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NATURE QUALITY IN ORGANIC FARMING: A CONCEPTUAL ANALYSIS OF CONSIDERATIONS AND CRITERIA IN A EUROPEAN CONTEXT

ABSTRACT. Nature quality in relation to farming is a complex field. It involves different traditions and interests, different views of what nature is, and different ways of valuing nature. Furthermore there is a general lack of empirical data on many aspects of nature quality in the farmed landscape. The present paper looks at nature quality from the perspective of organic farming, which has its own values and goals in relation to nature – the "Ecologist View of Nature." This is in contrast to the "Culturist View" characteristic of much conventional agriculture and the "Naturalist View" characteristic of the traditional biological approach to nature quality. This threefold distinction forms a framework for exploration of nature quality criteria in the farmed landscape. The traditional work on nature quality has mainly focused on biological interests based on a Naturalist View of Nature. In this paper we will explore how criteria for nature quality based on the Ecologist View can be developed and thereby feed into the ongoing discussion of the development of the organic farming practices. We suggest additional criteria for nature quality based on an Ecologist View of Nature: biodiversity; habitat diversity, extent and structure; functional integrity of habitats and agroecosystems; and landscape integrity, accessibility, and experientiality. The larger set of Naturalist and Ecologist criteria can provide a wider and more balanced basis for developing nature quality indicators that are relevant in the farmed landscapes. This broader approach to nature quality is also expected to benefit the general societal discussions and decisions on farming and nature.

KEYWORDS. Accessibility, aesthetics, agriculture, biodiversity, biological integrity, conservation, functional integrity, habitat, landscape, view of nature.

INTRODUCTION

The concept of nature quality has been defined in a biological context in the form of four criteria: wilderness, continuity, authenticity, and originality (Nygaard et al., 1999), see Box 1. This definition of nature quality is based on the conservation of the biological integrity of ecosystems. Karr and Dudley (1981) define biological integrity as "the capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region." That is, a site with high biological integrity will have had little or no influence from human society; it will be pristine or at least minimally impaired (US EPA, 2003). Generally, biological integrity refers to a system's wholeness, including presence of all appropriate elements and processes at appropriate rates (Angermeier and Karr, 1994; Tybirk and Ejrnæs, 2001). A biota with high integrity reflects natural evolutionary and bio-geographic processes and the concept is therefore normally applied to natural and semi-natural areas.

Box 1. Biological criteria for nature quality assessment

This is a definition of nature quality based on Nygaard et al., 1999. The definition is closely related to the concept of biological integrity (Angermeir and Karr, 1994) and consists of four (partly overlapping) criteria for nature quality assessment (mainly intended for natural and semi-natural ecosystems):

- *Wilderness* implies undisturbed natural processes without human interference or pollution
- *Continuity* in time (age) and continuity in space (size).
- *Authenticity* implies that nature should neither be constructed nor planned and should not consist of released wild animals or planted plants
- *Originality* implies native species and habitats

As shown later in the text, this definition is clearly related to a Naturalist View of Nature.

Recently, the concept of nature quality has also been used in the context of farming (e.g., Wenum et al., 1998; Reddersen et al., 1999), where "pristine nature" is a farfetched ideal, and in a much wider sense connected to landscape quality (Arler, 2000). The concept also plays a key role in new research on nature quality in organic farming (Tybirk and Alrøe, 2001). Agricultural practices and the position of agriculture in society are changing in accordance with new public agendas such as sustainability and multifunctionality, and the research connected to

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these changes is challenged to handle the inclusion of very different interests and different perceptions and normative concepts of nature. Traditional approaches may not be sufficient to give answers that satisfy all the interested parties in a future multifunctional agricultural landscape. Thus, when trying to apply concepts from conservation biology on productive agricultural ecosystems, there is indeed a need to clarify how the concepts are used and which values they represent. Likewise, when theories of nature quality linked to landscape perception are introduced, it is necessary for comprehensive research to take these aspects into account.

The present paper looks at nature quality from the perspective of organic farming, which has its own values and goals in relation to nature. Obviously, organic farming cultivates the soil with introduced species like conventional farming, but still rather distinctive principles are behind it. Four major reasons for exploring the relationship between organic farming and nature quality can be identified:

