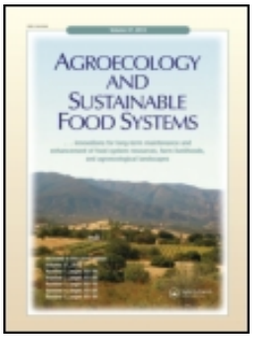

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Agroecology territories: places for sustainable agricultural and food systems and biodiversity conservation

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ABSTRACT
The development of sustainable agricultural and food systems is of significant importance considering the still-growing world population. For this, it is imperative to consider not only quantitative production issues, but also environmental issues such as water pollution, biodiversity loss, and land degradation as well as social and economic issues such as organization of supply chains and communication and coordination among stakeholders. However, the development of sustainable agricultural and food systems is so far almost exclusively proposed either at the scale of specific agricultural systems or for selected supply chains. Still strongly neglected is the development of sustainable systems at a territorial scale. We, therefore, present here the concept of agroecology territories. We define agroecology territories as places where a transition process toward sustainable agriculture and food systems is engaged. Three major domains must to be considered for the transition to take place: adaptation of agricultural practices; conservation of biodiversity and natural resources; and development of embedded food systems. Stakeholder group strategies, developed by those who actively engage in these three domains and are themselves actors in the transition, are integral to agroecology territories.

KEYWORDS
Agroecological practices; agroecological transition; conservation of biodiversity and natural resources; local food systems; stakeholder involvement; sustainable agriculture; territory

Introduction

A growing world population demands not only increased food production in certain regions of the world, but also improvements in fair food distribution and availability at local, regional, and national scales. Therefore, concepts for sustainable agricultural and food systems are needed both where quantitative production issues are addressed, and where environmental issues must be increasingly taken into account. The latter includes issues related to agricultural food production, such as water and air pollution, biodiversity loss, and land degradation. In addition, addressing imperative social and economic aspects, including organization and efficiency of supply chains and markets,

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communication and coordination among stakeholders, and farmer–consumer relationships is necessary in guaranteeing a holistic and systemic approach. These aspects can no longer be analyzed in isolation if sustainable agricultural and food systems are to be established.

Such approaches have been developed particularly in the strong, emerging framework of agroecology of recent years. Although agroecology has already existed for many decades (Wezel and Soldat 2009), different interpretations and concepts have been discussed in the last few years. These include interpretations of agroecology as a science, movement and practice (Wezel et al. 2009; Wezel and Jauneau 2011), agroecology as a transdisciplinary, participatory, and action-oriented approach (Méndez, Bacon, and Cohen 2013), and agroecology as policy is emerging (Gonzalez de Molina 2013; Sevilla Guzmán and Woodgate 2013). In addition, these different interpretations focus on different scales and dimensions. Research in agroecology, for example, has been enlarged from a) the plot, field, or animal scale to b) the farm or agroecosystem scale, the latter potentially being a landscape, and c) finally, in the last few years, to the dimension of a food system, which is increasingly cited as a major framework for agroecology (Francis et al. 2003; Gliessman 2007; Wezel and David 2012; Méndez, Bacon, and Cohen 2013; Wezel et al. 2014a). Agroecology as a practice focuses on the field scale, whereas agroecology as a movement is more linked to farm/agroecosystem and food system scales. Finally, agroecology as a science, a participatory and action-oriented approach, or a policy can have implications at all scales.

The aim of this article is to introduce the concept of agroecology territories. First, we will make an argument for the concept of territory in the agroecology discourse. Second, we will focus on the main features for a transition to agroecology territories. This will take into account aspects such as agricultural production, agroecological practices, territorial development, embeddedness of food systems, as well as biodiversity and resource conservation. We will also draw attention to examining the role of local stakeholders and stakeholder initiatives, with particular regard to a transition toward agroecology in territories.

