and off-site, and with and without case). Costs include the consequences of degradation but also the investment in sustainable land management. Although uncertainty over the long-term costs and benefits is the most important, it is shown that even required investments are often not well-known and may vary considerably. Some example assessments will illustrate the current state-of-the-art. Plans for CASCADE include the development of a tool for cost-benefit analyses linked to soil-water-plant models, which pays special attention to the optimum

timing of measures that prevent degradation processes. When the models have been applied and analyses concluded, the CASCADE recommendations will be evaluated through interviews with land users, community focus groups and experts, and through meetings with regional and national policy makers. Data requirements for this approach will be discussed along with user engagement opportunities.

3. POLICY ORIENTED RECOMMENDATIONS

3.1 *Can we really determine the state of soil degradation in a way that it can be linked to political issues?*

Soil degradation is a severe problem in drylands worldwide. For the past decades scientists have been trying to characterise soil degradation in drylands, to estimate related economic values, and to link them to political issues. We will present actual existing concepts to estimate the state of soil degradation in drylands. By focusing on these vulnerable ecosystems, especially by improving our understanding of the drivers and mechanisms behind shifts and by developing timely signaling tools (e.g. Dakos et al., 2012), we aim to bring the science of sudden shifts in soil – plant ecosystems a major step forward and to find ways in which these shifts can be avoided and livelihoods supported. The necessary knowledge and science of predicting ecological thresholds remain limited and the characteristics and potential impacts of these thresholds are yet to be fully understood. The challenge we face today is to develop the necessary science to support decision-making, while simultaneously taking into consideration the continuous process that characterizes land and resource management. We must develop sound policies in support of management decisions applicable to the high uncertainty of potential thresholds (Fagre et al., 2009). We will present potential solutions to link these thresholds to policy measures, and discuss the knowledge gaps and urgent questions to be answered.

4. CONCLUSIONS

Improved understanding of the occurrence of ecosystem catastrophic shifts in drylands is key to informing improved policy and practice, but significant benefit can only be expected when such knowledge is co-developed with stakeholders. This special session addresses the question how this engagement and impact can be realized within the recently initiated large interdisciplinary CASCADE project. The session aligns closely with the Valuation of sustainable land management (SLM) key topic of the Conference, and in particular the sub-topics “Awareness raising, research and education on the economics of DLDD”; “Good practice in sustainable land management and lessons learned”; and Land and habitat planning”.

In order to provide a user-friendly communication and knowledge transfer platform, which can be easily accessed by both scientific and non-scientific stakeholders, we are in the process of developing an online information system (CASCADIS) on the CASCADE website, which will include an interactive presentation of this Special Session with drop-down features that can be used by the readers to find basic information on the session, view the presentations and questionnaires, as well as find further information according to their interests. We also plan to include video clips as a powerful information sharing tool.

5. REFERENCES

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