- The international and national communities have explicit expectations and recommendations for conserving global biodiversity (Rio-Convention; EU Habitats Directive) implying that nature conservation should be integrated with agriculture. OECD and the Common Agricultural Policy of EU have recommended that nature conservation, environmental aspects, and landscape aesthetics should be integrated in agricultural policy and practice. A recent background report for a Danish Biodiversity Action Plan considers organic agriculture as an important measure to reach these goals (Wilhjelm, 2001).
- The international Federation of Organic Agriculture Movements has specific aims on the relationship to nature. (IFOAM, 2002). The organic farmers associations in the Nordic countries have stated explicitly that . . . *In organic farming, nature is conceived as having intrinsic value, and humans do have a responsibility to include the cultural landscape as a positive part of nature.* . . . (Strukturdirektoratet, 1999). In addition, the aim is to *consider nature as a whole with its intrinsic values and humans have an ethical responsibility to manage the cultural landscape as a positive element of nature.* The Danish association of organic farmers (ØL), furthermore, has the goal that the organic farmer should *use farming practices that take care of nature and environment, . . . and should do whatever possible to make all living organisms allies* (Strukturdirektoratet, 1999).
- Organic farming is developing rapidly in most European countries and numerous environmental benefits are expected from this agricultural practice in comparison with conventional farming. Organic production systems have been documented to reduce leaching of nitrate (e.g., Buller et al., 2000; Wascher, 2000; Stolze et al., 2000; Hansen et al., 2001) and have often been recommended as a tool to improve nature conservation. However, the impact of organic farming on nature and landscape quality has not yet been sufficiently documented.
- Environmental benefits from organic agriculture are key factors in marketing organic products. A certain minimum percentage of uncultivated areas present on each farm has been proposed as a general objective (van Elsen, 2000). In addition, Nature Conservation Plans have been proposed in several countries for each farm to ensure these goals (Smeding and Joenje, 1999; Tybirk, 2002). Such measures will potentially be used in marketing as the consumer expects more than just healthy products when buying organic food. Nature quality benefits may well become an important argument for the organic consumer.

Recent reviews have confirmed that in certain respects, organic farming, as opposed to conventional farming, apparently does provide better conditions for wildlife and less environmental problems in general (Azeez, 2000; Stolze et al., 2000). However, their conclusions are based on relatively few local studies and some of the generalizations are not well documented. The generalized indicators used by Stolze et al. (2000) often suffer from lack of precision and documented cause-effect relations and, consequently, there is a great risk of misinterpretation of the results. For example, the biodiversity conservation issue is often reduced to a question of leaving room for as many species and individuals of insects or plants as possible in the farming landscape. Many researchers are increasingly critical of this approach (Angermeier and Karr, 1994; Tilmann 1997; Weibull et al., 2003). Especially when the conclusions are expressed as overall indicators for decision-makers, these simplifications often lack scientific documentation.

Both from the perspective of society and organic farming, there is a need to explore nature values, define normative criteria for nature quality, and clarify and extend the empirical research findings on organic farming and nature. On this basis, relevant indicators to document the effects of different kinds of farming on nature and to assist the development of agriculture should be developed. The present paper is part of a larger research effort that seeks to fulfill these needs (DARCOF, 2003).

The holistic and cooperative attitude to nature in organic farming, especially, demands the development of comprehensive criteria for nature quality that address more than biological interests. In this paper, we will focus on the clarification of the normative and empirical aspects of the concept of nature quality and on the formulation of criteria for nature quality assessment. In the course of this, we will also seek to clarify needs for new research and development. Nature values in relation to farming would, in general, encompass ecological services related to large scale water and air cycles. We will, however, in the present context, largely delimit ourselves to the terrestrial environment, i.e., genes, species (whether cultivated or introduced; wild or native, higher or lower organisms), ecosystems, structures and processes in the farmed landscape, and the perceptions of these elements by residents, visitors, consumers, etc.

Accordingly, this paper has three major objectives:

1. To discuss conceptions of nature and normative views behind the concept of nature quality applied in farmed landscapes
2. To extend and balance the discussion of nature quality in organic farming to include and combine different interests such as production, nature conservation, and landscape aesthetics
3. To suggest additional criteria for nature quality assessment that are relevant to the perspective of organic farming and to different interests in the farmed landscape.

NATURE CONCEPTIONS, NORMATIVE VIEWS, AND INTERESTS IN NATURE QUALITY

Nature is a complicated concept and there are a number of different interpretations of what nature is and how it should be valued (e.g., Fink, 1993; Schwarz and Thompson, 1990; Hull et al., 2002). To keep things clear, we distinguish between these two aspects, conceptions of what nature is and normative views of the value of nature, and in keeping with the agricultural context, we focus on the relation of man to nature.

Two over-arching conceptions of the relationship between man and nature can be identified for the present purpose: a "distinctive" conception that sees man and nature as basically separate, and a "systemic" conception that sees man as basically an integrated part of nature (Alrøe and Kristensen, 2000). The distinctive conception has dominated the Western societies at least since the Enlightenment period, where nature was increasingly viewed as an object. The systemic conception is characteristic of organic agriculture and other alternative movements that have emerged in the last century due to increasing ecological concerns.

These two conceptions can be distinguished in various disciplines with relevance to the aims of this discussion. In conservation biology, for instance, two major schools are found: *compositionalism* and *functionalism* (Calicott et al., 1999). Compositionalism is entity-oriented, based on evolutionary ecology and takes man to be separate from nature (distinctive). It encompasses concepts such as biological diversity, biological integrity, and ecological restoration. Functionalism is process-oriented, based on systems ecology and takes man to be a part of nature (systemic). It encompasses concepts such as ecological services, ecological sustainability, ecosystem health, ecosystem management, and keystone species.