Territory as a necessary concept for agroecology

Although agroecology at the field scale, and more recently at the food system scale, is relatively clearly defined, there is still no established approach with concepts and definitions for agroecology at the intermediary scale of an agroecosystem, referring here to the landscape scale, and not to the farm scale. In general, experience has shown that working at the farm-scale alone cannot achieve a sustainable agricultural system (United Nations Environment Programme [UNEP] 2012). Therefore, a strategy is needed to link farm-scale activities with a landscape approach by integrating farming

and non-farming activities throughout a larger area (see also Lovell et al. 2010; Méndez, Bacon, and Cohen 2013). We refer here to landscape as a physical area with natural characteristics such as climate, topography, soils, and ecosystems. In agroecology, one current research approach at the agroecosystem scale is "to focus on plant and animal communities, food web interactions, and conservation biology in temperate as well as tropical agricultural landscape and agroecosystems" (Department of Crop Science, University of Göttingen 2014). However, this approach does not take into account any social, economic, or food system aspects and the food system scale that are today considered part of agroecology (Dalgaard, Hutchings, and Porter 2003; Francis et al. 2003; Gliessman 2007; Wezel and David 2012; Méndez, Bacon, and Cohen 2013; Wezel et al. 2014a). If we transpose this research oriented approach to an applied agroecology approach, rural or territorial development policies and the embeddedness of food systems also become important issues.

A first example to be considered is the Man and Biosphere program (MAB), which supports sustainable development (including agriculture) of model regions, called biosphere reserves, where people interact with nature in a responsible way (United Nations Educational, Scientific and Cultural Organization 2014). Despite the attention to sustainability, this remains an approach restricted to areas with ecosystems of national or international importance, thus seldom including so-called common, ordinary rural areas. In addition, this demands delineating an area with clear borders, which may be inadequate for the sustainable development of a given landscape or region. A second example is the ecoagriculture landscape approach (Scherr and McNeely 2008), which proposes managing landscapes for both production and conservation. However, this concept does not explicitly include a food systems approach. Therefore, the question remains—which concept should be used to develop sustainable agricultural and food systems at regional scales? We believe that agroecological principles, in particular, provide a good basis to conceptualize this shift in scale from field to food system, while simultaneously addressing interactions between stakeholders and landscapes.

We, therefore, propose the concept of "agroecology territories" to characterize certain defined areas in transition toward sustainable food systems. We refer to the term "territory" as "the projection on a given land of specific structures created by a human group, which includes the way to delimitating, managing and organizing the land in question" (Brunet, Ferras, and Thery 1992). Territory, thus, can refer to an area under the responsibility of local authorities such as regional municipalities (Elden 2010; Painter 2010). However, in this article, we define this concept using a broader approach, taking into account the way communities or a sociotechnical network (Callon 1986) of stakeholders interact with different landscape elements such as natural and agricultural objects. From an agronomic perspective,

territory also refers to the combination of farming systems with ecosystems that leads to the differentiation of production systems (Sebillotte 2000). Nevertheless, due to the interconnected nature of stakeholder relationships at a local scale, interacting with a myriad of issues, agriculture is no longer the only driver in a territory (Sebillotte 2000).

Our understanding of a territory also provides a framework to take up concerns related to conservation, sharing, and valorization of territorial resources. The term "resources" refers here to the appropriation of material elements such as water and land, or immaterial elements such as landscape identity and range of ideas, by stakeholders (Pecqueur and Gumuchian 2007). It, thus, questions the collective mobilization of territorial resources by local stakeholders for regional development (Pecqueur 1989) and also addresses the governance of the commons (Ostrom 1990). Moreover, the concept of territories provides insight in assessing the local or regional embeddedness of food systems, whether alternative or global market supply chains (Hinrichs 2000). The notion of an agroecology territory, therefore, provides a specific framework to conceptualize a transition toward sustainable agricultural and food systems.

Transition toward agroecology territories

We define agroecology territories as places engaging in a transition process toward sustainable agricultural and food systems. Three major domains must be considered for the transition to take place: adaptation of agricultural practices; conservation of biodiversity and natural resources; and development of food systems embedded in territories (Figure 1). Stakeholder group strategies, developed by those who actively engage in these three domains, and which are themselves actors in the transition, are also integral to agroecology territories.

