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Landscape management decisions and public-policy interventions

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Introduction

Landscapes change through a combination of natural and social processes. In agricultural landscapes, decisions on landscape structures and functions – here termed *landscape management decisions* – play a fundamental role with the farmers as the key actors. As producers of food and fibre and as owners of properties, farmers develop their holdings according to their interpretation of new constraints and new options (Van der Ploeg 1994; Shucksmith 1993). Whereas there is a fast growing body of literature on the changing agricultural landscapes, there is still a poor understanding of farmers' decision-making in a policy context. This is somewhat paradoxical, since a common aim of landscape-ecological studies of agricultural landscapes is to improve the policy-making process (Moss 2000; Wiens 1999).

The relationship between farmers' landscape management decisions, landscape change, and public policies is the subject of this paper. First, the relationship is analysed in respect to the main driving forces with emphasis on different types of policy interventions, farmers' decisions and agricultural regions. Next, we present – in some detail – examples from recent studies of landscape changes in different Danish agricultural regions, and finally, we discuss some implications of these empirical examples for the design and implementation of landscape policies.

The farmer's landscape decisions – between nature and society

The landscape is part of the farmer's structural framework on which he depends, but it is also a framework that he is constantly affecting (Brandt, Primdahl and Reenberg 1999; Reenberg and Baudry 1999).

On a historical time scale, natural and socio-economic conditions constitute the overall structure through which the agricultural landscape is maintained and developed. Climate, soil and hydrology are the most important natural production factors. Although specific agricultural conditions vary regarding technology and other social factors, favourable agricultural areas have usually remained stable over a long time span (Jongman and Bunce 2000; Meeus, Wijermans and Vroom 1990; Jensen, Kuhlmann and Reenberg 1987).

Of the social, economic and cultural conditions structuring the farmer's landscape decisions, there is no doubt that technology and market are central driving forces (OECD 1999). Despite the increasingly global impacts from technology and market

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there are no clear signs that European agricultural structures become more homogeneous at a local level. On the contrary, empirical evidence indicates that agricultural holdings become more heterogeneous and differentiated over time (Van der Ploeg 1994). In addition, changes in the urban–rural relationship are of importance to agricultural landscapes, whether they are located in densely populated urban regions, in which the rural population may increase due to a growing number of dwellers with urban incomes, or they are more remote rural landscapes characterized by depopulation (Halfacree 1997; Hoggart, Buller and Black 1995).

Local conditions, including cultural traditions and 'farming styles' are crucial factors in the development of this heterogeneity (Van der Ploeg 1994; 1995; Jones 1988). Another central factor in regional and local development of agricultural landscapes is public-policy intervention. Public policy may be seen partly as a response to undesirable changes (e.g. to avoid or reduce negative impacts on agricultural landscapes), and partly as the expression of political aspirations or visions for a better social future.

The types of public-policy interventions of particular relevance to landscape management and change can be grouped into four categories: 1) Expropriations and public ownership, 2) Regulatory interventions referring to agricultural and environmental legislation, 3) Grant aid schemes and other economic incentives, and 4) information, education and training.

Expropriations and public ownership represent relatively radical types of interventions, although some forms are more far-reaching than others. Land rights as well as property rights may be expropriated on grounds of public interests in the specific area. In capitalist countries such expropriations are, as a rule, followed by economic compensation to the landowners in question. In Denmark about 5 percent of the country is covered by so-called 'conservation orders', which are legal documents prescribing land-use restrictions and management obligations (beyond general legislation). Passing a conservation order is a special form of expropriation. Areas under conservation orders usually remain in private ownership and the affected owners receive a one-off payment to compensate for the loss of rights (Primdahl 1991).

Public ownership is a widespread instrument used to enable specific types of management in forests, national parks, nature reserves and other areas of special value. In The Netherlands public ownership of small habitats is even used as an instrument to maintain biodiversity within ordinary (unprotected) agricultural landscapes (Kristensen and Roepers 2003). Although public ownership of certain areas may have a long history and may be seen as a sustainable solution for highly valuable areas, public ownership is – in Ian Hodge's wording – *"not immune from the general problems of public-sector management, the conservatism in decision making, political interference, the limited incentives for efficiency and so on."* (Hodge 2000, p. 121).

Agricultural and environmental legislation of relevance in this context comprise farm-property and farm-holding regulations, environmental protection, habitat conservation, access rights, hunting rights, landscape and land-use regulations. Some of these interventions fall under old legislation, while other ones are quite new. Such regulatory interventions, which may or may not be connected to physical planning, usually function reactively in respect to change. They may regulate what is possible to do or not to do, when habitats, buildings, roads etc. are to be changed, but do not typically activate changes. The acquisition rights to farm properties, and tenure rights and rules are other examples of regulatory interventions. The regulatory system as a

whole provides the framework for other types of intervention, including establishing the framework for expropriation of property rights as well as for economic incentives. This means that the needs for expropriative interventions and economic incentives will change when legislation changes, although regulatory instruments cannot replace the two other types of intervention.

