

4

State of Denmark's nature and environment

Many different interests compete for use of the Danish countryside. The built-up areas and the road network have been expanded, and pressure on nature from arable land has increased at the cost of the landscape and biodiversity. It is this development that has increased the need to plan the use of the countryside and to protect and re-establish natural ecosystems.

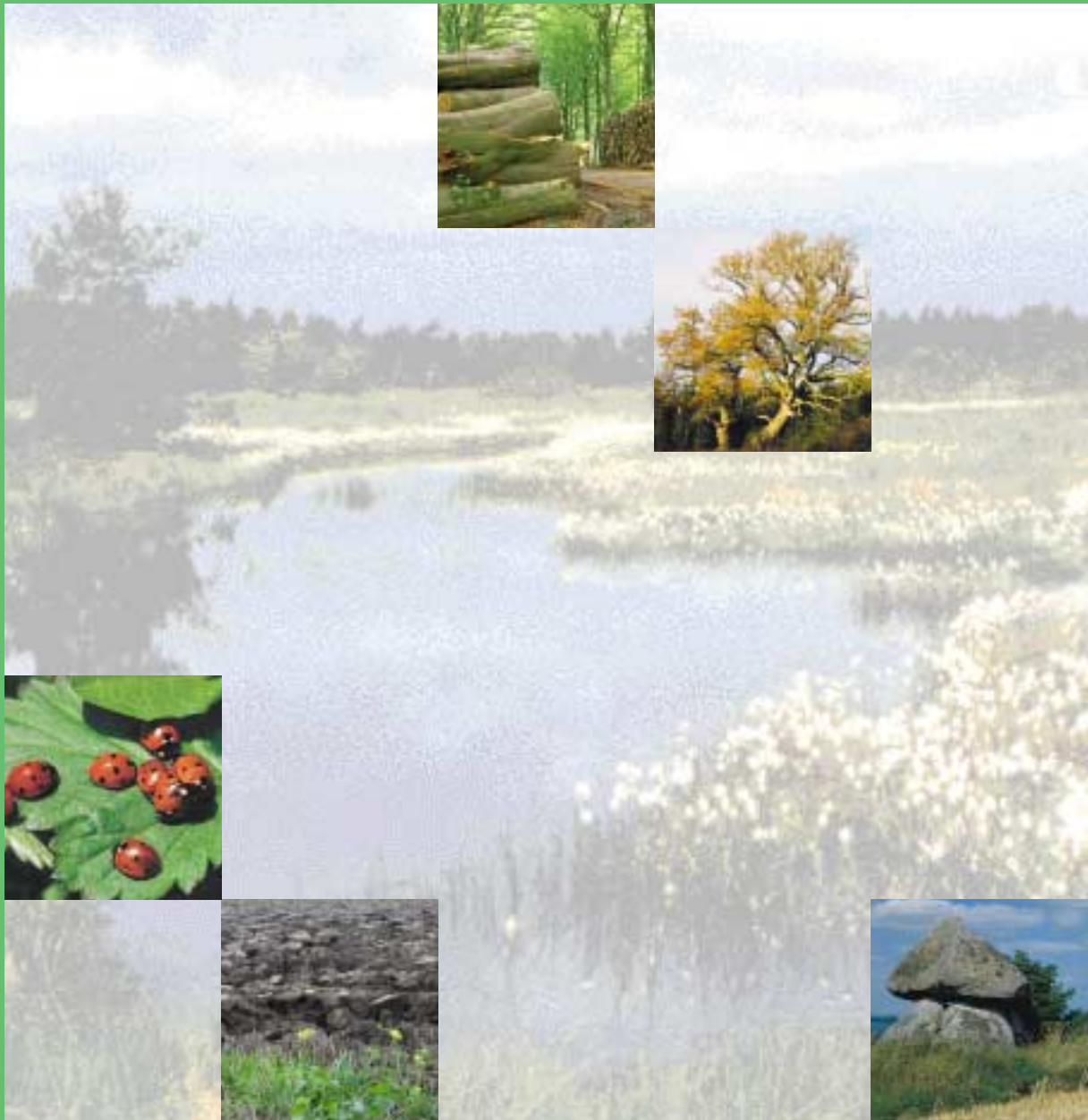






Photo: CDanmark

4.1 Introduction

Denmark is one of the countries in the world where land use is most intensive. Over the past century, radical changes have taken place: The built-up area has been considerably expanded, and land use for roads, farmland and raw materials extraction has increased. These changes in land use have taken place at the expense of Denmark's landscape, natural ecosystems and cultural environment.

Many natural ecosystems and landscapes have also radically changed character due to the increasing intensification of agriculture. Among other things, this has resulted in drainage of wetlands, land reclamation, channelization of watercourses and conversion of extensively grazed fields to cultivated fields. Land is still changing in character today. For example, forests are being planted in many places to provide recreational possibilities for society and to protect the groundwater used for the drinking water supply. Fields are being merged into larger units, and farming is still being intensified with the result that many valuable small biotopes have disap-

peared from the countryside. The situation for the small biotopes seems to have stabilized, though. The landscape is also changing character due to continued development of the infrastructure, e.g. major roads, electricity pylons, wind turbines, etc.

Compared to the early 1950s, the countryside has also become more polluted. The increased use of commercial fertilizer and pesticides, the increased atmospheric deposition of heavy metals, increased nutrient leaching and increasing waste production have enhanced pressure on the arable land. Over the past 10–15 years, however, atmospheric deposition and the use of pesticides and commercial fertilizer have decreased.

There are many interests competing for the right to use the Danish countryside, and much indicates that competition for the scarce land resources will intensify in the coming years due to the conflicting wishes to use the landscape and nature for different purposes. It is therefore necessary to prioritize land use to satisfy as many purposes and interests as possible while concomitantly maintaining landscape integrity. Consideration must be given to the

landscapes, to nature's ecological state and function, to the recreational value of the landscape and to the state of the cultural environments.

This prioritization and administration task is accomplished through such means as spatial planning, administration of the Protection of Nature Act and the sector legislation pertaining to the countryside, through designation of protected areas pursuant to international commitments and through compliance with international conventions and directives. The results of the continuous monitoring of the state of nature and the environment indicate the overall trend as well as the successfulness of the measures implemented.



Photo: NER/Anne Bodil Hald

This chapter therefore focuses on describing the interaction between nature, the landscape and society. The main societal pressures and trends include the generally increasing competition for land, the accumulated effects of years of changed land use (urbanization, traffic, and agriculture), and the more intensive exploitation of the soil as a resource (agriculture and forestry).

Finally, the chapter describes the consequences of using the soil as a recipient of waste, atmospheric deposition, heavy metals and other hazardous substances (pesticides).

The sectors that directly affect the quality and state of nature, the landscape and the cultural environment are agriculture and forestry, urban development, tourism and outdoor activities, as well as the transport and

energy sector. Nature and environmental management can be considered as sectors where the regulatory aim is to prevent or ameliorate the negative effects on nature and the environment of other sectors. The pressures, state and regulatory efforts are described for landscapes, natural ecosystem types, cultural environments, habitats, biotopes, species, and soil and water.



Photo: CDanmark

4.2 Land use in Denmark

4.2.1 State and trends

In a European context, Denmark is a distinctly agricultural country. Agriculture presently occupies approx. 67% of the land area, and Denmark is thus the European country with the greatest per-

centage of arable land. Around 1920, there were just over 32,000 km² of arable land in Denmark, corresponding to 74% of the area of the country.

The percentage of the total area occupied by built-up areas, roads and other paved areas is greatest in the eastern part of Denmark, in Greater Copenha-

gen and northern Zealand, and least in western Jutland, in Ringkøbing and Sønderjylland counties, where agriculture dominates (Figure 4.2.1).

