

1 Biodiversity and Food Security: From Trade-offs to Synergies (Editorial)

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26 Text:

27 Biodiversity and food security are connected in many ways. Across scales from genes to species,
28 landscapes and biomes, biodiversity is an important resource for humanity. It is the key for a broad
29 range of services provided by ecosystems. Biodiversity helps regulate the nutrient cycle, water (e.g.
30 floods) and mitigates impacts of climate change. Biodiversity is also of direct importance for human
31 well-being and for cultural and other values including recreation. The provisioning of clean water
32 and diverse food supply makes it vital for all people. Biodiversity at all levels, including the diversity
33 of genes, species and ecosystems, is lost at alarming rates. Critical factors for these trends are
34 habitat destruction, global warming and the uncontrolled spread of alien species. Pollution, nitrogen
35 deposition and shifts in precipitation further affect biodiversity.

36 Food security faces significant challenges due to population growth, poverty, globalization, climate
37 change and other factors. Supplying healthy food to all citizens is crucial for global development - to
38 reach it, not only food production but also equitable access to food for all people must be improved
39 substantially. Biodiversity loss and global food security are hence two major challenges of our time.

40 Linking these two areas from a research perspective, and seeking synergies between them is likely to
41 generate multiple benefits for social, ecological and economic development.

42 In October 2014, 108 scientists met in Aix-en-Provence, France, to explore these issues. Drawing on
43 a French-German Network of collaboration, established by the Centre National de Recherche
44 Scientifique (CNRS) and the Leibniz-Gemeinschaft (WGL), an international conference was organized
45 at the Mediterranean Institute of Biodiversity and Ecology (IMBE), aiming to “identify science-based
46 solutions for global sustainability focusing on the issues of biodiversity and food security”. During
47 sessions on “Environmental Changes and Food Security”, “Green economy, food security and
48 biodiversity”, and “Sustainable use of biodiversity”, “Conceptual pitfalls in the food-biodiversity
49 nexus”, “Science-based opportunities to reconcile food security, biodiversity conservation and
50 sustainable development”, overall 81 plenary and poster presentations were given. A selection of
51 papers is provided in this Special Issue.

52 Several conceptual studies illustrate new approaches to address conflicts and synergies between the
53 enhancement of food security and the conservation of biodiversity. Bernard and Lux (2017) use
54 socio-ecological discourse analysis to discuss whether—and if so how much—more food needs to be
55 actually produced to meet the future demand, how productivity could be increased sustainably and
56 how agroecology can be scaled up to these demands. Wittman et al. (2017) argue that rural
57 landscapes should be re-conceptualized as social-ecological systems and illustrate their approach for
58 the Brazilian Cerrado region. Through a structured literature review, Glamann et al. (2017) identify
59 the contrast between biophysical-technical and social-political approaches to understanding food
60 security and biodiversity conservation, showing that increased exchange between these
61 communities is needed. Salles et al. (2017) argue that an economic perspective could contribute to
62 the discussion on land sparing versus land sharing, for example by pointing out that the assumption
63 of a fixed agricultural production target is not realistic. They also show that the consideration of
64 productivity differences in such policies may strengthen the potential contribution of land sharing
65 policies to the conservation of biodiversity.

66 A series of regional studies offers examples for progress that can be made. For olive-oleaster
67 ecosystems in Morocco, Aumeeruddy et al. (2017) demonstrate the similarity between ancient and
68 modern practices in olive cultivation, and how these contribute not only to food security but also to
69 cultural identity. Bortolotto et al. (2017) show how, in the Brazilian Cerrado and Pantanal, how
70 knowledge networks can be designed to improve the economic condition of rural communities while
71 also strengthening food security and valorizing biodiversity and local culture. For Mexican wetlands,
72 González-Marín et al. (2017) study the use of wildlife for food security and the risks for this use from
73 water pollution, hunting practices and deforestation. In Philippine rice fields, Horgan et al. (2017)
74 found that ecological engineering can have multiple benefits for farmers and the environment,
75 including improved nutrition for farming communities, the creation of habitat for wildlife, and the
76 enhancement of regulatory ecosystem services provided by insectivorous and snail-eating birds.

77 In Burkina Faso, Koffi et al. (2017) show how, in woodlands and open landscapes, households shape
78 their adaptive strategies differently depending on the resources available and the structure of the
79 landscape, ensuring a significant contribution of forest resources to their food security. For semi-arid
80 silvopastoral systems in Chile, Root-Bernstein et al. (2017) show that transhumant rewilding of
81 guanacos has the potential to contribute to food security and sustainable agricultural production. In
82 a simulation study for France, Teillard et al. (2017) compared intensification, extensification and
83 reallocation of agricultural areas at fine scale, identifying potential “win – no loss” cases with near
84 zero additional costs for agricultural production. The study also shows that current mechanisms for
85 agricultural policy are insufficient to implement such optimizations in French landscapes. For
86 Uganda, Rwanda and Burundi, Van Soesbergen et al. (2017) show that different socio-economic
87 projections of areas of high agricultural development all lead to similar spatial patterns of habitat

88and biodiversity loss. To expand protected areas is crucial to avoid biodiversity losses in all three
89countries.

90For Europe, Mouysset (2017) argues that it is possible to reconcile agriculture and biodiversity with
91public policies, since it is possible to increase simultaneously the economic and ecological
92performances of agricultural landscapes compared to the current trends. However, it is not possible
93to optimize this reconciliation easily in an economic context, since the different criteria cannot be
94maximized simultaneously, and some trade-offs emerge between economic and ecological criteria.

95Finally, three studies consider biodiversity and food security at the global scale. According to Delzeit
96et al. (2017), allowing the expansion of cropland generally results in improved food security not only
97in regions where crop production rises, but also in net importing countries such as India and China.
98But the estimated cropland expansion risks to affect highly biodiverse regions, pointing to the need
99for spatially detailed and context-specific assessments to understand the possible outcomes of
100different food security strategies. Reducing meat consumption has been shown to have strong
101potential for the mitigation of both climate change and biodiversity loss. Stoll-Kleemann and Schmidt
102(2017) study various factors that might influence associated policies, finding that a 'health argument'
103or arguing for flexitarianism could be particularly promising to encourage reduced meat
104consumption. They recommend that emotional messages or new social norms could overcome
105current barriers such as cognitive dissonance. Rumpold et al. (2017) present an overview of
106possibilities to enhance the use of insect biodiversity not only as a human food resource but also as
107livestock feed resource as well as for therapeutical and biotechnological applications.

108In combination, these contributions paint a rich picture of the multi-faceted challenges associated
109with securing sufficient, healthy food for all of humanity while drawing on and conserving
110biodiversity. Solutions for reconciling biodiversity and food security require more than just
111controlling the environmental footprint of food production. The papers convey the picture that food
112security is under threat by interacting changes in biodiversity and its inherent biophysical structures
113and processes with changes in social, cultural and socioeconomic structures and processes. This
114Special Issue highlights the analytical basis and reasonable starting points for the pathways towards
115achieving the Sustainable Development Goals.

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