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The place of agricultural sciences in the literature on ecosystem services

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ABSTRACT

We performed a quantitative and qualitative analysis of the scientific literature on ecosystem services in order to help tracing a research agenda for agricultural sciences. The ecosystem services concept now lies at the heart of current developments to address global environmental change. Do agricultural sciences generate knowledge that covers this emerging theme? An analysis of scientific production allowed us to return to the ecological origins of this concept and see how little it has been appropriated by agricultural sciences until now, despite major focus on the issue of agro-ecosystems in the literature. Agricultural sciences tend to be more active in the field of environmental services, defined as services rendered by humans to ecosystems. The main studied services are those which have already been clearly identified and which act in synergy. Less attention is paid to the antagonisms between different services. These findings call for the implementation of agricultural research programmes that will consider the socio-agro-ecosystem as a whole and broaden the traditional issues addressed by agricultural sciences. We insist on three main management and operational issues that needs to be overcome if this is to be done: working at the landscape scale, increasing inter-disciplinary collaborations and take uncertainties into account.

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1. Introduction

1.1. Genealogy of the concept

The concept of ecosystem services is both a field for research and a sector for policy (Hill et al., 2013). According to Vihervaara et al. (2010) and Barnaud et al. (2011), the idea of the services rendered to humanity by ecosystems developed at the end of the 1970s. Its dissemination throughout science, expertise and public debate resulted from its institutionalisation in 1992 through the Rio "Earth Summit", which laid the foundations for the preservation of biological diversity and protection of the environment in international law. International initiatives concerning ecosystem approaches were announced in 1996 by the United Nations in the context of implementing the Convention on Biological Diversity, but the operational use of this approach in terms of ecosystem services only took form in 2004 in the context of a UN programme led by a group of international scientific experts, designed to better identify and evaluate the importance of ecosystems to human well-being: the Millennium Ecosystem Assessment (Millennium Ecosystem Assessment, 2005, Chap. 1, p. 27). This report ratified a definition that had already been proposed by Daily et al. (1997): "*Ecosystem services are the benefits people obtain from ecosystems*". Publication of the MEA was followed by a very marked rise in the number of scientific publications focused on this theme (Jeanneaux et al., 2012), and reflecting inclusion of the ecosystem service concept in numerous initiatives and international platforms such as the IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services), the SGA-Network (Sub-Global Assessment Network, operated by the United National Environment Programme, UNEP), or the implementation of evaluation and mapping programmes at a national or continental scale, such as the European MAES working group (Mapping and Assessment of Ecosystems and their Services, in support to the EU Biodiversity Strategy to 2020; European Commission, 2011; Maes et al., 2013), or several other national evaluations (e.g. Countryside Council for Wales, 2011). The development of those platforms and programmes trigger new insights, resources and subsequent organisational work for conservation sciences and strategies (Granjou et al., 2014).

In the same way that the concept of ecosystem services took some time to become a reality, the issues of agricultural biodiversity announced in 1996 under the UN process were only the subject of few working programmes during that decade, which saw the initiation of international public actions to defend biodiversity (the 2000 CBD Programme of Work). This international initiative was accompanied by regional commitments such as the Kyiv Resolution that endorsed the emerging role of the Pan-European Biological and Landscape Strategy in order to implement the CBD strategy. In the late period the concept itself is a matter of discussions crossing the boundaries of science and policy and reflecting on the weakness of some concepts and on the scope of the ecosystem services framework (Lele et al., 2013).

1.2. An opportunity for agricultural sciences

Linked to questions regarding the protection of biodiversity, the ecosystem service concept has been widely used to describe the services rendered by so-called "natural" ecosystems that are currently little impacted by human activities and frequently linked to defending natural resources or introducing sanctuaries to cover certain environments (e.g. wooded areas, natural grasslands, and wetlands). The ecosystem service concept has thus been little applied outside so-called conservationist approaches, although agriculture has tried to render its production systems more environmentally friendly – to varying degrees depending on the country – and notably relative to the issue of water pollution by nitrates or pesticides, or the contamination of soils. More recently, definitional discussion and ecosystem services classifications have included more clearly agriculture within their ontologies, including biomass resources for industrial uses (see, for example, CICES, 2013).

But agriculture could be seen as managing a large proportion of continental ecosystems, which occupy 40% of land on our planet. At this scale, the concept of the services rendered by agro-ecosystems is still only referred to implicitly in political initiatives impacting agriculture, and notably in Europe: the programme to control global warming (with an EU target of reducing net greenhouse gas emissions by 20% between now and 2020, http://ec.europa.eu/clima/policies/package/index_en.htm), or greening of the Common Agricultural Policy (upcoming reform to the first pillar, http://www.europarl.europa.eu/news/en/news-room/content/20130923IPR20606/html/CAP-reform-deal-MEPs-ensure-significant-improvements-in-future-farm-policy). At the same time, agriculture finds itself caught between maintaining or even increasing production in order to ensure global food security, an objective which often forgets the question of the solvency of demand or the quality of food supplies linked to public health targets, and the environmental nuisances it causes and that society or the ecosystems themselves can no longer withstand (erosion, eutrophication, pollution, etc.). Agriculture is therefore more than ever confronted by contradictory imperatives that could be addressed simultaneously through the ecosystem service concept, once this concept does not become a paragon for greening: to guarantee the supply of consumer goods (food, wood, drinking water, etc.), to supply new services such as the control of climate change or flooding, and to preserve the functional capacities of ecosystems, notably linked to biodiversity. This constitutes a paradigm shift in agriculture–environment relations reflected by the ecosystem service concept, from a vision of minimising the impacts linked to agriculture towards a systemic vision of managing natural resources in partnership with all stakeholders. In this context, study of the