Comparison of the percentage of arable land with the percentage of other land use categories back to the 1920s

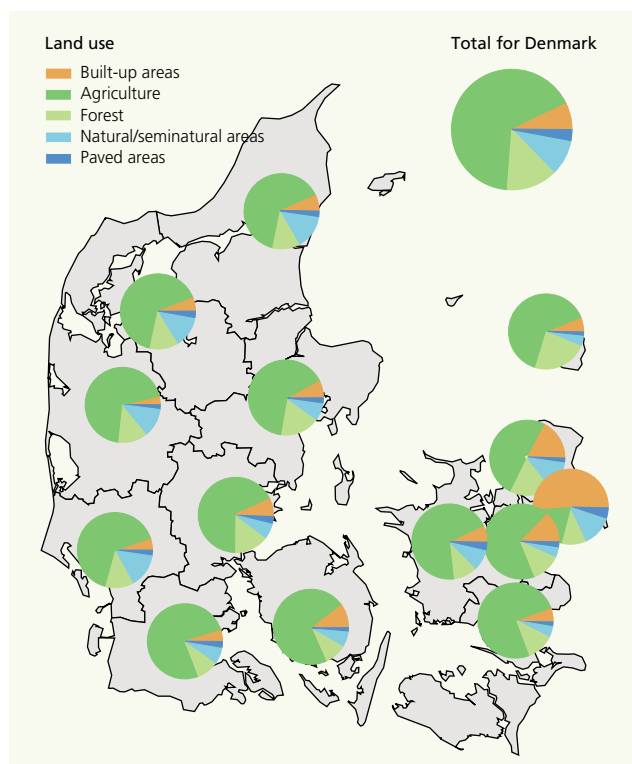


Figure 4.2.1

Relative distribution of land use in each county and in Denmark as a whole apportioned by main categories. "Built-up areas" encompasses all urban settlements as well as buildings in rural areas. "Agriculture" solely encompasses land cultivated in rotation. "Natural/seminatural areas" encompasses dry grasslands, heaths, sand/dunes, salt marshes, meadows, bogs and other wetlands, incl. lakes and watercourses. "Paved areas" includes roads, motorways, railways, bridges and dams. (Source: National Environmental Research Institute, AIS 2000).

reveals that the area of arable land has remained relatively stable (Figure 4.2.2). In contrast, the total urban area has increased and the area of uncultivated countryside has decreased. Over an approx. 100-year period (1896–1982), the built-up area has increased from 2% to 10% of the total area. The area occupied by streets, roads, railways and other paved areas has increased from approx. 1% to 5%, and the total area of forest and plantations has almost doubled.

Agriculture

The amount of conventionally farmed land has fallen markedly over the past 15 years, from approx. 2.82 million ha in 1986 to 2.65 million ha in 2000, a reduction of 172,000 ha. Most of this has been reassigned to urban development and recreational purposes. A further approx. 190,000 ha have been set aside under the EU set-aside scheme and hence can be deducted from the total area of cultivated land. Moreover, a further approx. 158,000 ha of the area under crop rotation are no longer farmed conventionally, but are instead cultivated organically by approx. 3,500 organic holdings (see Section 1.2.1).

An overall trend since the 1960s is the increasing percentage of land used for cereals production and the decline in extensively used land with permanent grass outside crop rotation, the so-called semicultivated areas that are rarely or never converted to other agricultural uses (1960: 341,000 ha, 2000: 166,000 ha). These areas include salt meadows, dry grasslands, meadows, etc. Expressed as a percentage of the total agricultural area, these semicultivated areas have fallen from 11.4% in 1960 to 6.3% in 1999, thus reflecting the intensification of agriculture. Structural development of the sector since the 1950s has also resulted in a reduction in the number of agricultural hold-

ings and growth in average farm size. Thus while the average holding size was approx. 29 ha in 1982, it is presently 46 ha (see Section 1.2.1). Cattle and pig herds are generally being concentrated in large holdings with a large amount of land. Major holdings with less variation in crops have moved the intensively cultivated agricultural landscape in the direction of increasing functional separation of the landscape with a more clear cut division between cultivated and uncultivated land. This development is expected to continue, not just at the national level, but increasingly also at the international level, where EU agricultural policy in particular will play a decisive role in development of the agricultural sector. This development is naturally sensitive to agricultural policy initiatives, though.

Land use by the agricultural sector will also slowly change in accordance with a number of nature and environmental policy measures such as the 1998 Action Plan on the Aquatic Environment II. Of the measures encompassed by this plan, afforestation of former farmland, the establishment of wetlands and restrictions on the use of environmentally sensitive areas (ESAs) in particular will change land use by the agricultural sector (see Section 3.8).

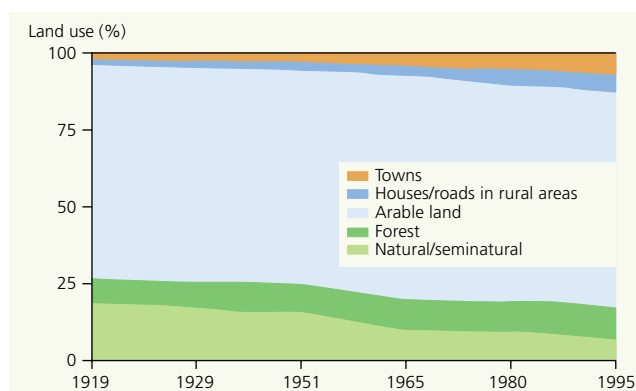


Figure 4.2.2
Development in land use in Denmark over the 20th century apportioned by main categories. (Source: Natur og Miljø 2000. Udvalgte indikatorer).

Forestry

In 1950, around 8.5% of the country was forest. In the subsequent 40-year period up to 1999, the area of forest gradually increased to 10% and is presently approx. 11.5% or 436,000 ha as compared with 417,000 ha in 1990. Just under half of the increase over the past 10 years is attributable to cultivation of ornamental greenery and Christmas trees (see Section 1.5.1). In most of the country, the development has been characterized by stagnation. The growth in forest area has mainly taken place in Jutland. Until the mid 1970s, growth there was mainly accounted for by conifers. Conifer acreage also increased on Zealand and the island part of Denmark during the same period. In both cases, the growth has occurred at the expense of broad-leaf forest. From 1976 until the present, the decline in broadleaf acreage has been superseded by an increase in both Jutland and on the island part of Denmark.

In 1989, the Danish Parliament decided that the area of forest in Denmark should be doubled during the course of the next 80–100 years. In order to achieve this goal, 5,000 ha of new forest have to be planted each year. However, afforestation amounted to an average of only 1,800 ha per year during the 1990s and 3,000 ha in 2001 (Figure 4.2.3).

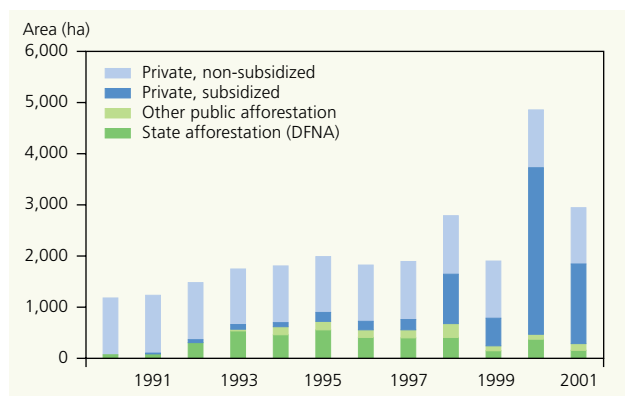


Figure 4.2.3
Development in afforestation in Denmark over the period 1989–2001 apportioned by private and public land. (Source: Natur og Miljø, 2001).

Urban development

The percentage of Denmark used for urban purposes has been growing since the second half of the 19th century, but especially during the second half of the 20th century. The urban area has tripled or quadrupled over the past 50 years. Since 1974, an area the size of Bornholm has been incorporated in the urban zone. Although the percentage of the country accounted for by the urban zone is still modest (6%), there are considerable regional differences at county level in the relative distribution between urban and rural zones (Figure 4.2.1). In Greater Copenhagen, for example, the urban zone accounts for 23% of the total area. The corresponding figure for Copenhagen County is 46%.

The tremendous urban development in Greater Copenhagen and the corresponding decline in other land use categories – primarily agriculture – is illustrated in Figure 4.2.4. Note how the first half of the period – up to 1980 – was characterized by slow development of the so-called “finger plan”, whereas the second half of the period was characterized by gradual urban development both within and between the “fingers”. The increasing urbanization has focused attention on municipal spatial planning of a number of important functions such as land use for housing, businesses and services.