Adaptation of agricultural practices

The adaptation of agricultural practices refers to the transition from current conventional practices, judged unsustainable, to those that are sustainable. The degree of transition, as well as the applied practices, vary depending on the farming system (e.g., arable farms, livestock farms, mixed farms) and are tailored to local conditions. Such practices are based on agroecological principles (Altieri and Nicolls 2005; based on Reijntjes, Haverkort, and Waters-Bayer 1992) and can be defined as agricultural practices aiming to produce significant amounts of food, which seek to valorize ecological processes and ecosystem services by integrating them as fundamental elements in the development of the said practices (Wezel et al. 2014b). These practices contribute to improving

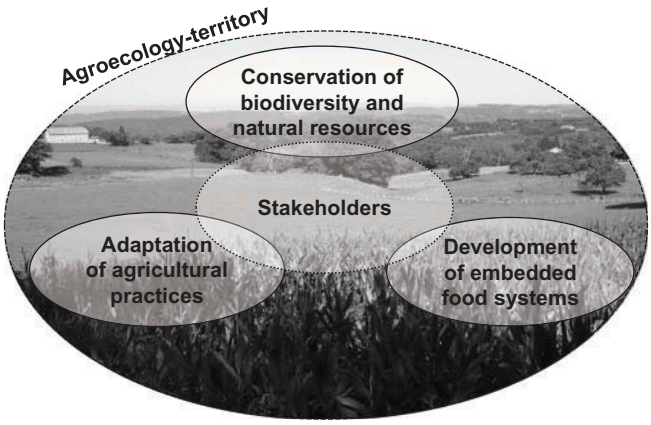

Figure 1. An agroecology territory with stakeholders as central actors and the three essential domains for transition. Agroecology territories are places where a transition process toward sustainable agriculture and food systems is engaged by different stakeholder groups. Three major domains must to be considered for the transition to take place: adaptation of agricultural practices; conservation of biodiversity and natural resources; and development of embedded food systems.

the sustainability of agroecosystems, and are based on various ecosystem services such as nutrient cycling, biological N-fixation, natural regulation of pests, soil and water conservation, biodiversity conservation, and carbon sequestration. A broad diversification of farming systems is generally favorable, especially with respect to biodiversity and resource conservation, but specialization of farming systems at the regional scale would not necessarily be an obstacle if they apply agroecological practices.

A transition toward agroecology territories requires evolving agricultural practices by integrating ecosystem services at the field, farm and landscape scale to develop and increase implementation of agroecological practices. Such a transition could be favored by a) facilitation of farmer-to-farmer knowledge exchange with field days at farms using different agroecological practices; b) providing an extension service delivered by agents familiar with an agroecological approach to farming practices; c) accompanying local groups of farmers, such as farmer associations, sharing use of machinery and carrying out certain field operations together, or sharing a common technical advising service; and d) providing incentives (e.g., agro-environment measures) to initiate change. Nevertheless in some cases, it might be necessary to set up regulatory policies to force the change of agricultural practices (e.g., in drinking water catchments).

A transition toward agroecology will be achieved when stakeholders are ready to change and adopt production systems by gradually or abruptly integrating more agroecological practices, promoting agrobiodiversity (e.g., by conserving local animal breeds or crop varieties), and conserving

biodiversity on their farmland. Agricultural practices are embedded in sociotechnical networks, and their adaptation is, therefore, highly reliant on the involvement and engagement of local stakeholders. Stakeholder involvement is one of the success drivers of change from "niche" agroecological innovations to agroecological sociotechnical regimes (Geels 2004).

Conservation of biodiversity and natural resources

A second domain that must be considered in establishing for agroecology territories is biodiversity and natural resource conservation. They are the foundation of life on earth, and biodiversity is the basis for many ecosystem services. Nevertheless, we are facing a continuous loss of biodiversity worldwide. Therefore, the question remains, how can this biodiversity be conserved, or reintegrated, into farming systems on the field, farm, and landscape scale? This includes diversity of crops and livestock, diversity of crop varieties and animal breeds on the farm and in the territory, as well as the diversity and sufficient abundance of seminatural landscape elements associated with agricultural land. Moreover, it generally concerns the conservation of species and natural habitats in a territory. Specifically, the management of green and blue networks or features (respective examples being hedgerows, vegetation strips, grasslands and rivers, creeks, and ditches), the objective of which is to ensure their functioning as ecological corridors in agricultural landscapes, also has to be considered. Regarding natural resource management in a broader sense, the following issues are amongst those that must be taken into account in the transition process to agroecology territories: protection of surface and groundwater from urban, industrial, and agricultural pollution; protection of soils against wind and water erosion; and protection of soils from contamination caused by other human activities.

