

Vulnerability to land-use change of ecosystem services provided by traditional European agro-pastoral landscapes – The French Alps as an example

Speaker: Sandra Lavorel.-

In this part of her presentation she showed an applied example of assessing “Vulnerability to land use change of ecosystem services provided by European traditional agro-pastoral landscapes in the French Alps”. This work was carried out by Sandra Lavorel, Fabien Quétier, Eric Garnier and Jacqueline De Chazal.

This work is all part of a MEA approach which says that the vulnerability of different regions and people who live there is linked with the changes in the delivery of ecosystem services due to global climate change. In this context, the VISTA project aimed to develop a framework and a methodology to assess vulnerability of ecosystem services in European cultural landscapes.

European agricultural landscapes are considered multifunctional because they provide a diverse range of ecosystem services (cultural, touristic, aesthetic, economic, environmental) so they are useful to study the relationship between the loss of biodiversity and the loss of ecosystem services.

The VISTA project was carried out in 11 sites from 9 countries in marginal agricultural areas which were subjected to a decreased management and reduced intensity use (extensification), associated with a decreasing plant biodiversity. If plant diversity is decreasing, which other associated services do local people lose?

The presented approach is about establishing a direct correlation between biodiversity, ecosystem functioning and ecosystem services. Using this approach they started recognizing ecosystem services (ES) (e.g.: food production, wildlife habitat) related to different stakeholders, then they recognized different descriptors or indicators of each ES (% legumes, % grasses, sward height) to link them to different ecosystem properties (ANPP, standing litter). The used idea is that if they understood the main ecosystem services in the landscapes, they will be able to assess the vulnerability to land use change and its consequence in to ecosystem services.

Vulnerability to land use change was assessed through its components: exposure, sensitivity and acceptability. Exposure is related to the application of different future land-use change scenarios in a landscape scale to discuss the consequences of these changes (compared to past land use) in ecosystem services. Sensitivity was estimated as the change in biodiversity and its consequences in ecosystem processes in a field scale. Finally, acceptability was considered as the valuation of changes in multiples services by local stakeholders in a landscape scale. This methodology incorporated an interdisciplinary approach that links social and ecological data starting in land-use change and follows in the consistent changes in biodiversity, ecosystem functioning and ecosystem services. The local data was supplied with a scenario approach.

One of the study sites of this work was carried out in Lautaret, Central French Alps. The ecological data was harvest through management and field experiments, semi controlled experiments, measures and observations in a long term research station. Social data was collected from stakeholders surveys (landscape or grassland were described underlying implicit values or importance) and ecosystem services narratives related to different cultural uses (post card, agro-rural, heritage). Using these narratives they constructed an ES matrix to link different ecosystem services with each cultural use and different ecological attributes with those ES (positive or negative indicators of them).

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Biodiversity in a changing World: Land use and other effects on landscape and regional diversity in the Alps.

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This methodology also included a historical approach. This was based in potential land use trajectories as results of different historical land uses with different biodiversity responses (and ecosystem functioning responses that affect ES). E.g.: Permanent grassland could be managed to mowing or to summer grazing, so there exist 2 different use trajectories of this vegetal community. All this data was combined with past aerial photographs and cadastral maps to validate the degree of change and to build a conceptual model about vegetation typology based on land use (which link different plant communities related to different land uses).

They used a functional approach to predict changes in ecosystem functioning through dominant plant functional traits (response and effect traits). The functional approach suggest that some traits presents in the dominant plants that live in a specific ecosystem could give us information about the main processes that determine the dynamic of that ecosystem (e.g. leaves traits like chemical components tell us about decomposition process and herbivore defence). This theory proposes a fundamental trade-off between a conservative and an acquisitive resource use by plants (plants that use the resource to live more and defend better are conservative, while plants that use the resource to growth fast and disperse more and better are acquisitive). In this case, traits response to decreasing land-use intensity (extensification) shows a predominance of conservative plants. In this point, they add functional traits in the conceptual model about vegetation typology based on land use to lead to a functional model of vegetation response to past and present land use in Lautaret. Through this approach, they tested the “mass-ratio hypothesis” (Grime 1998) which said that species effect on ecosystem functioning depend on their relative contribution to the community and on the trait value, defining trait value as the weighted mean of the trait value (species trait value weighted by species relative abundance in the community).

They developed a conceptual model that allowed to “use plant traits to understand ecological trade-offs and synergies in the delivery of multiple ecosystem services”. In this point she presented an example of trait related to land use, the leaf dry matter content (LDMC) that is an estimate of leaf tissue density. They found that if extensification increase, LDMC as a trait increased. The consequence is a decreased decomposition and an increased litter accumulation that produce a declining fertility. The same was applied to other plant traits (specific leaf area, leaf nitrogen content, etc) linked to different land uses to see the effect in the ecosystem functioning. In general terms, they could conclude that acquisitive plants were related to intensive land uses, with fodder production, soil nutrient supply and invertebrate diversity as main ecosystem services; while conservative plants were related to extensification, so carbon sequestration, soil conservation and pest control were the main related ecosystem services.

Once they had the current trends in plant traits, ecosystem processes and ecosystem services, they projected the future possible states of the system downscaling future IPCC SRES scenarios A1, A2, B1 and B2 to European land-use change scenarios. An economic and global scenario (A1) where all grasslands were converted to extensive summer grazing; an economic but more regionalized scenario (A2) where grasslands were converted to intensive/fertilized grazing or extensive summer grazing; and a more social and global scenario (B1) where grasslands and all post-arable grasslands were cut, not fertilized, and the rest was abandoned; and a more social and regionalized scenario (B2) where grasslands were fertilized and cut and the grazed grasslands stayed in the same state. For each scenario, they constructed a map to visualize what happened with each ecosystem services and biodiversity.

To validate the obtained data, they used LAMOS images to project composition gradients and scenarios impacts in ecosystem services. Taking into account this statistical approach (grassland typology) and the dynamic approach (PFT based modelling) they could obtain different change percentage in ecosystem properties and in ecosystem services to compare these approaches.

Finally, they could conclude which social groups were most affected to each land use change scenarios (stakeholder vulnerability) through an “acceptability outcome” for ecosystem services in each cultural land use: post card, agro-rural and heritage.

In general, they concluded that the ecosystem services perception depend on the space scale (global or locally). Locally exist more interest in the process that in the results. Some generalizations include that people interested in cultural and aesthetic values were more vulnerable, scenarios that promote a productive extensification led to a loss of biodiversity and related ecosystem services, and scenarios that promoted traditional agriculture also increased biodiversity conservation and the delivery of a broad range of ecosystem services.

This original approach that linked plant functional traits with vulnerability are very useful to model changes in ecosystem services in response to land use, and to understand ecological constraints to the simultaneous provision of multiple services for one side, and to assess vulnerability of different stakeholders across sites.

Is important consider that:

- Ecosystem services could vary in the future, so the scenario projections have to be analyzed carefully.
- Stakeholders could influence policies indirectly so the projections could vary too.
- The perception of the ecosystem services by the stakeholders could vary with the stakeholder age.
- The size of the region of study.
- Time scale assumptions.
- Models are very useful but have limitations.
- The maps are useful describing extreme trends but they are no forecast.
- The way to communicate the results.

Summarized by

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