Photo: CDanmark

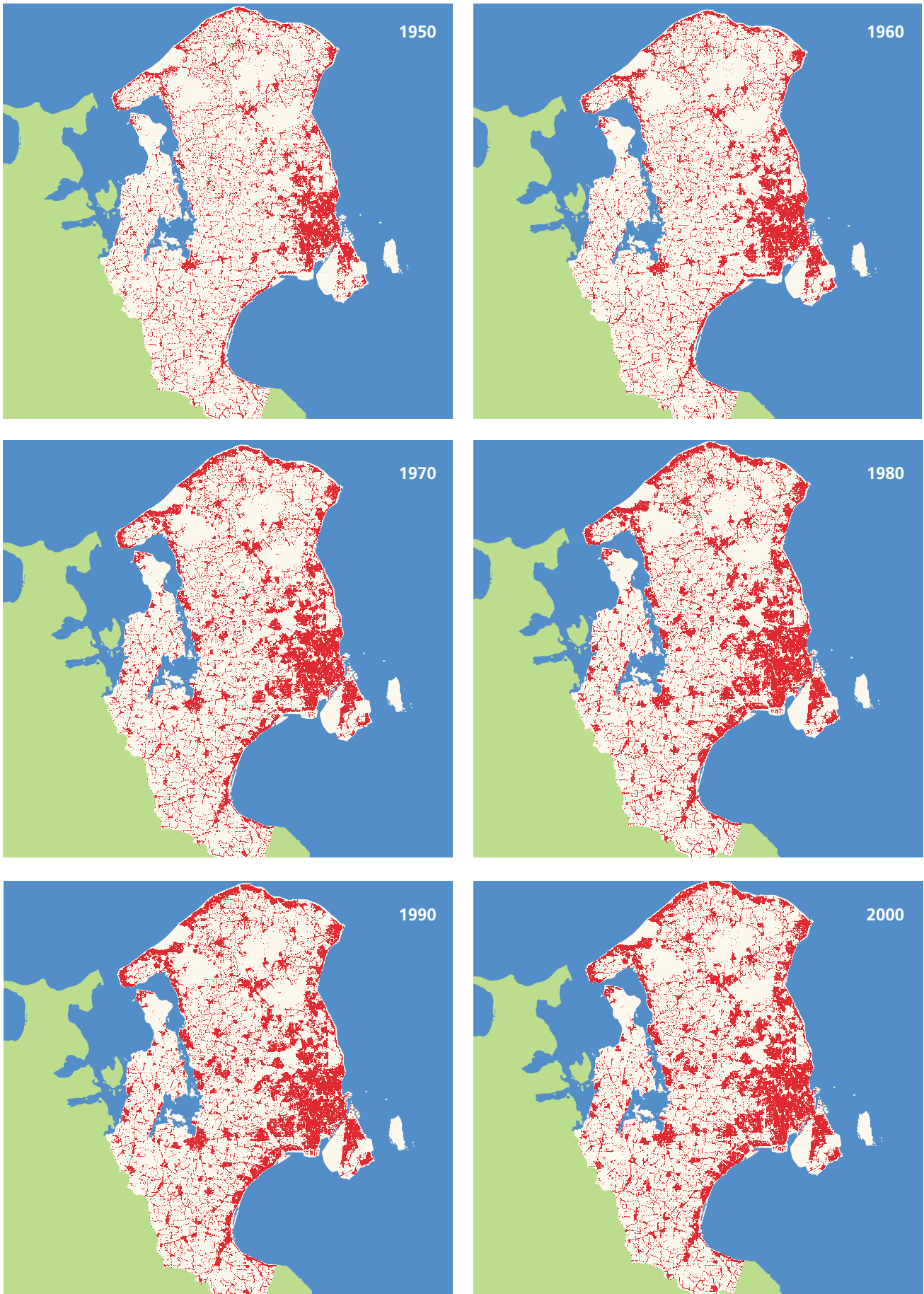


Figure 4.2.4 Urban development in Greater Copenhagen over the period 1950–2000 illustrated by the development in the built-up area. (Source: Hansen, H. S., 2001).

The increased use of land in the countryside for infrastructure, etc. has also aroused attention:

- The length of overhead high-voltage lines (132-400 kV) has increased from 4,915 km in 1989 to 5,403 km in 1998. The increase has occurred despite the fact that some cables have been laid in the ground.
- During the 1990s, the Danish motorway and main road network grew by over 300 km and reached a total length of 1,285 km in 2000.
- In 1989, 2,332 wind turbines had been erected in Denmark. By 1999, the number had reached 5,620 (Figure 4.2.5). Those erected in recent years have mainly been large wind turbines over 55 m tall. In 1999, wind turbine capacity totalled 1,771 MW, which is 23% more than the preceding year and more than five-fold greater than in 1999 (Figure 4.2.5). Around 79% of the wind turbines are located in western Denmark, especially in Nordjylland County, Viborg County and Ringkøbing County. The larger number of wind turbines and their greater height have necessitated the tightening of wind turbine planning requirements in recent years (see Section 1.3.1).

Development in land use over the coming 25 years – a future scenario

The potential development in land use has been analysed in a scenario for land use in Denmark in 2025. The analysis is based on the political signals from the past decade in the form of policy goals, strategies, action plans and national spatial planning policy. The analysis confirms that demands for land are increasing, and that the agricultural sector will have to relinquish considerable land. At the same time, large areas of conventionally farmed land will be converted to other agricultural uses, e.g. permanent grass (meadows, dry grasslands, etc.) and organic farming, in connection with efforts to safeguard the aquatic environment. If the current political goals are pursued unchanged, the forest area in Denmark will double over the next 100 years. An even rate of increase is expected throughout the period such that the forest area will have increased 30% in 2025, corresponding to an increase of approx. 140,000 ha forest.

The same scenario also assumes that nature restoration efforts will be accorded high priority. The growth in agri-environmental measures will be achieved through expansion of the organically farmed area and by conversion of land under crop rotation to permanent grass, for example in river valleys and peat soil areas. An increase of 50,000 ha is thus expected in the total area of natural ecosystems and small biotopes in the landscape, e.g. heaths,

dunes, bogs, lakes, watercourses, hedgerows and ditches.

Growth in land use for urban settlements and roads is estimated to total 15% up to the year 2025, corresponding to approx. 40,000 ha. This is largely expected to take place at the expense of arable land under crop rotation, which is expected to fall by 15% during the period. The area of land cultivated outside crop rotation, which has hitherto been falling, is expected to increase by 30% during the period, among other reasons due to conversion to permanent grass. This potential switch in land use indicates a certain degree of extensification of agriculture, which moreover is expected to undergo considerable change during the period. The number of holdings farmed on a full-time basis will probably be more than halved. This will lead to structural changes in the countryside with fewer, larger holdings with large fields near the farmhouses and fewer field tracks, footpaths, etc.

Much indicates that the competition for the scarce land resource will intensify in the coming years due to conflicting desires to use the landscape for different purposes. Competition for land will particularly affect agriculture-dominated areas with a high livestock density as these areas can coincide with areas of important natural or environmental value that are either protected or being considered for protection. This competition for land might make it difficult to attain several of the national goals.

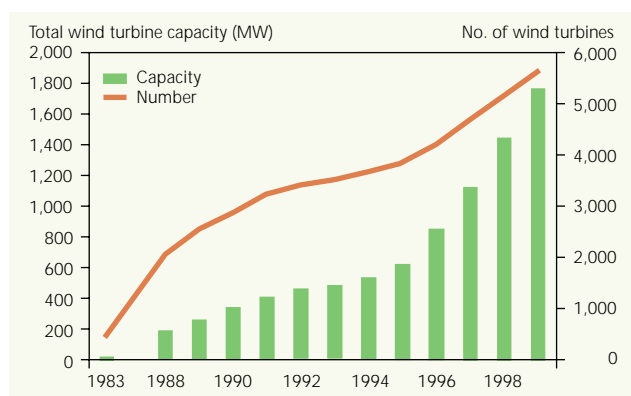


Figure 4.2.5
Development in the number of wind turbines over the period 1983–1999 together with development in the total capacity expressed in MW.
(Source: Natur og Miljø, 2000, Udvalgte indikatorer).



