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EIP-AGRI Focus Group

Forest Practices & Climate Change

MINIPAPER 5: Integrated management of forested landscape in the face of climate change

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Introduction – Motivation

There is increasing awareness of the need to integrate forest management in a holistic, **integrated landscape** approach that focus on all forest ecosystem goods and services, including biodiversity, and all stakeholders, while managing the functions of all land-use types.

The concept of the landscape is more complex than just a geographical area or a set of land uses. The landscape is the natural and functional background for the various ecological processes and interactions among organisms, including humans, to take place at various spatial and temporal scales. In other words, the landscape is a structure of interacting systems forming a characteristic section on the earth's surface created and maintained by the combined actions of biotic and abiotic factors and human activities.

Landscape mosaics including different ecosystems as farms, crops and forested areas are typical of rural areas across the European Union. In 40% of cases, a mix of natural, semi-natural and artificial lands surrounds European woodlands. Moreover, this pattern can be found in countries belonging to different European regions (Estreguil et al 2012).

Landscape dynamics are important for several reasons; they affect biodiversity and the provision of ecosystem goods and services such as disturbance regulation. Climate change, with all its consequences, can affect the composition and availability of landscape ecosystem services so significantly that will not meet the expectations of human society or even the landscape may lose its capacity to provide services for a long time. Moreover, mitigation and adaptation measures may also affect service provisioning in a complex trade-off process.

The purpose of this report is to examine the potential contribution of integrated forested landscape management to climate change mitigation and adaptation and the provision of ecosystem goods and services.

Dissertation

In this report, the focus is on three issues in the framework of **integrated forested landscape management**. How a **multi-sectoral view** on forested landscape management, allowing diversifying management strategies, could offer an effective long-term adaptive strategy to ensure the safeguard of the landscape in view of the risk and uncertainty under climate change. The characteristics of the **ecosystem services** (ES) provided and potentially managed at the landscape scale. In relation to that, it is crucial to understand the landscape trade-offs between different ES, as directed management in order to increase one, might negatively affect other ES. The important tactical and strategic landscape planning cannot be done without **integrating all stakeholders**. Negotiating and finding a widely accepted compromise is often the most difficult part of the whole planning process. However, assuring that all stakeholders have access to the information they need in a comprehensible way provides opportunities for better decisions.

Multi-sectoral view on forested landscape management under climate change: diversifying strategies to face uncertainty

Each manager involved in land management (forests, agriculture, water streams...) has to make dozens of decisions every day. Decisions can be short-lived and easily modified if the results are not as expected but some decisions can also have long-lasting impact and their consequences may affect even future generations. Therefore, the more precise we can predict the consequences of our decisions, the better.

Computer models can be used to make informed assessments of the probability of future events. The results of assessments might indicate changes to the local flora and fauna or impacts on the provision of ecosystem services. However, the future state of a landscape or ecosystem is always uncertain.

Categorizing the uncertainty of climate change is just as complex as climate change itself. It is clear that some options to reduce uncertainty are more robust than others. For example, reducing national/global emission will reduce uncertainty by constraining the range of possible climate change scenarios.

It is impossible to eliminate uncertainty but more robust data and information could improve the prediction models

However, considering the current uncertainty, the most robust management approaches seem to be these that perform satisfactorily over many plausible future scenarios instead of being optimal under an expected one only (of course, if a decision maker wants to minimize the regret of choosing incorrectly, where regret is the loss in performance). For landowners, incorporating risk into forested landscape management implicitly leads to diversified management strategies at the landscape level. We could diversify business strategies with aiming to minimize the risk of economic loss. This could be done by forming a portfolio together with other asset classes, e.g. agriculture, wood industry and others, or by holding parts of the whole forest estate in different regions.

Strategies diversification could also help from an ecosystem point of view. There are many different forest management approaches (from intensive plantation forests to forests without human intervention) and each of them provides a range of different ecosystem services. Diversification of the ecosystem services provided across different forest properties within the landscape should ensure that the entire forested landscape, in the long term, would fulfil some services even if others could not be provided in the shorter term due to the negative effects of climate change.

In short, diversification enhances the sustainability of forested landscapes and derived economic incomes through risk spreading. This could be highly beneficial in the face of unpredictable environmental or societal disturbances, which would be more frequent under climate change.

Diversifying management strategies across the forested landscape could help to reduce the risk of economical or ecological loss

Forested landscape´s ecosystem services under climate change

Heterogeneous landscape mosaics support higher biodiversity than homogenous landscapes, not only because they include more "natural" areas than extensive plantations but also because they provide different ecosystems and therefore different potential species. Interactions among various ecosystems also enhances species capacity to obtain different sources of habitat, food and refuge. Heterogeneous landscapes also provide vital ecosystem services efficiently such as soil protection (for example, creating natural barriers to erosion), pollination (due to the mentioned increase of potential sources of food), recycling of nutrients and water regulation (thanks to the interface between different habitats) (Baudry 2014). Moreover, landscape mosaics generate higher resilience to climate change than large homogeneous areas of forest or crops. Forest continuity in space *per se* could benefit forest fire spread; if accompanied by low species and structural diversity, continuity also benefits pest and disease expansion; if we talk about large areas of dense forests, the risk of drought-induced die-off is larger (EU Community strategic guidelines for rural development, 2006).