Normative views of nature

Within these two basic conceptions of nature, various views on the value of nature may be distinguished. We discern three "archetypical" normative views of nature (Alrøe and Kristensen, 2003). These normative views of nature should be distinguished from the scientific and strategic considerations discussed below. Within the distinctive conception of nature, we can discern a Culturist View of Nature and a Naturalist View of Nature. The Culturist View values nature that is controlled, well-ordered, cultivated, and useful to man, while the Naturalist View values the wild and authentic nature, untouched and uncontrolled by man. The systemic conception gives rise to an Ecologist View of Nature, which values the intimate and mutually benign relations between humans and nature.

This threefold distinction forms a conceptual framework for exploration of nature quality criteria in the farmed landscape. The three archetypes are extremes and are seldom expressed in pure form. Usually, statements about nature quality show some mixture or intermediate form, and the generic terms obviously do not preclude that the various actors may express different views in different situations.

Conventional farming mainly expresses a Culturist View of nature as something distinct from man to be controlled and exploited to the benefit of mankind. This view has ancient roots in religious ideas about man as a unique being in the world, made in the image of God. It is still evident in modern industrialized agriculture, where control is often symbolized by order — the cultivated nature should be neat and tidy – and spatially separated from "wild" nature.

The Naturalist View has evolved especially during the l9th and 20th centuries on the backdrop of modern city life. In this view, nature is valued as something wild and uncontrolled outside of man and to be used for joy and recreation and to remind us how the world was before civilization. This view has to a certain extent formed the basis for international conservation work.

Organic farming mainly builds on an Ecologist View of Nature. One of the basic normative principles of organic farming is that agriculture should cooperate with nature.[1] That is, the production should emulate and benefit from nature's systems and cycles, and help sustain them (IFOAM, 2002).

[1] Organic farming cultivates nature using both introduced species and selected varieties in an artificial production system. The distinction between introduced and native is not crucial from the Ecologist View.

In this paper, we will explore how criteria for nature quality based on the Ecologist View of Nature can be developed and thereby feed into the ongoing discussion of the development of the organic farming practices.

Different interests in nature quality in farmed landscapes

The traditional biological approaches are not sufficient when trying to evaluate the nature qualities of a farmed landscape, where human impact and human benefit need to be evaluated more broadly. In a multifunctional landscape, many different actors – with different views of nature – take an interest in nature quality. Apart from the interests connected to nature protection and conservation (biological interests), a comprehensive nature quality concept for farmed landscapes will have to include the interests in agricultural production or other types of commercial use (production/utilization interests) as well as the interests visitors have in landscape aesthetics, nature experiences, and recreational opportunities (aesthetic/recreational interests).

Comparing the three types of interests in the nature of farmed landscapes with the three normative views of nature we find that each type of interest may adhere to more than one view of nature. From a Naturalist viewpoint, agricultural systems are artificial systems, consisting to a large degree of non-native, introduced, invasive, and domesticated species, with little biological interest. From an Ecologist viewpoint, non-native species are potentially as valuable as are native species, pending on their function in the agricultural system. Both the Naturalist and Culturist View would aim to segregate agricultural land and wild nature, but they would disagree on the spatial extent of the different land uses. The Naturalist View would promote biological interests through conservation and protection of species and space for evolutionary processes, while the Culturist View would aim to utilize the productive potential where possible and relegate nature to unfarmed areas. The Ecologist View would be interested in possible benign interactions between different land uses, including extensive and uncultivated areas. Likewise, the Naturalist View would favor using extensive areas for nature tourism and possibly restrict access, depending on the vulnerability of the ecosystems. The Ecologist View would favor personal experience of the landscape and agricultural production, emphasizing possibilities for access and participation. A combined matrix of normative nature views and types of interests is shown in Table 1, with examples of strategic approaches to nature qualities in the farmed landscape. Some of the approaches are incompatible while others can be followed in unison in the same area.

Table 1. An overview of different strategic approaches to nature qualities in the farmed landscape based on three different types of interests and divided according to three normative views of nature. Note that the same individual can employ different interests and views of nature, depending on the situation.

Conception of nature	**Normative view of nature**	**Strategic approaches to nature qualities in the farmed landscape**		
		biological interests	*production/ utilization interests*	*aesthetic/ recreational interests*
Distinctive (compositiona-lism)	*Naturalist View of nature*	protecting uncultivated natural areas; careful management of semi-natural areas	securing subsidies for uncultivated and semi-natural areas; increasing nature tourism	respect for natural landscapes; restricted access; securing possibilities for contemplation and awe
	Culturist View of nature	relegating nature to unfarmed areas	optimizing natural resource use in farmed areas	enhancing the beauty of the cultivated; utilizing the landscape as a recreational apparatus
Systemic (functionalism)	*Ecologist View of nature*	co-operating with natural systems; enhancing habitat structure and function	sustaining soil and agro-ecosystems; maintaining ecosystem services	increasing accessibility; securing possibilities for experience, participation and intimacy

DISCUSSION OF NATURE QUALITIES IN ORGANIC FARMING

Having laid out the background for different perceptions of nature quality, we will, in the following sections, discuss specific aspects of nature qualities in organic farming.