4.2.2 Land under pressure – the changing landscape and cultural environment

Land use, the landscape and the cultural environment – objectives and quality terms

Since the end of the last Ice Age, i.e. over a period of 12,000 years ranging from the Stone Age to the present time, man has worked with and exploited nature in accordance with his technical competence. The landscape is an expression of the interplay between society and nature through the ages, and comprises an entity consisting of both natural and culturally modified attributes. In some areas the intensity of anthropogenic changes is considerable, in other areas the natural features dominate, for example special types of landscape, coastal areas or wetlands. All in all, though, man's activities and land use have become the dominant factors: Forests have been cleared and converted to arable land, low-lying areas have been drained, urban areas have expanded, new forest has been planted, and infrastructure draws new lines across the landscape. There is virtually no unspoilt nature in Denmark, and the Danish landscape can therefore be characterized as a cultural landscape. Man's exploitation of the landscape resource over the years has also created and affected many forms of cultural environment that we now consider to be valuable traces of our past. The limited land resource available necessitates effective planning and administration of land use.

In Denmark, land use and administration are based on the following overall objectives:

- To limit land consumption for urban development
- To limit urban sprawl
- To keep the countryside free of unwanted and uncontrolled settlements and installations
- To maintain a clear division between town and country
- To promote multifunctional land use, taking several interests into consideration in the same area of land
- To preserve and protect irreplaceable landscape assets.

The designation of new urban development zones is to be curtailed in order to save land resources to the benefit of agriculture and nature. Urban sprawl is to be avoided in order to maintain a clear division between town and country. Scattered dwellings in the open countryside increase expenses for infrastructure and make it difficult to create the foundation for public transport services. At the same time, they place pressure on landscape assets that we want to preserve, not least the unspoilt landscapes, natural ecosystems and valuable cultural environments.

Denmark is subdivided into urban zones, rural zones and summer cottage districts, which together comprise the total area of the country. Urban development can only take place in those areas where the Regional, Municipal and Local Plans permit land to be

transferred from the rural zone to the urban zone. According to the Town and Country Planning Act, the permission of the authorities is required before land in the rural zone can be parcelled out, buildings constructed or land use changed.

In recent years, the term "multifunctional land use" has gained popularity as the new ideal and principle for land management. The idea is that it should be possible to use arable land and woodland for purposes other than production. Use of the land also serves social and ecological purposes: Recreational purposes and protection of the drinking water supply, nature and the cultural environment. Attempts are being made to meet the various land use interests via the multifunctional landscape.

The landscape has been and always will be changed in step with societal development. Over the past decades, however, this has proceeded at a pace and with consequences far exceeding anything previously seen. The landscape is in danger of losing its diversity and regional characteristics, and hence its recreational value. In order to facilitate landscape administration the country was divided into three different landscape zones in 1972. Zone 1 encompasses the countryside areas of greatest interest, which are characterized by very extraordinary or varied landscapes. Zone 2 encompasses countryside areas of great interest, but with less variation and richness than zone 1. Zone 3 encompasses the remainder of the countryside. Apart from serving as the basis for landscape management, the zonation has also served as the basis for nature conservation and regional planning. The Regional Plans thus contain direct or indirect goals and guidelines for landscape protection. The regional planning also encompasses the designation of unspoilt landscapes and guidelines for their use.

An important element in landscape administration is the assessment of landscape vulnerability, which relates to the value of the landscape in question and its special characteristics (the landscape character to which the landscape's value is attributable). This can be special geological/topographical conditions, the landscape's scale and nature content, cultural modifications (including the landscape's pattern of natural ecosystems), special building structures, historical structures and the scenery. The degree of authenticity, the aesthetic conditions and their enjoyment value are other important elements of landscape assessments.

The cultural environment

The term "cultural environment" introduced a new, more dynamic understanding of the cultural traces than that associated with traditional administration of ancient monuments and buildings worthy of preser-

vation. The term expresses a shift in value from protection in the form of preservation orders on individual elements (e.g. burial mounds) towards dynamic preservation of areas where preservation is seen in relation to the landscape and societal development. Thus a cultural environment is not just something that already exists, but also the physical environment that will be formed in the future. Moreover, an existing cultural environment can be supplemented with new structures. The challenge is to plan for this while concomitantly taking the most valuable elements into account.

The cultural environment is a broad term for the historical moulding of the landscape. A definition of a cultural environment is "a geographically restricted area whose appearance reflects important features of societal development". Preservation of a cultural environment consequently involves many different interests, e.g. urban development, construction work and agriculture. Cultural environment interests are therefore met through spatial planning and the planning activities of the individual commercial sectors.

In the Regional Plans the valuable cultural environments are designated on the basis of an analysis of the areas' historical features and prioritization criteria such as:

- The narrative value associated with the cultural environments. Special ways of life are illustrated, for example at a specific point in time, and thereby become meaningful when placed in a temporal context.
- The historical source value associated with the elements and relationships of the cultural environment. This comprises a source for our knowledge of the past and hence is of scientific interest.
- The experience value associated with cultural environments that are particularly expressive, and where the culture-historical entirety and relationships can be immediately seen and experienced.



Photo: CDanmark

Our values change

Use of the land resources develops in step with societal development. The latter has led to greater prosperity and welfare, but has also created new problems for nature and the environment. Previously, land use was primarily determined by exploitation of the land for production purposes – especially for agricultural purposes. Today it has become increasingly necessary to also take into account protection of nature as well as the environmental, cultural environment and landscape assets associated with the recreational use of nature and the landscapes.

The national spatial planning policy – and hence land use values and the basis for county and municipal spatial planning – is chiefly expressed in the National Spatial Planning Report and in the state guidelines for the four-year revision of the Regional Plans. The National Spatial Planning Report thus contains the national spatial planning objectives and proposals for measures that can contribute to implementation of the objectives and promote the regional development work. The report is typically followed up by a number of projects in collaboration with the county and municipal authorities and others to test the new planning ideas. The state guidelines follow up on the spatial planning development work, and the state's requirements are adapted to societal development and new challenges.

Land use conflicts

The competition for land in the open countryside is considerable because of the many interests that meet there, including nature, environmental and landscape interests, as well as outdoor, agricultural and special

protection interests, e.g. associated with valuable water abstraction areas, natural ecosystems or bird species.

The conflicts of interest between for example agricultural production and nature and environmental interests have become increasingly evident. The land resource is limited, and the many interests increase the need for enhanced integration of protection interests in land use. Environmentally sensitive areas (ESAs) and valuable water abstraction areas can have a limiting effect on agricultural production, while afforestation and urban development completely preclude future agricultural production (Figure 4.2.6).

The next few pages present four examples of land use conflicts and describe the various interests. The challenge is to refrain from incorporating new land for urban purposes and locating certain installations in the open countryside. New areas for urban purposes must be assessed in relation to the developmental needs of the municipality in question. Reservation of land for commercial purposes in the open countryside can result in disconnected built-up areas and erase the clear division between town and country (Box 4.2.1). In line with the establishment of more installations in the open countryside, especially in coastal areas, our perception of the landscape becomes disturbed. Moreover, the nuisance posed to neighbours increases, for example noise and shadow from wind turbines (Box 4.2.2).

One of the most important challenges concerning the open countryside is to view the overall societal interests in land use and to ensure greater interaction between nature, environment, landscape, agricultural production and settlement potential of the open countryside. In recent years, considerable attention has focused on protection of the groundwater, especially the drinking water reserves. The requirements concerning reduction of nitrogen loss to the aquatic environment from agricultural sources will be tightened in 2002 pursuant to Action Plan on the Aquatic Environment II (Box 4.2.3). The desire for more goal-oriented protection of the groundwater can be combined with afforestation. New forests can contribute to protection of the groundwater and improve the outdoor recreational possibilities in the vicinity of the urban societies. This entails multifunctional land use that attempts to unite different land use interests (Box 4.2.4).