Grant aid schemes and other economic incentives include schemes for landscape management, landscape enhancement, habitat restoration, afforestation, various tax-deduction measures and agro-environmental schemes. Some incentives to promote 'improvements' to agricultural landscapes are old, such as the 19th-century drainage and reclamation programmes in Northern Europe (Baldock 1984), and many countries have strong traditions of collectively oriented partnerships through which local farming communities co-operated with public authorities to expand arable production. Such intensification-focused incentives have been replaced by programmes focusing on reductions in agricultural inputs and on landscape management issues in several countries in Northwestern Europe. The new programmes are typically based on individual voluntary agreements with the farmers, whereas the old programmes often were collectively based. In some of the former collectively based programmes individual farmers may have been forced to participate, for example in a drainage project, if the majority of property owners voted for the project, as was the case for Danish drainage and reclamation projects up until the 1980s. In general there is a challenge in combining incentives targeted to farmers as individuals with more collectively oriented types of activities at the landscape level. This balance is part of a wider problem of the forms and levels of public interventions in the individuals' pursuit of their self interests (Dwyer and Hodge 2001).

Information, education and training may be considered public policy to the extent that they are used by agencies to pursue collective objectives. There is a long tradition of State-managed or -subsidized advisory services in Europe, although many of them have been privatized during the last decades or the State support has been reduced. In recent years these bodies have increasingly provided advisory services on nature-conservation and landscapes issues (Mitchell and Baldock 1996). Nature-conservation and landscape bodies also have a tradition of providing information and training on environmental conservation and enhancement issues. Under the EU agro-environmental policies it has been possible for the Member States to support training and demonstration projects. Countries like Ireland, Portugal, Spain and Sweden have used this option to develop comprehensive programmes to train farmers (Buller 2000; Emerson and Gillmor 1999). Such instruments may be combined with other types of policy instruments, but they may also be efficient tools in themselves, when they are supporting activities undertaken by farmers for their own benefit (with or without subsidy), activities which may be much more beneficial to society if they are carried out in certain ways.

The four types of policy intervention have their own ways of functioning and may be seen as complementary rather than as alternatives. Other initiatives (private or public) are also of some relevance for agricultural landscapes, including labelling and creation of dedicated funds (Hodge 2000). The challenge is to make the right combination of policies functioning together and in combination with private initiatives through public–private partnerships. This is often difficult, because the individual policy usually belongs to a policy domain with an institutionalized set of underlying values and assumptions, which may be quite different from other landscape-relevant policies. Thus, agricultural policies are traditionally production- and income-oriented in a market context characterized by individual choices, whereas

nature conservation and planning are concerned with wider, social goals related to protection, maintenance and development of landscapes.

Farmers' landscape decisions

Compared to driving forces such as the market and technology, the individual farmer may be seen as less important. In fact, what farmers do on their own farms in a local landscape may not have long-term effects and may be quite different from what other farmers are doing elsewhere at the same time. Nonetheless, it is the farmer who plants and removes the hedgerows and who decides to drain or to abandon drainage, and it is often also the farmer who makes longer-term decisions about what should happen to the farm property as a whole. Landscape elements are not removed or established by abstract driving forces but by human decisions. This has two implications for the understanding of change and regulation of agricultural landscapes.

First, it is through the farmer that public policies are implemented, whether they are regulatory, incentive or information types of interventions (Kristensen and Primdahl 2000). If the farmers do not know of or accept the policies in play, they may be of very limited effect, and even expropriative instruments require a fundamental acceptance of legitimacy to work sufficiently. Second, major structural changes to landscapes (except those caused by natural incidents) usually start with single changes on single farms, and the study of landscape changes on the farm level is where we may first discover such changes.

We have found it useful to distinguish between two types of farmers' landscape management decisions, namely (1) decisions taken from an agricultural production perspective and (2) decisions taken for non-production reasons, for example with the purpose of improving the farm property as a living place, a visiting place or a wildlife habitat – to mention three common, non-production functions. Each farmer may take both types of landscape decisions, but from different perspectives and with different time frames in mind (Primdahl 1999; Kristensen and Primdahl 2000; Busck 2002). The priority farmers give to production or non-production functions, respectively, may be related to their dependence on income from agriculture and the farm history. Some case studies indicate that hobby farmers give less priority to production functions than full-time farmers (Gasson 1986; Primdahl 1999). In addition, the weighing may be influenced by the overall value system of the individual farmer (Busck 2002) as well as the farmer's position in the lifetime circle (Potter and Lobley 1996).

Empirical evidence from the last two decades shows that non-production decisions have been the main driving force of many landscape changes in Danish agricultural landscapes (Kristensen and Primdahl 2000). This is in contrast to the situation in former periods, where most landscape changes were driven by production-oriented motives. Many small biotopes have been removed in order to satisfy a demand for bigger and homogeneous fields, the ploughing of semi-natural grassland to fulfil a demand for more arable land. In addition, landscape elements have been established to improve production conditions, e.g. hedgerows planted on sandy soils in order to reduce soil erosion and ponds established to provide possibilities for cattle to seek water. Former production functions associated with small biotopes (e.g. ponds for drinking access for the cattle, stone and earth walls for fencing) and many semi-natural landscape elements, such as heath lands, wet meadows and salt mashes, are no longer an integrated part of the agricultural production system, due to changes in

technology and production practises. Instead farmers dig new ponds or restore former ones for a number of amenity reasons (e.g. for nature-conservation reasons or to have a place to walk to at night, as one farmer explained as the motive for digging a pond).

In some situations the producer and the owner of a given piece of land are not the same person. In 1997 this was the case for about 40 percent of EU farmland as a whole (European Commission 2000). In situations of short-term tenant farming or simple (often non-written) leasing agreements the owner and producer have different landscape practices and responsibilities. The producer will tend to make short-term landscape management decisions associated with crop and livestock production, and mainly influencing the landscape processes. The owner will be more focused on long-term decisions related to changes in landscape structures, such as the establishment of new forests and hedgerows. This distinction may be of particular relevance in situations where new landscape elements are considered, because such activities imply substantial use of capital and labour.