Organic farming systems seems to be an appropriate tool for planners to balance conservation and production, as organic farms support more rich and diverse flora and fauna, both introduced and native species (e.g., Stolze et al., 2000; Ahnstrøm, 2002; Biao et al,. 2003). However, the philosophy behind "the more biodiversity the better" requires a deeper discussion. The uncritical uses of "diversity indicators" in cultivated areas (e.g., higher diversity of weeds in the fields) seem to be derived from a Naturalist View with the aim of conservation of biological integrity. Policy-makers and planners have often used such indicators to try to maximize the biodiversity (number and diversity of habitats, the number of species and the genetic variability of the populations) in the agricultural landscape. However, many researchers have claimed that processes and functional groups of organisms are more important for ecosystem function than 'just' maximizing the diversity (e.g., Kareiva, 1994; Tilmann, 1997; Hodgson et al., 1998, 1999). For example, bogs and heathlands are species poor ecosystems but possess many biological qualities and biological integrity (processes such as closed organic nutrient cycling and podzolization, plant communities of extreme nutrient stress tolerators) not reflected in the biodiversity concept. In such an ecosystem, more diversity (e.g., due to nitrogen deposition) may from the Naturalist View even reflect degradation – the ecosystem integrity is threatened. From the Culturist View, nutrient enrichment increases the productive potential of "wastelands" and is not a problem.

The primary purpose of a farming system – whether organic or conventional – is to produce food for human consumption. But a comprehensive approach to nature quality in organic farming requires the balancing of biological, production/utilization and aesthetic/recreational interests in different areas and on different levels. Biological and productive considerations are quite different on the uncultivated and cultivated areas.[2] Therefore, these two area types, and the functional interactions between them (pests, pest control, and nutrient exchange), will be discussed in separate sections. Thereafter, we will discuss biological and aesthetic interests at the landscape level. Nature quality at the landscape level encompasses both considerations for the spatial aspects of habitat structure and function as well as for the aesthetic and recreational qualities of the landscape. The latter is often considered more subjective than the former, but we believe that both deserve more attention in balancing the functions of organic farming systems.

Biological interests on uncultivated farmland habitats

Numerous studies have indicated that organic farming has higher *potential* to accommodate biological concerns than conventional farming (Stolze et al., 2000; Ahnstrømm, 2002). It has been sufficiently documented for arthropod groups like butterflies and farmland birds that organic farms may give rise to more biodiversity. However, there is hardly any evidence that organic farming also favors native vegetation and arthropods in the permanent grasslands and the uncultivated habitats (Stolze et al., 2000; Ahnstrøm 2002; Aude et al., 2003).

Four major pressures affect the semi-natural habitats, such as permanent grasslands and meadows, in Denmark: changes in hydrology, fragmentation, eutrophication, and lack of management and, consequently, succession into shrub and forest (Ellemann et al., 2001). Organic farming may impact these biologically valuable biotopes in the same manner as conventional farming except for the absence of chemical fertilizers and pesticides. However, pesticides are rarely used on semi-natural areas in general and organic farmers may apply organic nutrients at (almost) the same levels as conventional farming systems.

The present-day semi-natural biotopes are often created and always maintained by man and are, therefore, somehow in conflict with the wilderness and originality criteria of the biological integrity concept of Nygaard et al. (1999) and Angermeier and Karr (1994) and the connected Naturalist View of Nature. Natural succession towards forest would be the consequence of lack of human influence in most grasslands, meadows, and heathlands. This would result in high biological integrity, but would reduce the extent of a number of valuable relict habitat types for species adapted to light and nutrient poor conditions. Such habitats were much more common 200 years ago but

[2] Even though these areas are quite different with respect to nature quality concerns, it is not possible to make a sharp distinction. Cultivated fields will in this context, include cropping fields, but also orchards, semi-permanent and highly fertilized grasslands (e.g., relaid every 5 years). Uncultivated farmland habitats include a variety of biotopes, such as unfertilized semi-natural pastures and heathland (often grazed), uncultivated small biotopes (hedges, road verges) and wilderness areas (small woodlots, lakes etc). Farmed landscapes are landscapes that are clearly influenced by farming activities, even though the landscape includes uncultivated areas.

have decreased dramatically during the intensification of agricultural systems since the 1950's – and today they support a high proportion of Stress-tolerators (*sensu* Grime, 1987) on the Danish Red List (Ellemann et al., 2001). As a consequence, the semi-natural areas are considered to have relatively high biological integrity also from the Naturalist View because it is argued that these habitats are the only present representative of the former temporarily open grasslands on poor soils grazed by wild ungulates (Thomsen, 1996; Ellemann et al., 2001). Semi-natural low nutrient habitats are seen as major refuges for species of international conservation interest, although somehow in conflict with the criteria of wilderness and originality. Therefore, continuity in time and space is perhaps the most important criterion for high biological quality of uncultivated biotopes in the agricultural landscape.

Semi-natural areas are extremely valuable habitats in the agricultural landscape for conservation of species and genes of threatened habitat types. Furthermore they are also of great functional importance for nutrient cycling (e.g., meadow retaining nutrients and thereby preventing leaching) and processes of succession (e.g., colonization). Attention should be given to developing organic farming practices (e.g., unfertilized buffer strips along uncultivated biotopes) that support the characteristic balance of functional groups of organisms for specific semi-natural habitats to ensure the processes and functions of those habitat types.