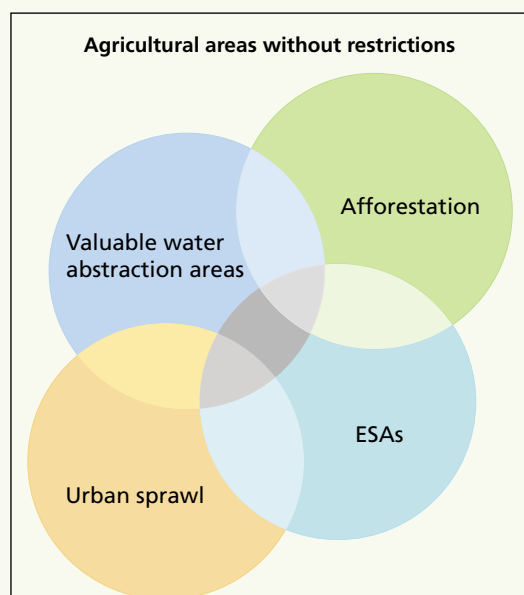


Figure 4.2.6
Schematic representation of the main conflicts of interest encroaching on agricultural land. ESA is an abbreviation for environmentally sensitive area. (Source: Danish Forest and Landscape Research Institute, 1998).

Large areas designated for business purposes in the Municipal Plans

Commercial development is moving in the direction of a knowledge society, and the transition from industry to services will reduce the need for traditional commercial districts for manufacturing enterprises. At the same time, the land requirements of the enterprises are changing. For example, locations near the town centres in architecturally exciting buildings are now preferred to newly established commercial districts on the outskirts of the towns. Building density is greater for service enterprises than for industrial enterprises. It is estimated that there will be at least five times as many jobs per hectare in the service enterprises as in the industrial enterprises. The possibilities for reducing land use for urban enterprises and hence for saving on scarce land resources thus seem to be good. Despite these tendencies, the Municipalities have reserved large areas of land for commercial development. Large planned commercial districts in the open countryside often lie unused, and the commercial districts that have been developed are often dissociated from the towns. This form of urban development is in conflict with the planning

principle of a clear demarcation between town and countryside.

The area of land designated for commercial use, but which remains unused, is almost as large as the commercial area already in use (cf. Section 5.4). The Municipal Plans operate with a time horizon of 12 years, whereas the amount of land designated for commercial purposes is sufficient for 45 years if one extrapolates from land use in recent years. This places restraints on future land use. The designation of so much land for commercial development will make it difficult to meet other important needs in the suburban landscape such as recreation and nature. The land designated for development by the Municipalities often lies in the rural zone where it can continue to be used for agricultural purposes. Alternatively, these rural areas could be used for periurban afforestation to help protect the groundwater and improve the recreational possibilities. Protection of the drinking water reserves has high priority and is difficult or impossible to combine with development of the same land for commercial purposes.

Box 4.2.1

New land for urban purposes has to be assessed in relation to developmental needs.



Photo: Highlight

Land use interests in the coastal areas

Box 4.2.2

Landscape and nature interests might conflict with the desire to live by the coast.

The coastal areas are subject to special national protection interests in order to preserve their nature and landscape value as whole stretches of open coast free of urban growth, technical installations and holiday and recreational facilities. These interests compete with the wish to establish housing areas in charming natural surroundings or to locate tourist facilities and a number of technical installations in coastal areas.

Around half of the coast is built up. On the land side, the coastal zones are regulated via a 3-km wide coastal protection zone that has to be kept free of installations and facilities, and a 300-m beach protection zone that must be preserved in its present condition and use. No corresponding planning regulations apply

to the seaward side of the coastal zone. An example of competing land use interests is the location of wind turbines on land. It is national policy to increase the percentage of the electricity supply accounted for by wind turbines. From the energy efficiency point of view, land-based wind turbines should be located in the coastal zone, where there is most wind. At the same time, however, we want to keep the coastal zone free of technical installations for aesthetic reasons. Nature and landscape considerations and neighbour interests in the area therefore need to be taken carefully into account. In the future, the wind turbines will mainly be established offshore, far from the coast. On land, the large number of small wind turbines will gradually be replaced by a smaller number of larger,

Box 4.2.3

Expansion of the agricultural sector might come into conflict with commercial and recreational interests.

On the island of Als, competition for land use is considerable. Livestock density throughout Als exceeds the requirements that will apply from 2002. Agriculture needs considerable amounts of land for spreading manure. This creates conflict in relation to other land uses such as urban development. A single golf course on Als has reduced the area of land available for spreading manure so much that this has caused considerable problems. In addition, the majority of Als is designated as a particularly valuable water abstraction area. In collaboration with the four Municipalities on Als, Sønderjylland County therefore investigated the land use situation in 1996.

The amount of land actually required on Als for the application of manure was approx. 17,000 ha, while the amount of land available was estimated to be 21,100 ha, corresponding to 80% utilization of the land available for applying manure. Thus only approx. 4,000 ha remain that could be designated for other land uses in the municipal planning.

Up to the year 2008, the area of land required for spreading manure is expected to increase to 19,775 ha due to an expected increase in the size of the pig herds on the livestock holdings. At the same time, it is expected that the area available for spreading manure will be reduced to approx. 20,500 ha in 2008, resulting in a utilization rate of 96%. This decrease is attributable to the Municipalities' expectation that approx. 500 ha of agricultural land will be reassigned from agricultural purposes to housing, business or recreational developments.

It is hardly likely that such a high utilization rate (80–96%) will be achievable in practice, however, thus underlining the pressure on land availability. For one thing, there are small farms and hobby holdings that do not wish to receive manure from other livestock holdings. For another, not all of the available land receives the maximum permitted amount of manure per ha. In practice, therefore, only a small amount of land remains that could be reassigned from agricultural purposes to other uses such as urban development.

Furthermore, the 1996 study does not take fully into account the more stringent livestock density requirements introduced pursuant to Action Plan on the Aquatic Environment II. Among other things, the harmony requirement for pig holdings is to be tightened from 1.7 to 1.4 livestock units per ha in 2002 (*Figures 4.2.7 and 4.2.8*). This example shows that in areas with many livestock holdings there is considerable pressure to use the land for spreading manure. This restricts the possibilities for all other uses of the land.



Photo: Highlight

more effective wind turbines. The landscape can thus be improved by planning since having fewer wind turbines that are more uniform in appearance and located in clearly delimited wind turbine clusters ensures a more aesthetically pleasing landscape.



Photo: cDanmark

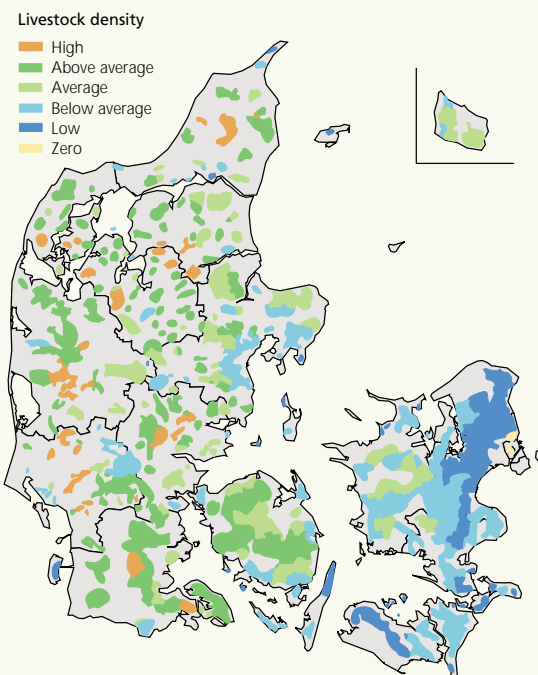


Figure 4.2.7
In 1997, all Danish Counties identified so-called "Particularly valuable water abstraction areas" where the drinking water resource is to be protected. These areas are often located on good agricultural soils, and the livestock density on many of them is high.
(Source: Danish Forest and Landscape Research Institute, 2001).