Since the 1992 Reform of the EU Common Agricultural Policy (CAP), EU subsidies have been moved gradually from production-based to land-based criteria. As a consequence, the relationship between owners and producers is changing. For landscape management decisions this change of payment criteria may have huge and quite unforeseen implications. In agro-environmental schemes under which the farmer signs 5- to 20-year contracts to ensure environmentally friendly types of farming (and to support farm income), the tendency seems to be that the owner, rather than the producer, signs the contract (Andersen, Primdahl and Solvang 1998).

Due to their traditional view of the farmer the authorities may be inclined to target the producer as the key person, although the owner often would be of more relevance, because he may have greater interest in the policy in question. This can cause implementation problems, either because the target person may be uninterested in the policy or – in situations where the owner and the producer are the same person – because he is approached from a wrong perspective (Primdahl 1999).

Three types of agricultural regions – empirical examples

Actor-oriented analysis of the relationships between public-policy interventions, farmers' landscape decisions and landscape change may only be applicable for relatively local landscapes and for a short to medium period of time; that is, within one or a few decades. For longer-term changes and for larger regions structural conditions and driving forces must be included in the analysis. In order to discuss the relationships in more general terms we will therefore distinguish between different types of agricultural regions and then consider the landscape change patterns and the associated policy issues within the structural context of these different regions.

The *intensively farmed and fertile regions* of Europe have been agricultural core areas for centuries (Jongman and Bunce 2000). The landscape structure is typically characterized by large fields, a high proportion of the agricultural area in rotation, and few fragmented uncultivated elements. Often the landscape structures have been relatively stable. However, policy intervention such as the EU Common Agricultural Policy has been a major driving force in the intensification of chemical inputs and the reduction of uncultivated elements, which have characterized developments of these landscapes in the 1970s and 1980s. Usually only a small proportion of these regions are designated as valuable habitats and landscapes, and common-policy interventions would typically be environmental management regulations and small biotope enhancement schemes.

In agriculturally *marginal regions*, characterized by poor soils, steep terrain, too little or too much water available for the crops, the landscape history is usually quite dynamic (Jensen, Kuhlmann and Reenberg 1987). In periods of good market conditions the intensively farmed parts of these landscapes expand at the expense of semi-natural areas and natural habitats such as moorlands, lakes and shallow coastal waters (Jongman and Bunce 2000; Healey and Ilbery 1990). Historically, highly supported '*improvement programmes*' such as heath reclamation, drainage and diking schemes have been significant drivers in the expansion of the farmed areas within such marginal regions. It is also often in regions with poor agricultural conditions that we find national parks, nature reserves and other protected areas, because agricultural expansion has not been economically feasible (Mather 1986).

A third category of agricultural regions is located in highly urbanized areas, and may be termed *urban fringe regions*. Often the agricultural conditions are good, which may have been one of the historical reasons for urbanization of the area (Mather 1986; Bryant and Johnston 1992). In such landscapes, agriculture and landscape structure may be highly affected by urban functions. Important public-policy interventions in such landscapes are recreational-access policies, public purchase of land for forests and parklands, landscape management programmes, green-belt regulations, zoning and other planning regulations.

These three types of regions constitute different structural frameworks for landscape change, although they are all affected by the same global changes in technology, the markets and the agricultural policies. The question now is: What are the current patterns in change and policy intervention? These are certainly not in any mechanistic way 'determined' by the agricultural region; rather they depend on the specific local context, on how the farmers (individually and collectively) 'combine' the options and constraints provided by external driving forces and their own values and intentions *with* present landscape structure (Jones 1988). To provide some concrete examples of current landscape changes with different implications for policy intervention, results from recent studies of change in three Danish regions are presented: (a) a moraine landscape in Eastern Jutland, (b) an outwash-plain landscape in Western Jutland and (c) the urban-fringe landscapes of Greater Copenhagen.

Favourable farming conditions - the Hvorslev-Bjerringbro area in Eastern Jutland

Located in Eastern Jutland on a moraine plateau intersected by a large river valley and smaller streams and erosion gullies, this example represents a fertile and intensively farmed region. The agricultural structure within the area is diverse, and includes full-time dairy farmers, pig farmers and crop farmers, as well as a large number of hobby farmers and pensioners. The main proportion of the area studied consists of plateaus with loamy soils and good agricultural conditions. On these plateaus the agricultural landscape has been relatively stable during the past 200 years (Caspersen 2002). The landscape is typical of Eastern Denmark with large, open fields, relatively few uncultivated patches and corridor elements. However, also less favourable soil conditions exist in the area, especially on river terrace areas and in the valleys. Such areas have been subject to more landscape changes (Caspersen 2002). As will be seen, in recent years the landscape has become less stable. This applies for both fertile and less fertile soils.

Table 1. Agricultural area with favourable farming conditions. Landscape changes in the Bjerringbro-Hvorslev area, 1991-1996, with owners' occupational status (data of one or more variables are missing for 100 observations)

Owner's occupation	Number of owners	Farm property area, ha	Farm properties *with* landscape changes	Landscape-change index[2]	Index, new elements[3]	Index, removed elements[4]
				– index sum/100 ha farm land –		
Full-time farmer	171	6917	47	3.73	2.49	0.37
Part-time farmer	16	482	4	6.96	5.09	0.62
Hobby farmer	262	3325	83	11.61	8.31	1.76
Pensioner	168	2477	87	4.44	2.20	0.73
Others	12	212	2	4.02	2.60	0.95
All	629	13413	222	5.93	3.98	0.80

N Full-time farmer: age < 67 and no income from outside the farm
Part-time farmer: age < 67 with an off-farm income < farm income
Hobby farmer: age < 67 with an off-farm income > farm income
Pensioner (receiver of any kind of pension)
Others: Funds, companies, municipalities, church etc.