Heterogeneous forested landscapes can provide a broader spectrum of ecosystem services and help conserve biodiversity

Ecosystem services depend on properties such as the extent, composition and spatial configuration of the elements forming the mosaic, which are in any case potentially manageable (Bennett et al 2006). For example, excessive compartmentalization could lead to fragmentation and associated environmental problems while unmanaged connectivity may favour spread of insect pests. Similarly, large close-to-nature forest areas may show low structural diversity and smaller habitat value than diverse mosaic landscapes.

This leads to the management of trade-offs between different ecosystem services and biodiversity since different configurations of the landscape will favour certain ES or aspects of biodiversity at the cost of others. For example, increasing tree cover at the landscape scale may increase CO₂ sequestration while reduce water availability, as well as agroforestry combinations could improve biodiversity at the cost of production. In the face of adopting different strategies, the planning process could look to minimize trade-offs or, based in different stakeholder needs, make the necessary choices.

Incorporating and integrating different stakeholders into the planning process

Incorporating a multitude of economic, social and ecological goals into landscape management requires that stakeholders representing all relevant perspectives are included in the planning process. In this respect, one purpose of the planning is to raise awareness about potential goal conflicts among stakeholders, e.g. private and public organizations. The many particular private forest owners often have multiple goals in forest management (e.g. Blennow et al. 2016). An identification of the stakeholder community should therefore be carried out in the initial stage of the planning process. Inviting citizens to participate, furthermore, is important in a democratic society and helping citizens to reach their own goals provides opportunity for effective communication (see Mini Paper 1). Management of forested landscapes benefits from including landowners since they are the final decision makers. On the one hand, private landowners can provide useful input to the planning process, for instance by contributing to scenario-narratives. On the other hand, landowners' needs would be better considered in the planning processes. Failure to engage stakeholders in an equitable manner in decision-making processes will lead to suboptimal, and unethical, outcomes. If all stakeholders are recognized, solutions should encompass a fair distribution of benefits and incentives.

At a landscape level, important information on the local environment and its dynamics is needed for decision-making. However, to bridge the research to innovation gap not only factual information is needed but also information on the needs of the decision-making agents in the landscape and "what works" in the local environment (see Mini Paper 1). Incorporating and integrating different individuals or groups of stakeholders into the planning process as well as communicating and explaining the results of the landscape planning are crucial elements of the integrated forested landscape management. The more appropriate and inclusive governance may provide the best balance among the entire socio-ecosystem needs.

Incorporating properly identified stakeholders into the planning process of landscape management can bring a lot of benefits locally as well as for society as a whole

Conclusions

Forested landscape management under climate change represents many challenges that need to be tackled for successful climate change adaptation and mitigation. Increasing uncertainty due to climate change means increasing complexity of decision-making processes. Diversifying management in order to support the provisioning of different goods and ecosystem services may reduce the risk of economic loss at the landscape level. It means that society should not prioritize only one use of forests in the landscape but should learn how to optimally combine different forest management strategies and share the benefits. This approach reduces the risk that in the future we could lose some of the important ecosystem services, such as water, soil protection or biodiversity. However, it increases the need of understanding potential trade-offs between these services in order to ease decision-making. Incorporating different stakeholders into the planning process supports acceptance, implementation and sustainability in the long term. Only a multi-sectoral and multipurpose view on the landscape allows finding the most beneficial solution, which minimizes the negative consequences of climate change. Nonetheless, in order to know how to incorporate these different interests is necessary to select which kind of collaboration will be the most appropriate to supply the expected outcomes. To provide the required knowledge, owners and administrations should put landscape management into real practice.

Research needs

- 1) How to quantify the trade-offs between ecosystem services at the landscape scale, considering climate change projections?

Among the different ES provided at the landscape scale to consider; the role of landscape mosaic and integrated management on fire-spread should be established. The effect of forest densification at the landscape scale, due to land abandonment, on drought-induced forest die-off is missing in current lines of research and should be more highlighted in research communities. The influence of climate change combined with land-use changes at the landscape level plays important role in expansion of certain pest species.

- 2) Which kind and scale of governance will enhance the delivery of ES and agreement between different stakeholders at the landscape level?

Is necessary to collect information on the needs and knowledge of the local decision-making agents. Only multi-sectorial teams and projects dealing with the landscape as a whole can bring answers to unpredicted needs. Research is also needed on how insurance schemes could minimise the risk of taking early action in forest management to adapt to climate change. As owners prefer to avoid risks, it should be looked how to incentivise them to take the risk to adapt their practices. In addition, in case of small and fragmented ownership, analyse how "landscape approach to forest management" will work like.

- 3) Real comparisons between single and landscape management benefits

The mentioned research needs and future ones should be tested by credible comparisons considering the potential advantages and constraints of landscape management versus stand level management.

Ideas for innovations

Although the human society will have better and better decision-making methods and techniques and will use better computing technology, the final decision how to manage the landscape will always be on the human side. The character of individual, or groups of, decision makers will play an important role in the implementation of adaptation and mitigation activities. Therefore, **tools and procedures for objective testing and evaluation of the real ecological and economic benefits of individual owners versus owners' associations into heterogeneous landscape units** should be developed as soon as possible.

Further research needs coming from practice, ideas for EIP AGRI operational groups and other proposals for innovation can be found at the final report of the focus group, available at the FG webpage <https://ec.europa.eu/eip/agriculture/en/content/focus-groups/new-forest-practices-and-tools-adaptation-and>

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