Other uncultivated areas on farms, which are much more influenced by the farming practice, are the linear elements of farming landscapes (Le Cæur et al., 2002). According to a "raw" biodiversity criterion for nature quality, the maximum number of species/genes should be represented in a hedge or a hedge network to give high score on a diversity index. In a functional interpretation (based on an Ecologist View) the affinities of the plant community to semi-natural habitats such as grasslands, meadows, or wetland would give higher score on a functional index illustrating the potential for colonization/restoration of the characteristic plant communities in the landscape. However, the diversity of species and habitat types may also be important for the functional interpretation due to the increased opportunities for multiple food-chain interactions between fields and, e.g., pest control organisms from the hedge (e.g., Marshall and Moonen, 2002). This suggests a functionalist interpretation of biodiversity and habitat diversity as a criterion for nature quality in organic farming.

From an Ecologist View, organic farming should care for maintaining and integrating the (semi) natural processes of the uncultivated areas on the farm. Research on the interaction of production and protection (e.g., by grazing) is needed to fulfill this goal.

PRODUCTION AND BIOLOGICAL INTERESTS ON CULTIVATED AREAS

On the cultivated fields, the major considerations for nature quality will always be the production/utilization interest and from a Naturalist View of Nature there is hardly any biological interests involved. However, the keystone of organic farming is to work with organisms that live in the soil (earthworms, collembola, fungi, microorganisms, etc.) and on the fields, to support a productive ecosystem with low pest burden, thus implying a key biological interest from an Ecologist viewpont. This section will discuss the links between the agricultural production system and the productive benefit of nature elements on the cultivated organic fields.

Productive considerations are closely linked to the ecological services of the agro-ecosystem and, thereby, to the organisms living in the fields. It is well documented that more species and more individuals of soil and surface living arthropods are present in organic farming systems than in conventional systems (Hald and Reddersen, 1990; Pfiffner and Mader, 1997; Elmholt and Axelsen, 1999; Kromp, 1999; Reddersen, 1999; Sunderland and Samu, 2000). Only in the case of aphids are there generally fewer present in organic fields (Reddersen, 1997). For higher animals, it is documented that more birds are present on organic farms – especially skylark (*Alauda arvensis*), which depends on the fields for nesting and foraging, although other factors such as crop rotation and field size also play a key role for birds (Reddersen, 1997; Odderskær, 2002).

Ecological services (nutrient cycling, water infiltration, pest control, etc.) are the most prominent contributions of the common and often very abundant species that have adapted to the very special habitat of agricultural fields, with its high nutrient level and frequent disturbances (favoring R and C-strategies *sensu* Grime, 1987). Few international conservation interests are directed towards these functional groups, as their habitats are very abundant and the organisms are generally relatively mobile and very adaptable to changes in the landscape. It is generally believed that biodiversity (e.g., high number of species) in the fields may improve ecological services. Furthermore, such diversity is determined by the management and quality of the different habitats (fields, small biotopes, etc.) (Elmholt and Axelsen, 1999; Reddersen, 1999). The speed of processes in a soil ecosystem is correlated to species diversity and these soil processes are of importance to some ecological services (Bengtsson et al., 1997). However, it is still an open question whether the functioning of the ecosystem is directly related to variables such as the number of arthropod species – the scientific literature does not give a simple answer.

The scientific literature on soil fauna suggests that the number of functional groups may be more important than the number of species for soil productivity because different species may substitute in the various functions (Elmholt and Axelsen, 1999). This is parallel to the proposed focus on functional groups above ground in the uncultivated areas (conditions for stress-tolerators). Ecosystem function may be affected differently by diversity according to the system, the species, and the processes studied (Bengtsson et al., 1997).

The major ecological services in organic agriculture are nutrient cycling, soil structure, natural control of pests and plant diseases and food-web interactions between weed species, soil microbes, fungi and fauna, epigeic arthropod fauna, and higher animals. The most important driving factors for these services are the amount and quality of organic manure and mulch, soil tillage, crop rotation, and crop diversity (Elmholt and Axelsen, 1999; Axelsen and Langer, 2000). Farm type influences these parameters on the individual fields, and for certain groups of organisms (e.g., carabaeidae) the organic farm practice influences positively the amount and diversity, compared to conventional farming (Kromp, 1999).

The most suitable criteria for nature quality in these settings is probably the functional integrity of the agro-ecosystems (*sensu* Thompson, 1997). There is a need for more research to develop good indicators for the expected close relationship between productivity and high diversity/density of arthropods in organically grown soils and fields. The complexity of interactions between species and functions are not yet fully explored so that simple biological indicators of productivity of soil are yet to be identified. Such indicators could assist the development of organic farming in accordance with its values and ideas.