1. The index is based on the sum of values assigned for new and removed non-cultivated elements. Changed field boundary is given the value 0.5 and changed thicket and pond are given the value 1. Permanent grasslands, greenery, forest, unmanaged patches, field roads, earth and stone walls and riparian strips are given the value 1 if the change is less than the average change of the element in question (measured in hectares or meters) and 2 if it is above. Since there is considerable variation in the length and type of hedgerows planted, the values given are dependent on the change under the 25% quartile, between the 25 and 50% quartile, between the 50 and 75% quartile and above the 75% quartile. For 1-rowed hedgerows the values are: 1, 1½, 2, and 2½; for 3-rowed 1½, 2, 2½ and 3, and for hedgerows wider than 6 rows 2, 3, 4, 5. There are only relatively few farms with uprooted hedgerows and the values depend on whether the change is under or over the average – for 1-rowed hedgerows the values are 1 and 2, for 3-rowed hedgerows 1½ and 3 and for 6-more rows 2 and 4.
2. As 1 but only new uncultivated elements with the exception of field boundaries are included.
3. As 1 but only removed uncultivated elements with the exceptions of field boundaries are included.

We have analysed recent landscape changes (1991-1996) based on information achieved through personal interviews in 1996. The interviews included 729 farmers representing approximately 140 km². Change of field size, planting of hedgerows, greenery and small thickets, conversion from arable land to permanent grasslands, digging of new ponds and dredging of existing ones are among the most important

changes in landscape structure within the period 1991-1996. Approximately 1 percent of the total area has been converted to permanent grassland (grassland equivalent of 0.4 percent has been reclaimed) and 1 percent has been planted with greenery (Christmas trees), which is a common 'crop' in Jutland. One in seven farmers has planted hedgerows during the period, about 40 km altogether. Of the new hedgerows the majority (60 percent) consist of 3 or more adjoining rows of deciduous trees (Primdahl 2001; Primdahl and Christensen 2002).

The study revealed some interesting patterns in farmers' landscape decisions. As it appears from Table 1 hobby farmers are responsible for the majority of changes both regarding removal and establishment of landscape elements. This indicates that the reasons for change may be more related to non-production motives than to production motives. Table 1 also shows clearly that the non-cultivated landscape elements (such as hedgerows, grasslands, greenery areas) are increasing, as more new elements are established than removed.