An important issue for an area's transition to agroecology territories is the improvement of biodiversity conservation and its management at field, farm, and landscape scale. This concerns both agricultural and non-agricultural land. Having agriculture and biodiversity conservation on the same territory is the based on the land-sharing model. Perfecto and Vandermeer (2010), for example, call this shared land the "agroecological matrix" in seeing this is an alternative to the land sparing or agriculture intensification model (see also Vandermeer and Perfecto 2007; Perfecto and Vandermeer 2010). On agroecology territories, farmland areas set aside for establishing seminatural landscape elements such as hedgerows, shrubs, grass strips, or small water bodies should be promoted. These areas should fulfill an ecological function as habitats for species, and serve as ecological corridors within the larger landscape (Figure 2). At the same time, though, they also need to have a function for farmers. This could be as field protection against wind and water erosion,

Figure 2. A composite landscape in southern France with different types of agricultural land and different types of seminatural landscape elements. In the case that also agroecological practices are broadly implemented or developed as well as embedded food systems, such a landscape could be an example of an agroecology territory.

reduction of nutrient transfer to surface or groundwater, and provision of habitats for pollinators and natural enemies of pests to facilitate conservation biological control. In respect to water quality management, agricultural practices with no or reduced risk of nutrient and pesticide leaching to the groundwater (or transport to surface water such as rivers, lakes, and drinking water reservoirs) have to be implemented. This, of course, also concerns water contamination from urban areas or industrial activities.

Stakeholder roles and initiatives are crucial in the transition to improved biodiversity and natural resource management in agroecology territories. Cooperation between local and regional authorities in charge of biodiversity and resource management (e.g., water agency, protected areas administration), non-governmental organizations, and other stakeholder groups such as farmers associations, cooperatives, or nature conservation organizations, are of vital importance to assure change. The transition strongly depends on the way networks interact regarding specific issues: comprehension of an ecosystem, ecosystem quality assessment, and resource management through individual or collective initiatives, or the framework of specific policies. Some examples of different stakeholder initiatives for improved biodiversity and natural resource management and the adoption of agroecological practices can be found in Hart et al. (2015).

Beyond stakeholder initiatives the question is, which policies already exist or have been launched for a territory? These could be, for example, agri-environment measures (European Commission (2014a), specific territorialized agri-environment measures (Ministère de l'Agriculture, de

l'Agroalimentaire et de la Forêt (2013), or European rural development programs such as LEADER (European Commission 2014b). All these programs combine the two domains of agricultural practices and biodiversity and resource management.

Development of embedded food systems

Finally, the third domain for agroecology territories which must be taken into account concerns the embeddedness of food systems. The issue here is to shift from a global "food from nowhere regime" to a "food from somewhere regime" (Campbell 2009). Links to territories bring opportunities to renew social and economic values and thus to change social and economic relations, but also to think about the ecological and social issues around food. Feeding people is not only a production issue but also one of making food available. This involves a great diversity of stakeholders beyond just farmers and consumers, such as actors in food chains (including food processing industries and marketing operators), actors from the voluntary sector (environmental or social organizations at the community or the national level), and policymakers, funders, and implementers. Also food sovereignty can be an important issue. For example, Pimbert (2009) states here the need having federations of elected citizen-based local councils linking villages, towns, neighborhoods, local economies, and ecological units, to establish re-localized and resilient food systems based on agroecology, eco-literacy, and circular economy models.

In our understanding of transition toward agroecology territories, food systems can be described as socio-technical networks linking people, natural elements, and artifacts that interact with food issues. Therefore, understanding agroecology at the scale of the food system encompasses the field, the farm, and the landscape scales, and expands the perspective to non-farming issues and actors.