INTERACTIONS BETWEEN FIELDS AND UNCULTIVATED AREAS

The discussion of biological and productive interests in interactions between agricultural fields and adjacent uncultivated areas is important with respect to two approaches to nature quality: protecting uncultivated areas from negative agricultural influences (Naturalist View) and maintaining ecosystem services that support the function of the agro-ecosystem (Ecologist View).

The interactions between fields and small biotopes in the farming landscape are strongly influenced by the high nutrient levels in the fields and the presence (in conventional farming) or absence (in organic farming) of pesticide drift from the fields. The loss of nutrients from cultivated fields into hedges in conventional farming may be slightly higher than from organic farming (due to displacement of artificial fertilizer). However, the loss of ammonia from the intensively cultivated organic fields using high levels of manure and slurry is sufficient to keep the small biotopes at high nitrogen levels also in the organic agricultural landscape (Aude et al., 2003). The effects of nutrients on herbaceous vegetation in near field habitats have in some studies been shown to be more important than pesticide application (Kleijn and Verbeek, 2000), and we cannot expect higher frequency of nutrient stress-tolerators (*sensu* Grime, 1987) on organic farms as compared to conventional. However, a recent study has documented that the absence of pesticide application during 10 years of organic farming results in significantly higher number of plant species in Danish hedgerows (Aude et al., 2003).

The plant diversity in small biotopes is important for the diversity of insects, as many insects are host-specific (Maudsley, 2000; Reddersen, 1997). This may have strong impact on the number and density of pest-controlling insects (e.g., spiders and beetles) that are able to colonize cultivated organic fields after over-wintering in hedges or grass-strips between fields (Thomas et al., 1991; Collins et al., 1997; Duelli, 1997; Toft and Löwei, 2002). Especially the mobile larger carabaeidae and "ballooning" spider species are able to colonize fields from uncultivated areas relatively rapidly and may have importance for pest control, such as of aphids, but also parasitoid wasps of aphids are dependent on uncultivated areas for parts of their lifecycle (Langer, 2001). It is obvious that when landscapes are more diverse and contain more uncultivated areas and smaller fields, the possibilities for such interactions are better (Duelli, 1997), but few studies have tried to compare the heterogeneity of organic versus conventional landscapes (Tress, 1999).

Positive effects of such interactions (from a farmer's view: pest control) in organic farming may have been overestimated in the scientific literature, although the interactions do occur and may have importance (Kromp, 1999; Reddersen et al*.,* 1999; Azeez, 2000; Landis et al., 2000; Sunderland and Samu, 2000; Stolze et al., 2000). Also the negative interactions (from a farmer's view: pests overwintering in hedges, weedy species invading from field margins, etc.) is of importance – and many farmers fear to face such problems by converting to organic farming. In any case, it is difficult to document and quantify these interactions as the conditions differ from field to field and between years.

The relevant criterion for nature quality here, based on an Ecologist View, is the functional integrity of the agro-ecosystem (taken to include the uncultivated areas adjacent to the fields). Undoubtedly the diversity and density of habitats in the agricultural landscape may influence the production system, but the overall effects are extremely

difficult to “translate” into a few reliable indicators. There is a great need to intensify research on these interactions and to develop reliable indications of a supposed functional integrity and both the positive and negative interactions between cultivated and uncultivated areas in organic farming systems.

BIOLOGICAL INTERESTS AT THE LANDSCAPE LEVEL

Landscapes are territorial or spatial units produced through the interaction between human societies and cultures with the natural environment (Wascher, 2000). They are viewed as integrating various functions demanded by society – the multifunctional landscape. These functions are sometimes split into economic, ecological, and cultural, reflecting the landscape as bearer of production (e.g., agricultural), flows of energy and matter, cultural identity, and recreational potential.

During the post-war intensification of the agricultural sector, maximization of productivity through intensification and specialization was closely related to the spatial segregation of functions. Furthermore, the dependency of agriculture on the natural character of the landscape was reduced. Production of unacceptably large agricultural surpluses, exploitation of natural habitats, pollution of water-resources, and abandonment of farming in areas without intensification potential have, however, necessitated a re-orientation of policy towards the potential of agricultural multifunctionality, producing environmental and cultural values along with economic value. From an Ecologist View, this creates an optimal situation, as a focus on integrated multifunctionality enhances policies that support the integration of other human aspirations in the agricultural landscape.

Farms exert a joint but uncoordinated impact on the landscape as an ecological system (Baudry, 1989). The development of high-input systems has reduced the area of extensively cultivated fields, grassland, uncultivated areas, and small biotopes. Those fragments that remain result mainly from farm-level decisions and do not necessarily correspond to landscape-level demands for larger uncultivated patches, corridors, or stepping-stones. The landscape level management of habitats thus becomes ever more crucial for the purpose of leaving room for the natural processes (Reenberg and Baudry, 1999). Development of organic farming in this respect, and the societal promotion and direction of organic conversion are a potential instruments for such management.

Several structural aspects have been pointed to as crucial to the quality of farming landscapes with respect to biodiversity. At least 25 of the habitats listed in the EC Habitats Directive are associated with agricultural land use. Apart from their presence, biological quality, and extent, the spatial configuration needs to be considered. A number of studies have provided evidence of the relationship between landscape structure and aspects of biodiversity (e.g., Dramstad et al., 2001, Luoto, 2000,; Luoto et al., 2002,:Weibull et al., 2003).