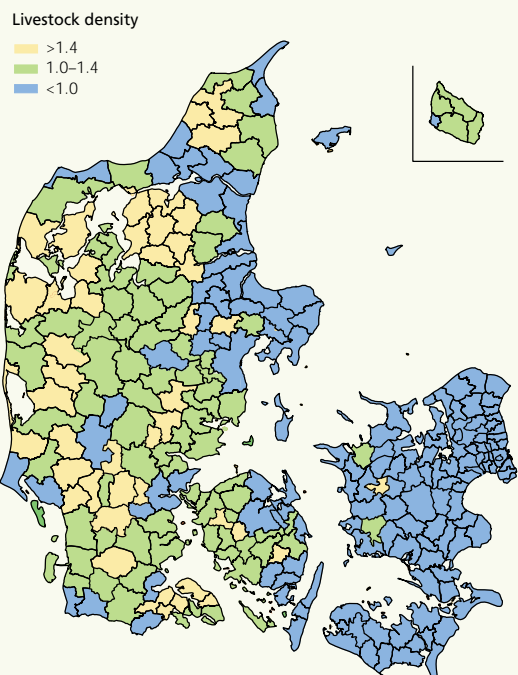


Figure 4.2.8
Livestock density at municipal level shown as the number of livestock units (LU) per ha arable land. In 2002, the harmony requirements will be tightened to a maximum of 1.4 LU/ha for pig holdings, 1.7 LU/ha for cattle holdings and 1.4 LU/ha for other holdings. The figure encompasses all livestock species and all the arable land within each municipality irrespective of whether the land is actually used for spreading manure.
(Source: Danish Institute for Agricultural Sciences, 2001).

Protection of the drinking water resource at Drastrup in Aalborg Municipality

Box 4.2.4

New forests can help protect the ground-water.

Around 1/3 of the drinking water for the city of Aalborg is abstracted from the aquifers near the village of Drastrup in Aalborg municipality. In the area in question there are a number of gravel pits, livestock and crop holdings, Christmas tree plantations, meadows, etc. Due to the character of the area and its proximity to Aalborg, recreational use of it is considerable. The question is whether the various land use interests in the area can be united through dialogue and planning, for example by using the land for protection of the drinking water resource while concomitantly allowing recreational uses. When present-day land uses are incompatible with protection of the drinking water resources, the planning task is to identify alternative uses of the land, e.g. conversion to more environment-friendly farming practices. Since 1986, Aalborg Municipality has been working in cooperation with Nordjylland County and a number of other actors on an integrated planning project at Drastrup aimed at ensuring the drinking water supply for Aalborg municipality in combination with concomitant urban afforestation.

The project, which is based on a supplement to the Municipal Plan outlining a land use plan for the area, includes extensivization of agricultural land use in the area through voluntary agreements, land purchase and resale with provisions as to

future land use, closure and restoration of gravel pits, state afforestation, land redistribution, etc. (Table 4.2.1). The interaction between the use of land redistribution and an active public planning policy aimed at ensuring groundwater protection, afforestation for recreational purposes, environmentally sound agriculture, etc. has proven decisive. Among other things, this has resulted in new forests, changed cultivational practice and recreational footpaths with access to scenic views of Aalborg and the Limfjord landscape (Figure 4.2.9).

The success in enhancing protection of the drinking water resource at Drastrup is attributable to the fact that the efforts have not solely focused on groundwater protection, but rather on diversified land use in the area with a mosaic of forest, pastures, footpaths, scenic views, etc. The Drastrup example shows that it is possible to promote multifunctional land use in order to protect the drinking water reserves and promote the recreational potential near towns. It also shows that implementation of multifunctional land use is a very prolonged process, however, and that it is therefore necessary to comprehend how the various planning tools work, and whether they need to be improved.

Table 4.2.1

Land use and ownership at Drastrup – before and after implementation of the plan.

	Land use (%)	
	Before	After
Meadow	6	5
Wet meadow	1	1
Permanent grass	14	14
Agriculture	51	30
Conifer forest	15	35
Broadleaf forest	13	15

	Ownership (%)	
	Before	After
Publicly owned	17	47
Privately owned, with declaration	83	50
Privately owned, without declar.	0	3



Figure 4.2.9

Land use plan for Drastrup near Aalborg, where the municipal authorities have utilized planning, support schemes, land redistribution and negotiation over the past 15 years in an attempt to protect the drinking water resources and develop the recreational potential of the area through afforestation, establishment of footpaths, etc. on the outskirts of the town.

The Drastrup project is a good example of versatile land use, but also demonstrates the difficulties of achieving unified solutions.

(Source: Aalborg Municipality).

The impact of land use on the landscape and cultural environment

Denmark is a small country, and the countryside is shrinking and becoming divided because the towns are growing, and new forms of technical installations are arising.

This development is problematic in cases where urban development does not keep clear of the special features of the landscape or is not adapted to the topography such that the location and form of the settlements are out of character with the landscape. A further potential problem is the establishment of new buildings in landscapes or urban areas that comprise valuable cultural environments without taking into account their overall historical character or the value of the individual historical elements. Growth in the total urban area can therefore pose threats to the landscape and the cultural environment.

By way of example, groups of family houses or hobby farms around villages considered worthy of preservation can easily erase the culture-historical and landscape assets. The village's growth pattern and relation to nature are disrupted, and the narrative value of the cultural landscape is diminished. Other cultural environments are threatened by the desire to change the use of areas where the original use is no longer economically sustainable. For example, many of the functions associated with the quality of our coastal environments are under pressure. Just think of the small fishing hamlets with their modest facilities for processing the catch, and the ferry landings and small boat yards.

The major road systems can disturb our enjoyment of the Danish cultural landscape. This is partly attributable to their large size, which affects our perception of the proportions in the cultural landscape and reduces the monumentality that often characterizes the location of manor houses, churches, burial mounds and alleys in the landscape, and partly due to the fact that the systems often cut through important culture-historical and landscape entities and form barriers in the landscape.

Denmark has experienced a marked increase in both the number and size of wind turbines. The largest wind turbines can appear very dominating in the Danish landscape. For example, their large size renders wind turbines visible over great distances. A 90-m tall wind turbine can normally be seen above all other elements in the landscape at a distance of 2 km. It is not until a distance of 10 km that the wind turbine starts to blend into the ordinary landscape with hedgerows and settlements. Thus wind turbines should not be placed in valuable landscapes or landscapes with a varying topography, where the size of the wind turbine will change our perception of the

landscape's character. Similarly, our perception of the valuable structures and elements of the cultural landscape such as churches can be disturbed by the rotation of the wings.

The scale in the Danish landscape is modest with height differences typically lying in the range 15–20 m. The landscape's small proportions make it difficult to blend high-voltage cables into the landscape in a harmonious manner, and the general increase in the number of overhead cables therefore increases the threat to the landscape and cultural environment. The pylons for the 400 kV cables are approx. 40 m high and hence inevitably mar the landscape. Because of their dominance, the structures can interfere with our experience of a cultural environment.

Afforestation

Afforestation and changes in the distribution between conifer and broadleaf forest represent a change in the character of the landscape. The change can both support and counteract or veil enjoyment of the landscape and its narrative value (*Photograph 4.2.1*). Areas where the settlement structure and the basis for subsistence are related to forestry have been influenced by forest during development of the structures. In these cases, afforestation will support the landscape's culture-historical dimension. Conversely, afforestation in the open countryside, where the topographical picture is characterized by activities associated with agriculture, could weaken the landscape's historical narrative value. Similarly, forests planted between public roads and a burial mound will veil the view of the burial mound, thereby detrimentally affecting experience of

Photograph 4.2.1

State afforestation in Funen Forest District.

The newly planted area acts as a false front arrangement in front of a conifer stand, and will eventually grow up and blur the contrast between the forest and the open countryside. Moreover, the forest will come to appear inharmonious as the two types of stand are so different.

(Photograph: Liv Oustrup)



the landscape. Afforestation generally improves the recreational conditions. Near towns in particular, the improved possibilities for access to the landscape are of great significance.

Light pollution

Artificial outdoor lighting is increasingly being used in a manner that can often be characterized as light pollution (*Photograph 4.2.2*). The wasted and bothersome light can be considered an environmental pollutant on par with other pollution phenomena. Artificial outdoor lighting provides desirable illumination, but can also have unintended effects that are so appreciable that they are experienced as light pollution, e.g. light smog, blinding light, penetrating light or even light chaos. Avoidance of such forms of light pollution is desirable both for aesthetic and functional reasons as well as simply to save energy. Light pollution is not referred to in the current Danish legislation, but the Counties can, pursuant to the provisions of the Protection of Nature Act that ban outdoor advertising in the open countryside, order cessation of the use of floodlights or the suchlike in individual cases if the light source seems to be placed in the open countryside.

