



The Role of Organic Farming in Providing Ecosystem Services

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Abstract Ecosystem Services (ESS) are defined as the benefits humans derive from ecological processes and the ecosystem functions (MA, 2005). The functionality of agro-ecosystems is strengthened through ES like pollination, biological pest control or hydrological services provided by natural ecosystems (Sandhu et al., 2010). Agro-ecosystems also produce several ESS such as carbon sequestration, regulation of soil and water quality and support for biodiversity (Power, 2010). On the other hand agriculture may have a negative impact on neighboring natural ecosystems. Organic farming is the most sustainable and environmentally compatible way of agricultural land use, by using biological methods for regulation of pest and diseases instead of chemically-synthesized pesticides and mineral fertilizers. Thus organic agriculture minimizes negative impacts on nature-related ecosystems while simultaneously providing positive ESS like biodiversity.

Keywords ecosystem services, agro-ecosystems, organic farming, sustainability

INTRODUCTION

Stable ecosystems are required for a functioning natural balance. That is necessary for nature-related as well as for anthropogenically influenced systems. Essential goods like food, forage, fuel and fiber are provided by agricultural ecosystems (Power, 2010; Porter et al., 2009). For a sustainable production of these products fertile agro-ecosystems are needed, especially to cover the increasing demand due to a growing world population.

There are several interactions between natural and agro-ecosystems which can be illustrated and also valued by the concept of ecosystem services (ESS). ESS is defined as the benefits humans obtain from ecosystems and their functions (MA, 2005). With regard to agro-ecosystems it is necessary to take both aspects into account: consumption as well as provision of ESS. This document research deals with the description of these interactions and especially with the effect of different land use intensities (conventional vs. organic farming). Unlike conventional agriculture, the use of chemically-synthesized pesticides and mineral nitrogen fertilizers in organic farming is excluded. For this comparison the concept of ESS is used (Swinton et al., 2006).

ECOSYSTEMS

The term ecosystem includes i.a. both natural and agricultural systems. They have basically a comparable structure, consisting simplified of producers, consumers and destruenters with close interactions to each other (Fig. 1). The system is self-regulating and in the long run in equilibrium (Fig. 1a). Depending on the intensity of use, agricultural systems have various effects on different groups. In conventional farming the biomass production increases strongly (producer) through the

intensive use of synthetic chemical fertilizers and pesticides, the biomass of consumers (pests etc.) is selective decreased (Fig. 1b). Organic farming as a sustainable form of agriculture is an intermediate position, by using biological cycles for the regulation of the agro-ecosystem instead of chemicals (Fig. 1c).

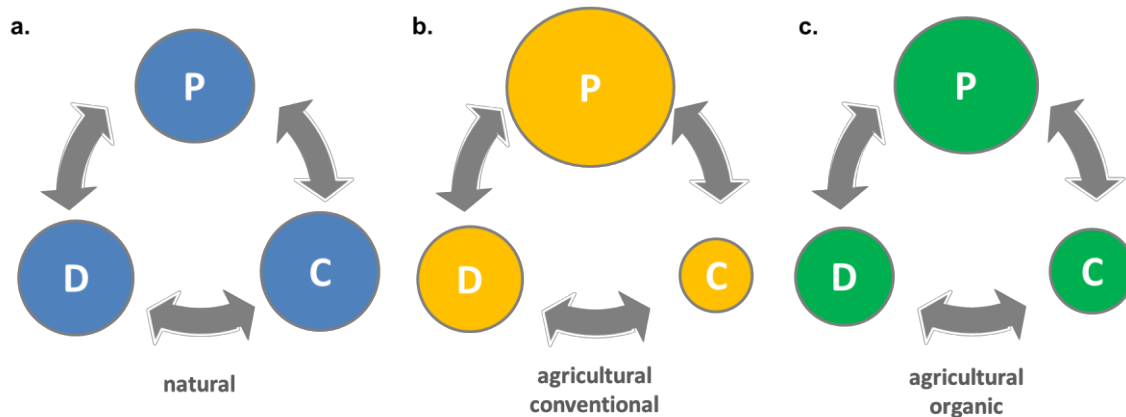


Fig. 1 Schematic types of ecosystems with their different dimensions of producer (P), consumer (C) and destruent (D)

THE THEORY OF ECOSYSTEM SERVICES

Defined as the benefits people obtain from ecosystems, ESS includes supporting, provisioning, regulating and cultural services (Figure 2, left side; MA, 2005). Supporting services are i.a. pollination, biological control, soil formation, carbon sequestration or nutrient cycling, which are all vital for supplying food and other raw materials (Sandhu et al., 2010) and mentioned as provisioning services. Regulating services affects e.g. hydrological flows, floods, water quality, climate conditions or diseases. There is also a cultural dimension of ESS that provides aesthetic, recreational or spiritual benefits for the people.