Two general attributes have been suggested as descriptors related to landscape structure in addition to habitat extent (Wascher, 2000). The first is heterogeneity, describing the spatial variation in the landscape and thereby including both the diversity of habitat types and their degree of interspersion. The second is connectedness and functional connectivity, which is related to the degree of fragmentation of the landscape and the relative isolation of habitats.

In particular, two aspects of the farming practice — whether organic or conventional – drive the impact of farming on the spatial structure. One is the continuous reorganization of the structure of habitats through the rotation and layout (including joining) of the cultivated fields and the possible effect on the extent and continuity of uncultivated areas and small biotopes. The other is the land use/crop rotation and the degree of intensification and specialization of the cultivation practice.

In Denmark, the numbers and size of (semi) natural habitats in the agricultural landscape have decreased (Reddersen et al., 1999; Ejrnæs, 2000) during the modernization period, even though the numbers of small biotopes have stabilized and even improved in some areas since the mid-1980’s (Brandt et al., 1999). Moreover, the geographical differences in agricultural potential have been reduced through drainage, chemical fertilizers, and irrigation, leading to a homogenization of agricultural habitats with a high nutrient status. Generally, the nutrient cycling in the Danish farmed landscape is open (large import and export of nutrients) and there is a lack of correlation with the local abiotic conditions.

A comparative analysis of organic and conventional farms in two Danish counties found that fallow fields are generally fewer on organic farms than on conventional, and the area of permanent grassland far larger. The number of organic farms with permanent grassland is higher and the grassland is treated more extensively (Tress, 1999). The number of fields is higher and the size of fields is lower on organic farms creating a more diverse mosaic within the farm (Clausen and Larsen, 1997; Tress, 1999). There is a positive correlation between the organic farms and the existence of small biotopes in Denmark. Tress (1999) found a slightly larger share of uncultivated areas (< 2ha) on organic farms than on conventional, but also a significantly larger share of inner and outer hedgerows. An earlier study showed that organic farms contain a higher heterogeneity in biotope structure than conventional farms. This

reflected that organic farms were localized in areas where the biotope density was generally high (Clausen and Larsen, 1995).

The studies referred to above (Tress, 1999; Clausen and Larsen, 1995) were, however, carried out at the farm level and did not evaluate the effects of changes in land use on the landscape level. Thus, it is not known whether the organic practice has changed the overall structural layout of the landscape in a way favoring the biological nature values, or the potential role of organic farming in doing this.

If organic farming should respond to landscape considerations, land use, and management practices would need to be reconsidered at the farm as well as at the landscape level. Organic farming need to adjust the land use to the natural conditions as the lesser nutrient input of organic farming systems requires a more thorough consideration of nutrient management, implying rotation practice with, e.g., clover for nitrogen fixation. It has been suggested that a minimum of 3-5% of each farm should be designated to on-farm Nature Conservation (van Mansvelt and van der Lubbe, 1999; van Elsen, 2000). From a macro-level perspective, such minimum standards on the extent of uncultivated areas should rather be implemented at the landscape level, where due consideration of land form and habitat structure could be taken.

Organic farming have many potential benefits of collaboration, including fodder production, utilization of manure, and grazing (Jørgensen, 2001), and the resulting land use may have potential positive impacts on the landscape diversity. The idea of collective Nature Conservation Plans among farmers in a single county has been discussed in a Danish context, and could become a link between the farm- and regional planning level (Tybirk, 2002).

AESTHETIC AND RECREATIONAL INTERESTS IN THE FARMED LANDSCAPE

For the majority of the urban population, nature quality is primarily linked to the landscape, and the border between nature and culture is not primarily defined by wild versus cultivated, but rather by the urban grey versus the rural green (Fink, 1993) – the aesthetic experience. With a predominantly urban population and a rural population in which the farmer numbers are decreasing, the demand for an aesthetically and recreationally satisfying landscape development increases. Landscape perception is essentially subjective and may only be fully understood relative to the characteristics of the observer, but some general attributes related to positive landscape assessments are suggested (Antrop, 2000). Some of these are related to nature qualities:

- some degree of spatial order (not too rigid), in terms of expression of relationships and coherence, and allowing understanding
- diversity and variation
- movements of elements in the landscape, such as water and man made objects (wind turbines, tractors, etc.)
- tranquility and quietness
- accessibility and freedom of movement.

From a Culturist View, the landscape may be seen as the physical room for recreational activities – like a sports arena – or as an apparatus for physical activities. A steep hill may be seen as a physical challenge on the mountain-bike, rather than the result of geological processes – indicating that the emotional dialogue with the landscape is lacking (Højring, 2001). However, the landscape may also be the object of the recreational experience – the landscape and the nature in the landscape is the goal for the visit. Birds, geological formations, forests, botany, hunting – or the landscape as a whole – require and offer an emotional dialogue. It could encompass numerous aspects that the consumer may consider of importance such as diversity and cohesion of landscape components, site-related characters and peculiarities, historical continuity, seasonal aspects etc. (Hendriks et al., 1997). In Denmark, the agricultural landscape has today only significant daily importance for some 15% of the population living or working in rural areas, but the agricultural landscape still is very important for recreation in the weekends and holidays – 90% of the Danish population is actively using the rural landscape (Jensen, 1998).

