

Ecosystems under pressure: Agriculture, forestry and conservation under global changes

Perspectives from the new generation of scientists

A group of 22 PhD students from 11 institutions all over Switzerland met for a three-day workshop in January 2020 on top of the Rigi mountain to discuss about pressing issues and challenges associated with global changes in agriculture, forest and conservation biology.

The Rigi-Workshop was set up by the Platform Biology of the Swiss Academy of Sciences (SCNAT) to promote interdisciplinary exchanges between young and senior scientists. During this workshop the students had the opportunities to present their PhD work and to expand their scientific network to other disciplines.

Based on the input lectures of five researchers the students were asked to work out the main current issues as well as future challenges and opportunities in agriculture, forestry and conservation biology. To cover different perspectives, students were split into groups with different background. The ultimate goal was to identify potential solutions for more sustainable use of the planet's resources with the main focus on central Europe.

The workshop was a great success thanks to the high motivation of the students. Lively and intense discussions highlighted that this new generation of scientists is truly concerned by the current environmental issues and feel responsible to propose solutions. In spite of their different backgrounds, their opinions about the main challenges/issues converged and a consensus was reached at the end of the workshop. The students underlined the emergency of the situation so that actions should not be delayed. Among the different solutions proposed, raising public awareness as well as effective communication across scientists, stakeholders and policy makers were highlighted. Students also debated about the efforts needed to clearly communicate recommendations from the scientific community towards policy makers and stakeholders.

The workshop was supported by the SwissForestLab and the Commission for Phenology and Seasonality as well as the following institutions: Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), Swiss Federal Institute of Technology (ETH), Institute of Organic Agriculture (FiBL) and the Swiss Ornithological Institute. The input lectures during the workshop were given by Martin M. Gossner (WSL), Martin Hartmann (ETH), Sibylle Stöckli (FiBL), Nicolas Strebel (Swiss Ornithological Institute) and Yann Vitasse (WSL).

Here is the synthesis of the workshop output written by the students.

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1. Agriculture

1.1. Current issues

Human population is currently facing tremendous issues concerning agriculture. These include the following three main concerns. Today, food systems lack sustainability and resource efficiency in terms of production, distribution, and consumption patterns. This is reflected in overexploitation of resources, ecosystem degradation, unbalanced distribution systems as well as food waste.¹⁻³ The second main issue is the intensity of land-use and agricultural expansion for food production.⁴ This intensification of agricultural practices mainly triggers the overuse of resources such as soil, water, space along with a loss of biodiversity and reduction of ecosystem services.⁵ These two anthropogenic changes exacerbate climate change impacts, which are itself a major issue for agriculture.⁶ Indeed, intensive agriculture leads to accelerating greenhouse gas emissions that contribute to global warming.^{7,8} Climate change in turn affects agricultural systems through increased frequency of extreme events (e.g. drought), ongoing temperature rise and shifts in precipitation patterns. Furthermore, climate change also promotes the incidence of pests, diseases, and invasive species, enhanced by changing phenology.^{9,10}

1.2. Challenges

In order to tackle these issues and enable a sustained production of agricultural goods in the future, the development and implementation of sustainable production methods is crucial.^{11,12} To reach this, policies and ultimately society must provide a framework in which farmers are able to optimize their agricultural practices. To open new possibilities for farmers, it is important to build a market that prioritizes sustainable agriculture.¹³ However, this requires changes in policies and consumption behaviour, which is fuelled by raising awareness in society.¹⁴ Increasing awareness of consumers plays an important role in the transition to a more sustainable production, but this may take a long time. This points to the need that scientists and policymakers should work together and

initiate immediate actions. Furthermore, farmers are increasingly confronted with difficult decision to balance the needs for food security, sustainability while maintaining an economically profitable production. Moreover, changing farming management is a delicate issue, as cropping practices have been developed over generations and it is challenging and potentially risky to modify these practices in such a short timeframe. Hence, it will be challenging for societies, policymakers and scientists to promote the transition towards a more sustainable production in cooperation with farmers.

1.3. Potential solutions

Promoting behavioural changes for food production and consumption is discussed here as a central piece of the solution towards improving food system efficiency, decreasing land use intensity and dealing with climate change issues. We recommend that consumption patterns be directed towards local food (shorter production chains), seasonal crops, and prioritizing consumption low in the trophic chains (i.e. switching to more plant-based diets). Furthermore, environmental externalities have to be included in the cost of the final product in order to foster shifts in buying/producing behaviours. The current state of climate change is so pressing that there is a crucial need of action, which has to be implemented in the agendas of each level (e.g. politicians, scientists, farmers and consumers). In this scenario, transparent communication between farmers, consumers, scientists and politicians is needed. This means that the power among stakeholders needs to be balanced, different actors coming with specific and complementary knowledge need to collaborate and define/adjust/improve metrics along the way, in a long-term monitoring scheme. Once this collaborative platform is established, understanding the value of resources and biodiversity and working towards adaptive agricultural managements will be facilitated.