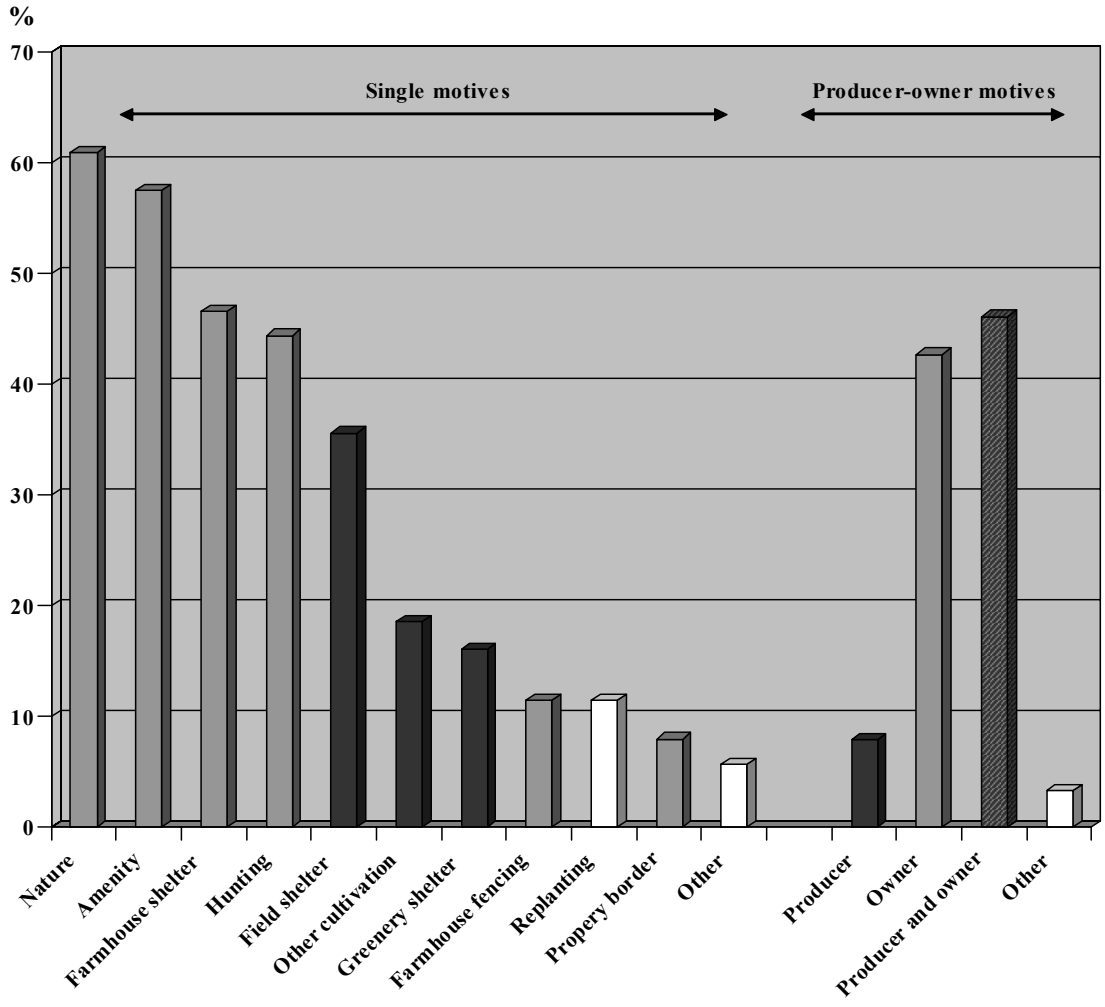

Figure 1. Farmers' motives for planting hedgerows in the Hvorslev-Bjerringbro area are measured by frequency of each motive. The four columns to the right are based on combinations of the different motives in question, for each individual farmer. The different grey tones signify how the motives are categorized in non-production (light grey), production (dark) and 'other' (white) decisions. The figure is based on interviews with farmers who have planted new hedgerows in the period 1991-1996 (Primdahl and Christensen 2002, p. 147).

With the purpose of identifying more directly the role of production and non-production decisions, an additional study was carried out in 1998 regarding the hedgerow-planting activity. The 100 farmers who had planted one or more hedgerows from 1991 to 1996 were interviewed by telephone about their motivations for planting the hedgerows (Primdahl and Christensen 2002). The result is shown in Figure 1.
Non-production motives such as 'shelter for the farm house', 'hunting', 'nature assets', and 'aesthetics' are the four most frequent motives. Also a production motive such as 'shelter for the fields' occurs frequently. Since each hedgerow may be planted for several reasons, the combined pattern of motives is shown in the right-hand part of the figure. It appears that production motives do not occur very often as the only type of motive, whereas non-production motives exclusively, and combined types of motives, are more prevalent.

Even though well-established grant aid schemes are in operation within the area, the study showed, somewhat surprisingly, that most of the hedgerows and new ponds were established without any support. Half of the new thickets were planted using the game-planting scheme and only few new forest areas were planted under the afforestation scheme. In addition, EU agro-environmental policies have not been implemented successfully in this area, as only about 2 percent of the farmers have signed an agreement. Finally, the study showed a profound lack of knowledge among the farmers about habitats protected on their own farm property under the nature-protection law (Primdahl and Christensen 2002).

Concluding, this implies that the public policies have influenced many of the landscape changes in the study area, but far from all. The fact that farmers were not aware of the restrictive regulation on habitat protection reveals that there is a basic information problem, although the current trend is towards net establishment of uncultivated landscape elements. What is more important is that few policy objectives have been formulated related to the development of landscape assets in such intensively farmed regions, and that the potential of farming advisers informing farmers about eventual landscape objectives is not utilized, as farmers do not enrol in grant aid schemes and related advisory services.

Less favourable farming conditions – the Nees area in Western Jutland

Nees is a rural parish covering approximately 3700 ha in Western Jutland close to the North Sea. It is located on an outwash plain with poor sandy soils *(podsols)*. In the late 19th century, approximately half the parish was covered by heath, of which most has been reclaimed (Bramsnæs and Primdahl 1991). During the 20th century hedgerows have been planted to reduce wind erosion of sandy soils and a number of small woodlands were also planted – "for usefulness [for firewood] and for adornment for the eye" as a local peasant wrote in his diary about 100 years ago (Damgaard 1983).

Studies of landscape change in Nees parish were conducted in 1990 and 2000, respectively. In 1990 grain prices were decreasing, and the community was worried about the future. Arable land was sold for less than 20,000 DKR (ca 2,700 Euro, 2002)/ha, and although most farmers were livestock farmers (dairy or pigs) many were planning to extensify land use. Interviews with farmers in 1990 revealed that great changes in land use could be expected. It is evident from Table 2 that more than 25 percent were planning to afforest farmland, and 20 percent considered converting arable land to grassland. Based on this information the research team in 1990 proposed two alternative landscape plans, each with a great proportion of the parish being afforested. The community agreed on one of the alternatives and asked the

county council (which is responsible for countryside planning) to designate a large proportion of the parish as 'afforestation zone' in order to give property owners access to a subsidy scheme for afforestation. Nees parish was the only farming community in the county actively promoting the designation of afforestation zones. In addition, some farmers contacted the State forestry agency offering to sell their farms or part of their farms to the agency for afforestation and landscape enhancement projects.

Table 2. Agricultural area with less favourable conditions for farming. Farmers' plans for concrete changes based on interviews in June 1990 (n=97-99) and actual changes during 1990-2000 based on interviews August 2000 (n=94).

	A. 1990[1]	B. 2000		C. 2000
	Plans for[2]:	Proportion of farmers who have made changes	Proportion of land changed	New plans for:
	% of farmers	%	amount of change /100 ha	% of farmers
Changing arable land to permanent grassland	19.6	5.3	0.3 ha	8.5
Changing permanent grassland to arable land	1.0	3.2	0.6 ha	2.1
Afforestation	26.8	17.0[3]	4.7 ha	20.2
Planting greenery	7.2	6.4	0.4 ha	6.4
Planting hedgerow or thicket	58.6	43.6	682.3 m hedgerow 0.4[4] thickets	41.5
Removing hedgerow or thicket	30.3	22.3	351.5 m hedgerow no thickets	17.0
Establishing pond	28.3	10.6	0.3[4]	16.0

1. Bramsnæs and Primdahl (1991).
2. The question was asked: Do you consider … within the next 10 years.
3. Including 12 farmers who have sold land for public afforestation.
4. Thickets and ponds (including 3 ponds which have been dredged) were measured in number, and the area was not calculated.