Little is known about the influence of organic agriculture to aesthetical attributes of the farming landscape (Højring, 2001). Organic farming has been found to perform well according to criteria on sustainability assessment – including criteria related to perception and sensory qualities (Stobbelaar and van Mansvelt, 2000). There is little doubt that the values and norms of the farmer is reflected in the farming practice and thereby influencing the landscape. Increased access to the farmed landscape and possibilities for experiencing the functions of farming would be a natural consequence of the Ecologist View, which would result in a closer relationship between the visitor and the organic farming landscape.

In many ways, there is a good agreement between the Ecologist View of nature and some general discussions of criteria for habitat and landscape management (see, e.g., OECD, 2001; Wascher, 2000; Gulinck et al., 2001; Antrop,

2000). Most landscape values refer to a general criterion of integrity – meaning coherence, harmony, visual balance, undisturbed functional entities, continuity over time, and land use fitness to the natural characteristics (Gulinck et al., 2001). For nature quality, landscape integrity thus denotes an increased emphasis on adaptation to the natural character of the landscape, as well as to sensitivity towards the landscape as a whole. Together, landscape integrity, accessibility, and experientiality might well be criteria to be further developed for nature quality in organic farming.

CONCLUSIONS AND FUTURE PERSPECTIVES

Nature quality is a concept that has different interpretations stemming from different basic views of nature, and that needs to encompass different dimensions stemming from the multitude of interests in nature that are present in society.

A set of criteria for nature quality has been developed from a Naturalist View of Nature (see Box 1) that can be applied to natural areas. However, from the Naturalist viewpoint, it is a paradox of many semi-natural ecosystems that human influence increases or maintains biodiversity (e.g., grazing). This supports the call for a more differentiated approach to nature quality. While the criteria of originality and authenticity are difficult to apply directly to farmed areas, continuity in time and space (and to a certain extent wilderness) can still be used as criteria for evaluating (aspects of) the biological integrity of uncultivated and semi-natural areas in the farmed landscape from a Naturalist perspective.

Organic farming, building on an Ecologist View of the relationship between human and nature, is in a favorable position in the development of a more comprehensive set of criteria for nature quality. We suggest an additional set of criteria for nature quality assessment based on an Ecologist View of Nature: biodiversity; habitat diversity, extent and structure; functional integrity of agro-ecosystems; and landscape integrity, accessibility, and experientiality (see Box 2).

Box 2. Additional criteria for nature quality assessment based on an Ecologist View of Nature

We propose the following additional (partly overlapping) criteria for nature quality assessment in organic farming

- *Biodiversity* on different scales (genes, species) taking into due account the different ecosystem functions of non-native, native and keystone species
- *Habitat diversity, extent and structure*: different types of habitats, heterogeneity and functional connectivity on different levels
- *Functional integrity of agro-ecosystems*: maintenance of ecological services, sustenance and reproduction of soil and other functional elements
- *Landscape integrity*: coherence/harmony, working functional entities, land use adapted to natural preconditions
- *Accessibility* and *experientiality* of the farming landscape

It would be valuable for the organic farming societies to consider how to integrate the various nature qualities into their farming systems and practices. The larger set of Naturalist and Ecologist criteria can provide a wider and more balanced basis for developing nature quality indicators that are relevant and useful from the perspective of organic farming. This broader approach to nature quality, with an increased awareness on the importance of different views of nature, is also expected to benefit the general societal discussions and decisions on farming and nature.

The future communication on nature quality would benefit from the development of indicators that are reliable and understandable for the farmer, the researcher, and the policy maker, based on explicit criteria for nature quality.

Future decisions on farming and nature will also benefit from improving the empirical knowledge of different aspects of nature quality in the farmed landscape. In the above sections, a variety of research needs have been identified from the perspective of organic farming. In semi-natural areas, on the farm, and in the landscape, more emphasis is needed on the potentials for integration of production, recreation, public access, and nature conservation. These could be issues such as grazing optimization for conservation purposes or farm-tourism. In the productive fields, more emphasis on the links between diversity and functional groups on soil living arthropods would be essential to explore whether high soil biodiversity is correlated to high productivity. The interactions (positive and negative) between fields and uncultivated areas or linear landscape features such as hedges needs to be explored further and quantified. For example, do the functional groups of arthropods in uncultivated elements of the landscape have parallel functional groups in the fields? The nature perceptions of organic farmers should be explored and knowledge on their integration of nature conservation practices in farming practices would be

beneficial to start the practical integration of productive, aesthetic, and conservation considerations. Best management practices and possible additional measures favoring nature quality should be explored, and it should be investigated what the drivers for these farm strategies are. Moreover, potentials for whole landscape-oriented management of nature quality through collaboration, platforms, or other measures should be explored.

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