Excess or inappropriate artificial outdoor lighting not only expunges absolute darkness, but also the experience of nature's natural light. Irrespective of whether one's glance is directed at the night sky or towards the open landscape at night, light pollution will diminish the possibility to experience the night landscape as a contrast to the day landscape. Apart from negatively impacting on the aesthetic effect of the dark, light can also pollute other light in the sense that one light source can be too dominant relative to other relevant light sources.

Photograph 4.2.2

Advertising signs in the open countryside dominate and veil our impression of the nocturnal landscape. (Photograph: Michael Varming)



Cultural environment

Description of the specific consequences of land use for the cultural environment requires geographical delineation of the individual cultural environments and a precise definition of the properties/qualities that render them worthwhile preserving. To this end, work is going on to develop indicators measuring to what extent the cultural environments in question have preserved or deviate from the physical expressions that comprise their value, for example as settlement patterns, architectural traits or visual entities.

The cultural environment's qualities are among other things attributable to its historical source value, narrative value and experience value, here perceived as the recreational quality associated with the visual and physical accessibility. Changes in such aspects as land use, location boundaries and vegetation, as well as roads, footpaths and publicly accessible areas, i.e. access roads to and within the cultural environment, will typically constitute changes in the cultural environment's assets.

Two areas in Vejle and Roskilde Counties have been selected to illustrate the use of indicators. The area in Vejle river valley around Ravnning Bridge constitutes a rich cultural environment with major landscape assets that are under considerable pressure from structural changes in agriculture and forestry. The description of this cultural environment is primarily based on the County's report "Culture-historical protection areas in Vejle County". The area around Jyllinge in Roskilde County is very dynamic, and is not least an area characterized by rapid urban growth over the past 30 years. The Jyllinge area is identified as a valuable cultural environment in Roskilde County's proposal for their 2001 Regional Plan as well as in the project "Cultural History in Planning".

Photograph 4.2.3

Across from the river valley the landscape consists of an even moraine plateau primarily consisting of moraine clay.



Example: Raving Landowners Association in Vejle river valley

The Vejle river system is one of the most complex areas in Denmark as regards its geological origins. As a consequence, a wide range of different landscape forms are to be found within a relatively small area.

Raving Landowners Association well illustrates the characteristic relationship between villages and the land belonging to them after the agricultural reform at the end of the 18th century, when the individual farms were allotted arable land on the moraine plateau as well as land for hay making, while grazing was done on the slopes and in the bed of the river valley. In addition, there are the physical traces of a number of ancillary functions for the agricultural society such as the forge and the school, which together help describe the conditions in a village community around 1900. The area thus constitutes a cultural environment with a history of land exploitation and sociostructural conditions over a period of several hundred years. The historical source value is associated with the preservation of this cultural environment's many individual elements such as dykes, hedgerows, road systems, meadows, cattle trails as well as the village's 14 farms and forge, school, waterworks and grocery store.

The visual possibility to experience this cultural environment is associated with the dykes and hedgerows that can be seen as lines in the landscape, and which delineate the individual properties as well as the Landowners Association as a whole. The possibility to physically travel along the roads and footpaths within the area that comprises Raving Landowners Association is also of considerable importance for being able to experience and understand the structure of the Landowners Association and the function of the various constituent elements.

Photograph 4.2.4

The flat bed of the river valley consists of moist peat soils. From down in the valley one can see the river valley's steep slopes, which separate the actual river valley from the moraine plateau.



A large number of freshwater fish farms have been established in the river valley and the area has attained a primary function as a recreational area (*Photograph 4.2.5*). In the background one can see the river valley slopes, where the spaces between the broadleaf stands and the open dry grasslands used for grazing are gradually being planted with trees, especially conifers. In summary, the cultural environment is affected by the changes in land use that differ from the cultivation patterns of the traditional agricultural society, and commercial forestry therefore diminishes the comprehensibility of the landscape's history.

Within the boundaries of the village landowners association (*Photographs 4.2.6 and 4.2.7*) the dykes, hedgerows and roads around Raving illustrate a characteristic agricultural reform pattern – radial land redistribution – where strip holdings were exchanged for radially arranged compact holdings. In connection with cessation of cooperative cultivation it was decided to let the majority of the farms lie on their former positions within the village. From there, it was possible to equitably redistribute the uniform and fertile moraine soil between them like the slices of a pie. The dykes, hedgerows and roads between these holdings help to promote understanding of how much land a village needed, and what types of land were exploited.

Photograph 4.2.5

A large number of freshwater fish farms have been established in the river valley, and the area serves a recreational purpose.



Characteristic of current development, the individual fields are becoming larger and larger. This means that the property boundaries that help describe the village's ownership and use relationships to the land are being erased. This changes Ravning Landowners Association from a narrative about a landscape with a characteristic small-scale agricultural structure with small, multifunctional holdings to a landscape with a completely different scale and a greater degree of homogeneity.

The original village school (*Photograph 4.2.8*) has now been converted to an ordinary home. Changes in the function of buildings are often accompanied by conversion work that reduces the buildings' architectural character and culture-historical value and deteriorates the possibility to understand their original function and role.

Abolition or as in this case closure of field tracks reduces the possibility to move around in the landscape and to experience and understand the structure of the Landowners Association and the function of its various constituent elements (*Photograph 4.2.9*).

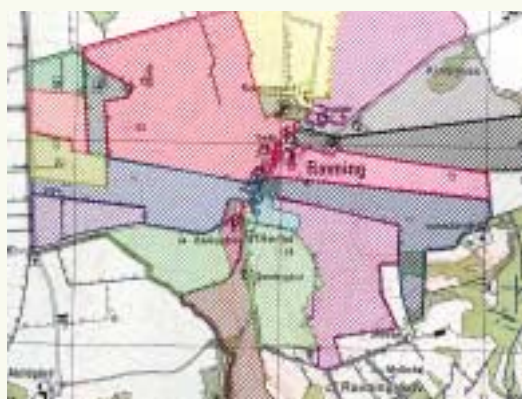
On the slopes of the river valley (*Photograph 4.2.10*), which were formerly characterized by open dry grasslands used for grazing and by small broadleaf stands, thick conifer forest has been planted. This disrupts the visual connection between the valley, the slopes and the moraine plateau above and hence the immediate

comprehensibility of the relationship that used to exist between exploitation of the three landscape types in the traditional agricultural system. Moreover, the conifer forest endows the landscape with a character different from its former light and more open character.

In the agricultural system of the past, the cattle trail in Ravning, which is indicated by dykes and pol-larded hedgerows, used to lead the cattle from the village down over the slopes to the river valley below (*Photograph 4.2.11*). The cattle trail is threatened by inadequate maintenance or by direct eradication as a result of changed use. The inadequate maintenance diminishes the cattle trail's historical source value.

Structurally speaking, the landscape shifts from one characterized by small farms and small fields to one with a few farms with large fields. In its general appearance the Landowners Association is thus characterized by the same development that has characterized the rural districts over the past 50 years, i.e. gradual erasure of the holding boundaries from the time of the agricultural reform through afforestation and removal of dykes, hedgerows and field tracks, and through general changes in the functional structure of the Landowners Association. The changes in land use thus indicate that the traditional interplay between the central fields and outlying fields has ceased.

Photograph 4.2.6
(Upper left)
Reform of holding boundaries: Agricultural reform map from 1794.



Photograph 4.2.7
(Lower left)
Present-day map.



Photograph 4.2.8
(Upper right)
Former village school, which is now an ordinary home.



Photograph 4.2.9
(Lower right)
Closure of a field track.



Example: Jyllinge in Roskilde County

Because of its location near Roskilde Fjord and the beautiful area around Lake Gundsømagle in the Værebros river valley, the town of Jyllinge has attracted many inhabitants. Jyllinge has therefore grown considerably, and the original relationship between the settlement, the fjord and the agricultural land has thereby been veiled.

An old painting of Jyllinge (*Photograph 4.2.12*) shows the town's original location on a moraine slope beside Roskilde Fjord, with the fishing hamlet and the fishery-associated facilities on the low-lying beach front beneath the slope and the farmhouses and church and forge up on the moraine plateau above. What is exceptionally characteristic about the cultural environment in Jyllinge is thus the relationship between the village and the fishing hamlet, which are connected by a network of lanes and footpaths down the coastal slope. Apart from a number of physical elements such as fishermen's cottages, fishing gear sheds, farmhouses, the forge and the church, the cultural environment also consists of a number of activities. For example, the fishery-related activities are valuable aspects of the cultural environment's narrative value. Without these activities, the cultural environment would simply consist of pieces of scenery from the past.