In 2000, a new study was carried out and the farmers were once again visited for personal interviews. Table 2 and Figure 2 show that a great deal of afforestation has taken place in the period 1990-2000, some of which has been carried out by the State forestry agency. During the interviews many farmers said that the new forests had improved the parish as a place of residence and new families with young children (and urban incomes) have moved to the parish. The study revealed that a large number of new hedgerows had been planted. Most are deciduous hedgerows (of 3 or more rows), some of which replace the old one-rowed spruce-tree hedgerows (*Picea glauca* and *Picea sitchensis*). In addition some new ponds and thickets have been established. In order to gain an impression of future landscape changes the interviews included questions on which changes the farmers had considered carrying out. Table 2 shows

that a large proportion of farmers are still planning to increase the uncultivated part of their farmland.

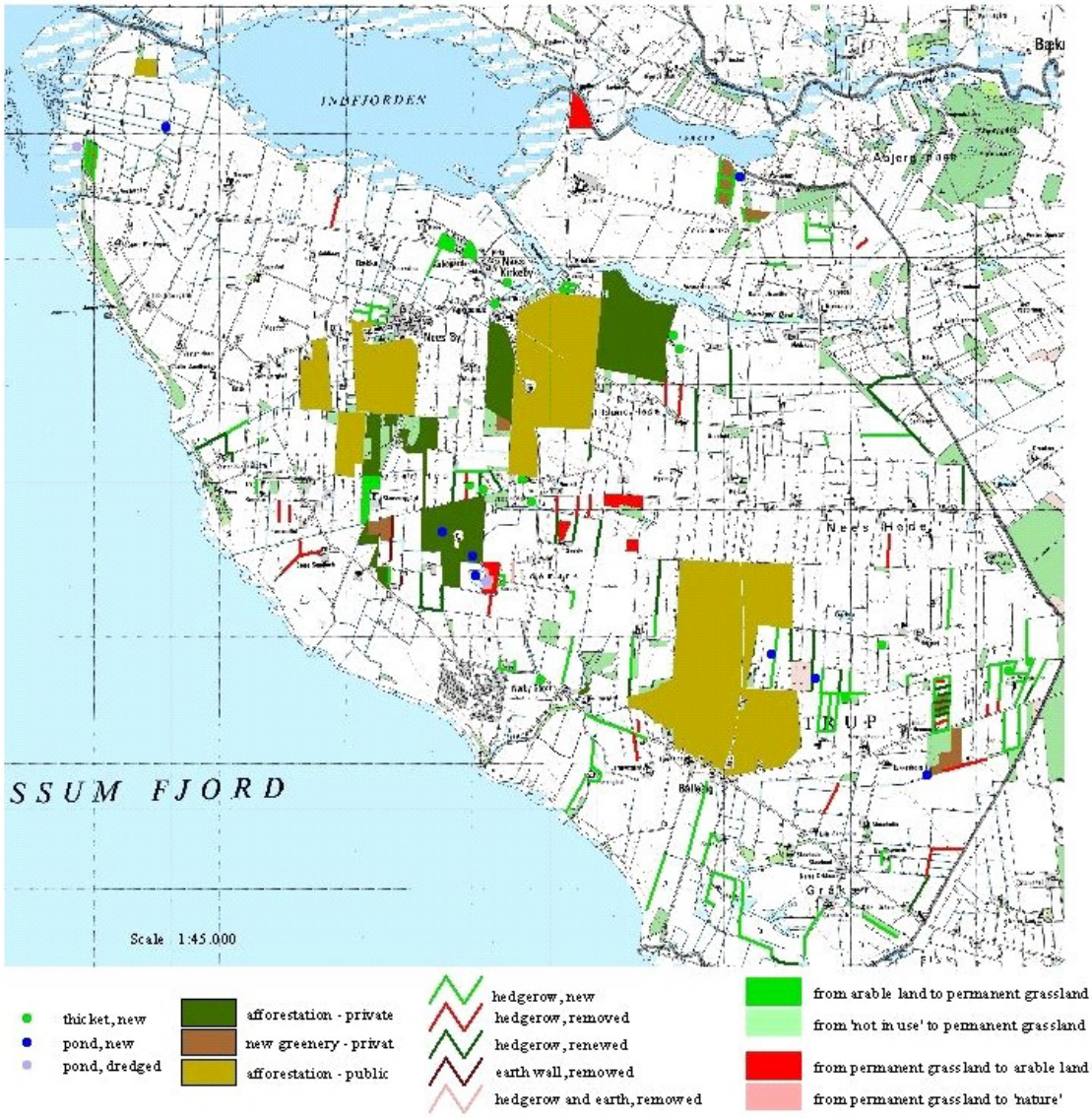

Figure 2. Map of landscape changes in Nees parish 1990-2000

The majority of hedgerow planting and removal, thicket planting and afforestation have been carried out using public subsidies. In this region there is a long tradition of participating in subsidy schemes, and, in contrast to the area of Hvorslev-Bjerringbro, full-time farmers carry out as many landscape changes as hobby farmers. This is reflected in the motivations farmers expressed concerning hedgerow planting. Even though half of the hedgerows planted were related to non-production motives exclusively, still 20 percent (14 percent when length of hedgerows is regarded) were motivated solely by production reasons (Busck 2003).