Examples of embedded food systems include the development of food products such as "terroir products" (Barham 2003), or those with a geographical indication label (Chazoule, Jouve, and Lambert 2009; European Commission 2014c). Moreover, it is also important to reestablish a consumer–producer link and reduce food systems carbon footprint through direct selling or community supported agriculture (CSA), or with midscale values chains (Lev and Stevenson 2011; Stevenson et al. 2011). The qualification processes for products, such as those sold directly or labeled with geographical indication, are of real interest in re-thinking consumers' roles and quality standards in the evolution of farmers' practices, and in integrating a wider approach to ecological issues in agroecosystems. As part of the evaluation of the transition to an embedded food system within a territory, it is useful to assess the following aspects: whether provision of collective catering is

significantly based on local and regional products; whether shops and supermarkets have established the concept of selling local food; or whether producers have developed direct selling or CSA systems.

Diversity of transition dynamics in territories

Stakeholders are central to transition dynamics because they implement actions in given territories (Figure 1). The combination of individual and collective actions leads to the agroecological transition through the constitution of a community (a specific organization of stakeholders) consisting of farmers, local politicians, local environmentalist nongovernmental organizations, and food system actors (including local consumers). This community of stakeholders can, for example, promote environmental protection of a landscape or develop local agricultural characteristics. In these cases, stakeholders integrate the landscape scale into their decisions and actions. The agroecological transition, thereby, becomes territorial (Figure 2). In studying an agroecology territory we need to observe the community of stakeholders who combine actions for the adaptation of agricultural practices, the conservation of biodiversity and natural resources, and the development of embedded food systems. In such communities leaders may differ from territory to territory. For instance, a group of farmers or consumers, and stakeholder or community actions can be very heterogeneous. In the case of stakeholders organizing themselves, there may be a series of actions coordinated by any one major stakeholder—a regional natural park, for instance. However most of the time, in the majority of territories studied, stakeholder actions for agroecology are less organized, less visible, less publicized, quite specific, or just emerging. In these cases, the variety of actions tends to be more difficult to detect because actions are very heterogeneous and not necessarily directly related to agroecology. To study agroecology territories, a participative and transdisciplinary action-oriented research methodology is particularly appropriate (Méndez, Bacon, and Cohen 2013). Depending on local issues, this type of approach enables stakeholders of different specialties and preferences to interact. The close proximity of researchers of different disciplines and stakeholders permitted by this methodology allows identification of agroecological actions in a territory (Dalgaard, Hutchings, and Porter 2003). Together, they can reconstruct action histories and build an agroecological future for a territory.

Nevertheless, the relevant scale of agroecology territories may be called into question. Actually, each stakeholder has its own "territory," defined as the relevant space for action. Moreover, the local-based approach on agroecological practices cannot ignore the role of global forces on stakeholder's capacity to undertake changes (Pimbert et al. 2001). This suggests a need to develop a comprehensive understanding of scales in agroecology territories,

and a comprehensive approach of global regulation that impact local practices. It may be that it is not possible to talk about a singular agroecology territory, but rather about plural territories that have a strong common overlap, and some bounded territories specific to certain types of stakeholders.

Conclusions

The development of sustainable agricultural and food systems is of significant importance considering the still-growing world population. For this, it is imperative to consider not only quantitative production issues, but also environmental issues such as water pollution, biodiversity loss, and land degradation, as well as social and economic issues such as organization of supply chains, communication and coordination among stakeholders, and farmer–consumer relationships. Whereas examples of sustainable agricultural and food systems development at the scale of specific agricultural systems or for selected supply chains already exist, the development of sustainable systems at a territorial scale is still noticeably neglected. We have, therefore, presented here the concept of agroecology territories.

An agroecology territory can be defined as a territory where a) a transition toward sustainable agriculture based on agroecological practices exists, b) biodiversity and resource conservation is taken into account, c) territory-linked embedded food systems exist, and d) stakeholders support the transition toward sustainable agricultural and food systems.

There might be other important factors to be considered, depending on the context and how the agroecological approach is being applied. For example, people's livelihoods may be implicit in one or several of these domains, or even be its own domain, in particular in developing countries (Amekawa et al. 2010; Amekawa 2011), but the three major domains defined before are for us the major underlying ones for agroecology territories.

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