Socio-ecological shifts in agricultural landscapes: Farmland abandonment as a driver of threats and opportunities for biodiversity and ecosystem services.

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Abstract

In agricultural landscapes around the world, intensification of production and land abandonment are the two main trends impacting biodiversity and ecosystem services. Intensified agriculture is mostly seen as negative for biodiversity but effects of abandonment are controversial among scientists and practitioners. In the European context this is particularly relevant as agricultural policies subsidize farmers to prevent abandonment trends and maintain the resilience of low intensity agricultural systems. Abandonment is often the outcome of a regime shift in agricultural socio-ecological systems where the loss of social structures that ensured the diversity of agricultural practices leads the system into a new alternative state, with the potential arising of novel ecosystems. While abandonment can be detrimental to biodiversity in non-intensive farming systems, it can also provide an opportunity for re-organization following disturbance and the regeneration of natural habitats. Thus, maintaining the resilience of agricultural systems or promoting the transition into a new stable state, characterized by the regeneration of native habitats, are two possible management options to these changing agricultural landscapes. We examined the effects of these different management options on biodiversity and ecosystem services along an abandonment gradient from farmland to forest, each one of these representing an alternative stable state in these rural landscapes. We combined insights from a local case study in NW Portugal with a global meta-analysis on how impacts of abandonment on biodiversity are reported in scientific studies. Effects of abandonment were assessed through different indicators, from species richness and functional diversity for multiple taxa to the provision of multiple ecosystem services. At the global scale, abandonment impacts on biodiversity were reported in contrasting ways across world regions, and this was influenced by conservation views focused on pre vs. post abandonment conditions. In the study area, intermediate farming intensity, compared to abandoned forest habitats, generated higher plant richness at small scales and when post-abandonment forest was highly fragmented. In contrast, at larger scales, both farmland and forest had high species and functional diversity of plants and birds, while moths were more diverse in forests. All land uses provided multiple ecosystem services, but while provisioning services were highest in farmland, forests benefited regulating services, a difference not reflected in species richness distribution. In contrast to current European policies, abandonment was not found to be disadvantageous to biodiversity, except for species richness at very small scales. Thus, both alternative stable states, farming and post-abandonment
succession can generate high value ecosystems. In order to sustainably manage abandoned lands, farmland abandonment needs to be analyzed in a broader and cross-scale perspective, combining different types of indicators, from species to ecosystem services, and avoiding pre-conceived ideas on conservation, not always beneficial to the sustainable management of these landscapes.

**Keywords:** Socio, ecological regime shifts, farmland abandonment, agriculture, biodiversity, ecosystem services, novel ecosystems, conservation views