Despite the large amount of area being afforested fewer farmers have actually planted forests (or sold land for afforestation) than those considering doing so in 1990. It also appears that a much smaller proportion of farmers than intended have converted arable land into grassland, and the net exchange between grassland and arable land is towards more arable land. Various uncertainties related to the interview method may contribute to these results, but no doubt the main explanation can be

found in the reform of the CAP in 1992. This reform dramatically changed the threat of agricultural marginalization in areas like Nees, partly due to changes of some of the subsidy payments from production-based to land-based payments, partly by introducing very attractive set-aside payments. Whereas the land payments varied with the 'productivity' of the soil, the set-aside payments in Denmark were – and are – the same, irrespective of the soil quality. For farmers in Nees parish this has been an attractive alternative to converting arable land to grassland or forest, since they were offered 2,700 DKR (ca 364 Euro, 2003)/ha, when signing a set-aside agreement. Only arable land may be set aside, and this is probably the main explanation why only a few farmers have converted arable land to grassland, and less than expected have planted forest. The changing policies may also be the reason (in addition to the rest of the CAP reform and combined with very high pork prices in the 1990s) why land prices tripled to about 60,000 DKR/ha in 2000.

In sum, the main change taking place in Nees these years is the extensification of land-use, mainly in the form of afforestation. This process is highly supported through afforestation subsidies under the EU afforestation scheme and through State purchase of land and subsequent afforestation as part of the government's goal of increasing the wooded area in Denmark for multiple purposes. Also other non-cultivated landscape elements are growing in numbers and area/length. Altogether this leads to increased landscape heterogeneity, which may be one reason why hobby farmers have been moving to the area. However, it is also clear that the 1992 reform of the CAP has been highly beneficial for the farmers in Nees, partly because of the relatively high set-aside payments they were offered. The set-aside payments together with other parts of the pillar one schemes of the CAP may be the reason why conversion of arable land to permanent grasslands has not occurred in the area.

Urban fringe landscapes in Greater Copenhagen

Since the so-called 'Finger-plan' for the Copenhagen Metropolitan Area was published in 1947, the urban–rural relationship has been an important part of the physical planning objectives for the region. The idea was that the urban area should develop along five efficient transportation lines (railway and highway). The city of Copenhagen would be the palm and the surrounding municipalities would develop along the fingers. Regardless of location in the 'finger', the idea was that people should be able to walk to the railway station in 10 minutes and a walk in the opposite direction should not take any longer to reach the agricultural landscape.

Although the Greater Copenhagen area has indeed developed along these five lines the palm is abnormally huge and the fingers suffer badly from swelling. The agricultural landscapes are also in trouble, because they are increasingly becoming 'non-agricultural', especially close to the centre of Copenhagen. The growth of hobby farmers (Table 3) is partly due to liberalization of acquisition rights to farm properties under 30 ha according to the Danish Agricultural Holdings Act and partly because of liberal praxis of granting exemptions from the regulations. Therefore, also many farms larger than 30 ha have been purchased by hobby farmers.

A study of landscape changes in six local areas closely bordering towns of different sizes and proximity to the city of Copenhagen was carried out in 1984 and 1994 (Ogstrup and Primdahl 1996). In 1994 two additional areas were included. Among the results of the 1994 study it was found that:

– the proportion of full-time farmers has been reduced significantly in most areas since 1984;

- tthe proportion of farms with farm buildings used for non-agricultural purposes increased, the closer the area was to Copenhagen City;
- the livestock density has dropped so dramatically in the 10 years period that dairy cows have almost disappeared in five of the areas, and other types of livestock have been reduced except for sheep and horses;
- planting hedgerows is among the most common landscape changes, besides the general 'urbanization' through more and more non-agricultural functions being located in the urban fringe;
- hobby farmers are playing the most active role in the landscape changes.

Hedgerow plantings within the eight areas are shown in Table 3. It appears that hobby farmers are most active in most areas, whereas full-time farmers have not participated in any plantings in four of the eight areas. This indicates that most of the hedgerows are planted mainly due to non-production motives, with little or no relation to agricultural production.

Table 3. Agricultural areas in the urban fringe of Greater Copenhagen. The length of hedgerows planted, sorted by farmers' occupational status. Planting activity is divided by the total area owned by the respective group of farmers.

Owner's occupation[1]	area 1	area 2	area 3	area 4	area 5	area 6	area 7	area 8
	Metres of hedgerows planted 1984-1994 / 100 ha							
Full-time farmer	0	0	0	224	54	0	1665	11
Part-time farmer[2]	0	-	0	333	442	-	-	0
Hobby farmer	211	3224	260	199	897	312	859	793
Pensioner	0	396	199	0	0	348	248	0
Others	0	0	0	2626	0	0	0	0
All	47	2400	117	370	233	293	819	98
Total area	275	315	807	500	534	461	404	543
Number of farmers in 1994	18	21	31	23	22	22	24	22
	Proportion of full-time farmers (%)							
In 1994	5	9	3	18	32	14	17	27
In 1984[3]	16	17	9	*	52	*	42	20

1. For definition of the farmers' occupational status see note 1 for Table 1.
2. '-': no part-time farmers within the respective area.
3. Area 3 and 6 were not included in the 1984 study.