2. Forestry

2.1. Current issues

Forests in central Europe are facing major issues, notably with current climate change. They need a long time to regenerate, while climate is changing at a fast rate. Trees that are growing today will have to deal with various climatic conditions within the next decades. In particular, they are likely to face severe droughts and more extreme events in general. Temperature increase leads to shifts in species distribution, in elevation and latitude.¹⁵ Forest health is threatened by climate change, new pathogens and pest species, pressure due to herbivores, as well as soil, water and air pollution.¹⁶ The combination of these threats may lead to severe damages. High fragmentation and low diversity at different scales are threatening resilience of forests in a changing world.

2.2. Challenges

The main challenges for forest management arise from the long-life cycle of trees. This means that current forest management has consequences over the next decades; and the present forests are the result of management decisions made decades ago. This makes it particularly difficult in a rapidly changing environment. Relying solely on natural adaptation is not a viable option, and calls for more management intervention.¹⁷ Stakeholders may have conflicting interests due to the wide range of goods and services provided by forests. These include timber production, cultural value, biodiversity, protection from natural hazards, and other ecosystem services.¹⁶ Balancing these different interests may be challenging and could lead to political inaction and/or societal conflicts.¹⁸ Another challenge is financing the active management implementation, and promoting the sustainable use of local forest products.

2.3. Potential solutions

Dealing with the multiple challenges of central European forests requires addressing economic, policy and management dimensions of forestry, supported by solid science communication. Economic incentives such as subsidies recognizing the multifunctionality of forests or the introduction of new labels are promising ways to increase marketability and sustainability of forest management.¹⁹ For example, "Schweizer Holz" is a new label covering the whole wood-value chain,

making the use of local forest resources more attractive. Also, forest policies should be adapted in a participatory fashion to acknowledge multiple ecosystem services provided by forests.^{20,21} To deal with rapidly changing environmental conditions and societal demands, forest management should focus on increasing resilience by assisting adaptation. This may include increasing diversity in terms of stand structure and species composition, or assisting species migration.

3. Conservation

3.1. Current issues

Species diversity is currently decreasing one thousand times faster than observed in the fossil record, and this rate is expected to further increase during the 21st century.²² The main drivers of species diversity loss in Central Europe are due to human activity. The intensification of land use together with ecosystem fragmentation and urbanisation lead to habitat loss, or can directly influence the health of organisms (e.g. pesticides, pollution).^{23,24} Climate change further compounds these issues, driving migration of populations towards higher altitudes²⁵ and latitudes, and increasing extinction risk²⁶. In addition, there are conflicting interests between stakeholders pertaining to trade-offs between biodiversity conservation and human activities. One emblematic example is the recolonization of the wolf in the Alps, generating conflict between livestock holders and conservationists.

Diversity helps maintain a large set of ecosystem functions^{27,28} and sustain multiple services beneficial for human well-being²⁹. We, therefore, have to address the following challenges in order to reduce anthropogenic impact on ecosystems.

3.2. Challenges

Biodiversity loss is happening fast, meaning we have limited time, as well as resources for generating solutions. As such, we need to prioritize conservation management actions, and improve our understanding of complex species interactions, in order to better predict responses to management.³⁰ In addition, a lack of consensus both within the scientific community and between scientists and practitioners makes it difficult to implement action. Furthermore, management needs to happen on global, as well as local levels, which should be tightly linked to each other²⁴. This requires efficient communication among stakeholders. Finally, implementation of actions can be challenging due to the current public perception of nature, and minimal awareness of the importance of preserving functioning ecosystems.¹⁵

3.3. Solutions

To address the main issues and challenges affecting biodiversity conservation, changes need to be made on multiple levels. In order to provide heterogeneity in habitat composition and configuration, techniques for ecosystem and landscape management should be diversified.³¹ Researchers from different scientific disciplines should reach a consensus on conservation strategies, so that clear recommendations can be delivered to policy-makers and practitioners. Likewise, there should be a channel for practitioner and policy feedback, so as to adapt research to need.³² Finally, a paradigm shift in public perception of nature is essential, necessitating education following an evidence-based approach. This will generate additional pressure for policy change, and resource production efficiency and redistribution, as well as change how humans interact with nature, and their awareness of environmental issues.

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