The historical source value is mainly associated with the architecture and settlement structure represented partly by the fishermen's cottages and partly by the farmhouses and small homes. In addition, everything from the church, the forge, the fishing gear sheds, the slipway, the tarring sites, the net-drying ground and the landing place to the facilities for inshore hunting contain valuable architectural and constructional information.

Visually, the cultural environment can be experienced from the fjord. On the land side the view has markedly deteriorated, among other things because of the buildings. Regarding the possibility to physically move around in this cultural environment, public footpaths and roads are found throughout the whole area.

As with the description of Ravning Landowners Association, there are examples of a number of structural and functional changes with important consequences for this cultural environment's narrative value, historical source value and experience value.

Since the mid 20th century, Jyllinge has undergone considerable urban growth, and some of the original service functions have moved out of the village to the new built-up area. The majority of the village's fields have thus been developed. The village has thereby lost its connection with the areas that comprised the basis for its subsistence during its agricultural days.



Photograph 4.2.10
(Upper left)
The slopes of the river valley are now planted with stands of broadleaf trees.



Photograph 4.2.11
(Lower left)
Cattle trail at Ravning.

Photograph 4.2.12
(Upper right)
Painting of Jyllinge's former location.

Photograph 4.2.13
(Lower right)
Jyllinge fishing harbour.

The fishing harbour (*Photograph 4.2.13*) with its fishing gear sheds, slipway and net-drying ground and the fishing hamlet “Klinten” with its stone bridges to the boats have been preserved, however, and endow this cultural environment with qualities that make it a special experience.

The houses in Jyllinge (*Photograph 4.2.14*) are no longer bound commercially to the surroundings as they were in the past. The village itself and the old fishing hamlet (*Photograph 4.2.15*) have become much more densely built-up, among other things through the construction of extensions to the existing buildings. As a consequence of the general increase in welfare and the increasing requirements as to house size and quality, they are expected to become even more densely built-up in the future. The photograph shows how modern buildings have been constructed along the coast to meet the desire for attractive locations. In contrast, the fishermen’s cottages were originally built there to facilitate exploitation of the fjord’s resources.

The development of Jyllinge (*Photograph 4.2.16*) has changed the view to this cultural environment considerably. Thus the village can no longer be experienced from a distance, although the church tower projects above the rooftops marking the location of the village. From the fjord side there is naturally good visual access and a good view, but the impression is disturbed by the many buildings that serve as a backdrop for this cultural environment.

Summary

The functional relationship between Jyllinge, the fjord and the agricultural landscape is of less importance than previously. Jyllinge church and harbour are entities worthy of preservation with clear culture-historical value, however. The fishing activities also express a vibrant cultural environment, which is no longer the case with the village itself. It is exactly the idyllic and well preserved cultural environment together with the location on the fjord that has resulted in Jyllinge attracting many new inhabitants. Consequently, the village has acquired a new function as a satellite town for Roskilde and Copenhagen.

Photograph 4.2.14
(Upper right)
An unspoiled village atmosphere with farmhouses located on the village street.

Photograph 4.2.15
(Left)
Modern buildings established along the coast.

Photograph 4.2.16
(Lower right)
Jyllinge viewed from the fjord, where the impression is disturbed by the many buildings.



4.2.3 Objectives and measures

Land use

The national guidelines for the 2001 revision of the Regional Plans focus on land use for new urban growth. The National Planning Report 2000 focuses on spatial planning in interaction with commercial development, transport and the environment. It is emphasized that cooperation and partnership both within the public sector and in interaction with the private sector are important preconditions for the development of regional policy. The National Planning Report 2000 points to the fact that the designation of land for commercial purposes must be adapted to commercial development of the future. As the need is limited, the Counties are encouraged to reduce the designation of new commercial districts and instead to reuse older areas that are now unused. In addition, the land that has already been designated for commercial purposes, should be reconsidered.

Protection of the aquatic environment is another important priority area in order to protect the ground-water and biodiversity. Nitrogen loss to the aquatic

environment is therefore to be reduced. In this connection the livestock density requirements for the spreading of manure will be tightened in 2002, the area of forest is to be doubled, and organic farming is to be promoted.

An example of a new theme in the national guidelines for the 2001 revision of the Regional Plans that reflects the new values is the demand that the Counties must designate valuable cultural environments in the Regional Plans (the "third dimension" of Danish environmental policy). This demand is based on the 1995 Cultural Environment Report and aims to protect the Danish cultural heritage and qualify the balancing of interests in the open countryside so as to also encompass physical elements and structures in the landscape of culture-historical value.

A number of amendments have been made to various Danish Acts to support multifunctional land use and environmental adaptation, including the Planning Act, Environmental Protection Act, Protection of Nature Act, Water Supply Act, Watercourse Act, Fertilizer Act and Agricultural Holdings Act.

Objectives for land use in the countryside

- Land use for urban growth, technical installations and infrastructure is to be limited
- The forest area is to be doubled
- The aquatic environment is to be safeguarded so that the water supply can be based on pure groundwater
- The coasts and the unspoilt landscapes are to receive special protection against technical installations and urban settlements
- Valuable cultural environments and landscape elements are to be safeguarded and protected
- Accessibility to outdoor activities in the open countryside is to be enhanced
- Biodiversity is to be ensured through enhanced nature restoration and more ecological corridors in the landscape
- Sufficient land is to be preserved to ensure sustainable agriculture
- Integration and multifunctional land use is to be enhanced so as to enable more land use interests to be met on the same land and to prevent land use conflicts in the open countryside

Objectives for landscape protection and preservation of cultural environments

- Cultural environment interests are taken into account together with other interests in spatial planning and other decisions concerning land use in the open countryside and in the towns
- The character man has imparted and continues to impart on the landscapes and the towns should render them rich and varied and hence a potentially worthwhile experience
- Landscapes and towns are to contain both valuable individual elements and understandable entities that reflect the use of the surroundings during the various ages
- Public participation in cultural environment work is to be further strengthened
- The cultural environment and the landscape assets are to be ensured in spatial planning as well as in actual management of the landscapes

The landscape and the cultural environment

Societal development must continue to make room for a diverse and valuable cultural landscape. Special planning and preservation efforts are needed in order to be able to fulfil this goal. The landscape and cultural environment interests are to be satisfied through spatial planning. The Counties designate valuable cultural environments in their Regional Plans. The 2001 revision of the Regional Plans includes the first examples of how the Counties have designated and hence attempted to protect the cultural environments.

New measures

Greater attention is to be paid to the landscape and the cultural environment in connection with environmental impact assessments, including in the Regional Plans. This is promoted by a handbook explaining how these aspects can be dealt with, how one can describe value, and how one can measure and describe the main pressures and impacts on the landscape and cultural environment.

There remains a need to develop indicators for the landscape and cultural environment area so as to create a tool able to describe the development in the state of selected landscapes and cultural environments, as well as to describe the effect of the initiatives implemented to ensure that priority landscape and cultural environment values are preserved.

The project "Bornholm Cultural Environment Atlas" is being initiated to survey the most important cultural environments on the island of Bornholm. Among other things, the project's developmental dimension encompasses the development of methods for iden-

tifying valuable cultural environments in towns and in the country. This is based in part on the experience gained from the Danish Forest and Nature Agency's work with "Municipal Atlases" and from the project "Cultural History in Planning".

The so-called Steen Hvass Committee is working on drawing up proposals for a strategy for future state policy for our physical cultural heritage. The strategy is expected to be completed by the end of 2001. With the Council of Europe's adoption of the European Landscape Convention, focus on the landscape has now increased. The Convention is to be followed up nationally.

Deliberations are now going on concerning what new aspects to include in the coming national guidelines for the next revision of the Regional Plans. The follow-up on the recommendations of the Wilhelm Committee, the coming implementation of the Water Framework Directive and regulation of the agricultural sector are examples of themes that will play an important role and influence future land use and hence not least the state of the landscape and cultural environment. Moreover, based on the cultural environments already designated in the 2001 Regional Plans, consideration is being given to the need for clearer guidelines for the Counties concerning how the designation of cultural environments should be conducted.