In summary, the studies showed that the urban–rural fringe of Copenhagen is changing rapidly. Hobby farmers are replacing full-time farmers and agricultural production is changing towards a more extensive and hobby-based type of production. From an environmental point of view (including biodiversity), this may be viewed as a positive development. However, it is not entirely positive that the number of full-time farmers decreases. The professional farming culture may disappear, ending demand for the lease of farmland for production. In the longer terms this may possibly

result in dramatic landscape changes from open farmlands with views and a network of field roads, to a closed tree-covered landscape with few views and limited recreational access – a more 'privatized' and a more wooded landscape than the old agricultural landscape.

Discussion and conclusion

Agricultural landscapes in Denmark are changing in somewhat similar patterns across different regions. These changes are mainly driven by structural changes such as changes in the ownership structure of farm properties. The studies presented indicate that non-production types of landscape decisions are important in recent landscape change processes, but they have also shown that a 'productivist' dimension is still present among farmers and develops parallel to the 'non-productivist' types of change. The changes are part of new multifunctional developments in agricultural landscapes and as such they are related to the new urban–rural relationships, where a growing proportion of people (including a growing number of farm owners) living in agricultural landscapes are urban employees. However, they are also related to changes in the markets, in agricultural policies and in the values and the associated landscape practice of full-time farmers. Similar patterns of change in England have been discussed in a wider agricultural context focusing on the usefulness (and lack of usefulness) of concepts such as 'productivist' as 'post-productivist' (Wilson 2001; Evans, Morris and Winter 2002).

Agricultural policy, first of all the CAP, is the single most important public policy affecting the agricultural landscapes in Europe and this is also the case for two of the Danish examples (A and B). In the fringe of urban areas in Greater Copenhagen, planning policies may be more important, since the development pressure here is massive, and the landscape would therefore be structured completely differently without such regulations. Also nature-conservation policy, forest policy, agro-environmental policy and other 'landscape policies' have been affecting landscape changes. However, there is little doubt that public-policy interventions would have been more effective if the authorities had not seen farmers as mainly producers, generally underestimating the non-productive functions of modern agricultural landscapes. It may also be easier to co-ordinate and integrate the different types and domains of policy interventions, if the overall perspective is more territorial and less agricultural production-oriented, simply because most people living in the landscape, including full-time farmers, have an interest in how their total environment develops.
All this does not imply, of course, that agricultural production will vanish or be reduced to a minor driving force in the landscape change process. In most areas, agriculture will remain important for the total change process, although it will vary considerably from time to time and from region to region. The examples presented reveal a diversity in the problems to be dealt with, when relationship between farmers' landscape management decisions, landscape change and public policies are analysed.

In urban fringe regions agriculture must be protected against 'sub-urbanization' and agricultural marginalization, if the 'rural' side of the boarder should remain rural and in fact if there should remain any distinct urban boarder. The example from Copenhagen clearly showed that agricultural functions (such as livestock production for instance) were disappearing. The English 'Green-Belt Policies', which efficiently have ensured clear boundaries between the urban and the rural area in the most urbanized regions (Elson, Walker and Macdonald 1983), may be a useful solution to

the protection of agricultural landscapes in other urbanized regions of Europe – including the Copenhagen area. However, physical planning policies do not prevent transformations of the agricultural structure and the resulting landscape changes. Development of specific 'landscape policies' to maintain the rural part of the urban–rural fringe may be required in highly urbanized regions.

In intensively farmed regions with favourable farming conditions a general challenge to landscape policies will be to reduce intensity and to enhance the landscape structure from cultural, biological and aesthetical view points. Most European habitats considered of high value are those located in areas with poor agricultural conditions, since most of those originally located in areas with rich soil and favourable climate were removed centuries ago. To what degree such rich natural habitats will be restored (or be 'allowed' to develop over a long time) and other non-productive functions will play a role, will depend on the types of farm owners in the region and on the policies being implemented. The study showed that a number of landscape changes were made in the once more stable landscape. The majority of changes were related to non-production decisions or combinations of non-production and production motives; grant aid schemes and related advisory services were seldom used.

One of the great challenges in such intensively farmed areas is to find the right combination of legislative policies, grant aid schemes and information policies to ensure that the positive changes are spatially coordinated and that principles such as the 'polluter-pays principle' and 'best available technology principle' are complied with. A more comprehensive and landscape-oriented policy approach may be a solution to this problem.

In the regions with unfavourable agricultural conditions, the agricultural landscapes are changing in the direction of extensification. The agricultural landscapes may change dramatically, simply because agriculture may not survive in such areas, if prices of the main product continue to drop relative to their cost of production. In some regions such changes may be considered desirable, because extensification, such as afforestation, may improve landscape functions related to residence, recreation and wildlife, and may possibly also increase the chances that people with non-faming incomes move to the areas. The challenge is to design policy solutions ensuring that all the individual changes are co-ordinated and resulting in coherent landscape enhancements. In other regions extensification may be considered disadvantageous, since it may result in the loss of important landscape values associated with continuous farming. Farmers may be offered different types of subsidy schemes both to avoid the abandonment of agriculture and to ensure that society receives value for money in terms of landscape protection and management.

However, agricultural landscapes have always been dynamic and there are no reasons to believe that this will fundamentally be changed. Protection against changes everywhere is hardly desirable and it seems unlikely that farmers, in the long run, will be able to argue for subsidies at the level they receive today. Priority must be given to the services that farmers will be paid for, and to the specific areas where they will be paid for them. Outside such priority areas agricultural landscapes will remain highly dynamic and farmers' landscape decisions will be a key to understand the changing processes. Many of these decisions are poorly known at present, but it is quite likely that they are undergoing significant changes in motives and objectives. Knowing more about the nature of these current change processes will, without doubt, be useful for improving policy design and implementation.

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