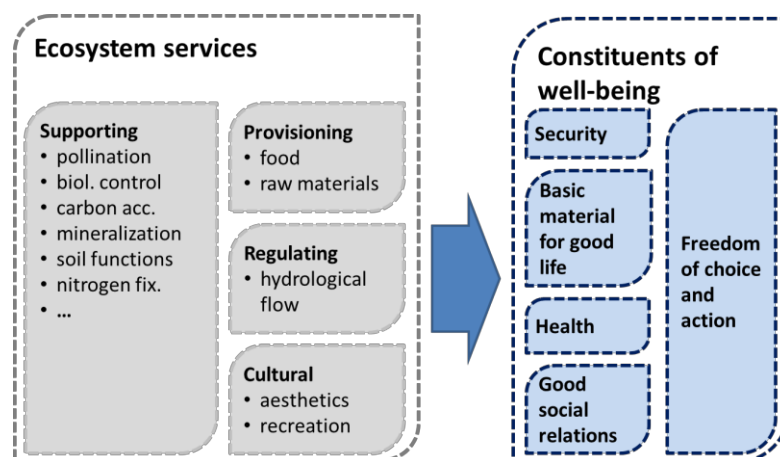


Fig. 2 Ecosystem services and their connections to human well-being

Source: adapted from (MA, 2005)

Well-being of human species is fundamentally dependent on the flow of ecosystem services (MA, 2005). People's well-being is assumed to have multiple constituents, including security, basic material for a good life, health, good social relations and freedom of choice and action (Fig. 2, right side). Security means secure access to natural and other resources, personal safety as well as safeness from human-made and natural disasters. Aspects like adequate and secure livelihoods, enough food at all times, shelter and access to goods like clothing etc. are understood as the basic

material for a good life. Under health factors like feeling well and having a healthy physical environment and access to clean air and water are summarized. Good social relations include mutual respect, social cohesion and the ability to help others and provide for children. Freedom of choice and action means the opportunity to achieve what an individual values doing and being. It is influenced by all other constituents of well-being and is also a precondition for achieving other components (MA, 2005).

ECOSYSTEM SERVICES AND AGRICULTURE

Agriculture represents humankind's largest engineered ecosystem which is embedded into a web of natural ecosystems (Zhang et al., 2007). The effects and direction of the strong interactions between managed and untouched ecosystems depend on the agricultural production system. Adapted management practices are able to diminish many of the negative impacts of agricultural land use without reducing the provisioning services (Power, 2010). Otherwise intensive agriculture utilizes large quantities of fertilizers and pesticides and acts as a major driver for land use change and degradation of ecosystems (Sandhu et al., 2010). By using the concept of ESS it is possible to get an indicator for long-term sustainability of agricultural production balancing between ESS demand and supply (Björklund et al., 1999).

Conflicts through agriculture

In particular, under intensive conventional management practices neighboring natural ecosystems may be damaged, also known as ecosystem disservice, which can lead to increasing production costs or reduced productivities (Zhang et al., 2007). For example the biodiversity of unmanaged ecosystems provides important services to agriculture while extensive application of fertilizer and pesticides have adverse effects. Also the groundwater related to intensive agricultural usage often contains high concentrations of nutrients and pesticides which affects human's well-being (Tilman, 1999). Furthermore unsustainable farming practices encourage problems like soil degradation, meaning a reduction of nearly all ESS for the future.

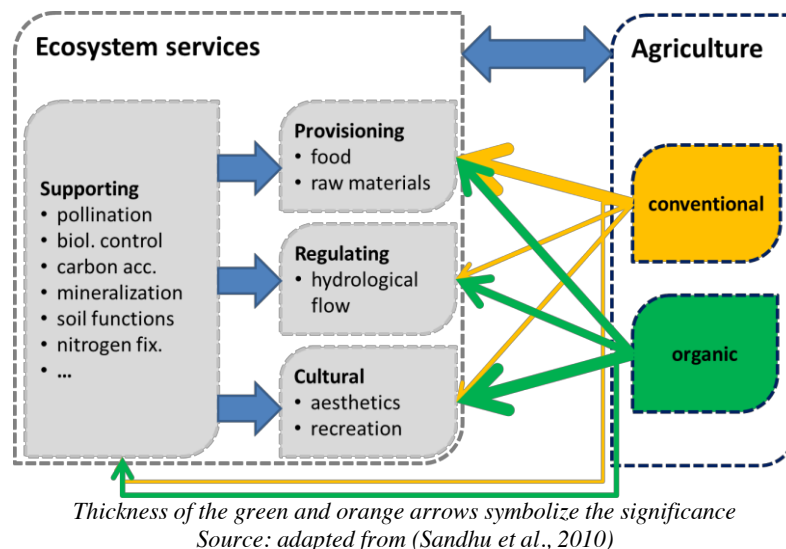


Fig. 3 Interaction between ecosystem services and different agricultural systems

Services from agriculture

Of course the main ESS from agro-ecosystems is the provision of classical products (food, fuel, fibre etc.). But farmers also help to maintain several other services that make agriculture productive (Fig. 3).

Regulating and cultural services flows from agro-ecosystems vary greatly depending on the management system. Besides there are also supporting ESS such as pollination, biological pest control, carbon sequestration or soil nutrient renewal supported by agricultural usage (Swinton et al., 2006; Power, 2010).

Benefits from organic farming

Even if the amount of provisioning services in terms of yields per acreage is smaller than under conventional regimes, the balance of all services and disservices is better in organic managed agro-ecosystems (Fig. 3). Especially the damage of neighboring natural systems is less pronounced. Thus supporting ESS can increase by promoting the nature cycle through organic farming. Also the regulating and cultural services within organic production systems are higher due to wide and more diverse rotations, no monocultures and often more small-scaled structures.

CONCLUSIONS

As shown, agriculture does not only have negative impacts on nature-related ecosystems but also generates own positive ESS. Particularly favorable becomes the balance in agro-ecosystems under organic farming practices. For a secured worldwide food supply long term productive ecosystems are needed. Organic agriculture fully matches these conditions as the most sustainable way for production of food and other raw materials.

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