5 Man and the urban community

The Danish towns are growing. In densely populated towns the resources can be utilized more effectively to the benefit of the environment, for example through public transport and district heating. Urban sprawl entails increased transport and altered landscapes and cultural environments. The environment influences human health, but it is very difficult to differentiate environmental impacts from the effects of living conditions and lifestyle. Threats from pollution further add to the experience that we live in a risk society.

Photo: NERI/John Jensen

5.1 Introduction

5.1.1 Man and the environment

It is actually we human beings who are responsible for the environmental problems facing society. We create environmental problems through our consumption of goods, food, transport, housing, etc. The greater our consumption, the more has to be produced, and the greater the resulting emissions of pollutants to our surroundings.

Much is done to reduce pollution from society's consumer-oriented activities: Energy efficiency is increasing, cars are driving further per litre of petrol and are being fitted with catalytic converters, agricultural pollution is being reduced, etc. In some cases, however, consumption increases more than the increase in efficiency. This can be illustrated by examining the relationship between consumption and a number of pollution indicators (*Figure 5.1.1*). Despite the increasing consumption it has been possible to reduce emissions of CO_2 through energy effectivization, afforestation and the use of cleaner fuels. Waste production, which is more directly correlated with the level of consumption, has not decreased. It is increasing less rapidly than consumption, however.

In addition to trying to reduce consumption (a goal not yet achieved), a shift in the direction of environmentally cleaner goods and services can be pursued, for example through reducing the environmental impact of production and ensuring that the goods contain fewer hazardous substances. Furthermore, we can help reduce the waste disposal problem, for example through active sorting and recycling schemes. One of the means of enhancing awareness among the general public are the so-called "Local Agenda 21" activities. As a follow-up on the 1992 Rio Conference on sustainable development, activities have been initiated at the municipal level to involve the public in the move towards more sustainable development locally (*cf. Section 5.4*).

In some cases the pressure on the environment affects our health. It is very difficult to distinguish between the health impact of the environment

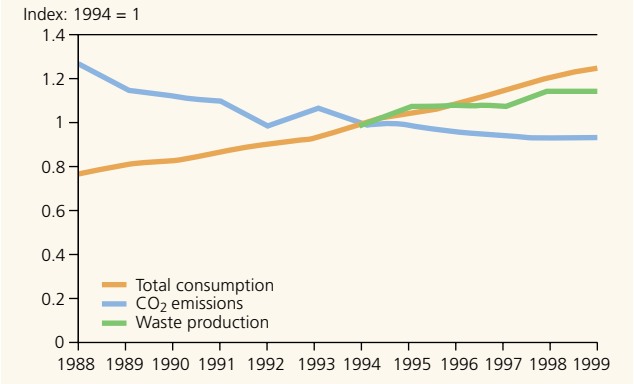


Figure 5.1.1

Development in consumption and two indicators of pollution: Waste production and CO_2 emission. Waste production data are not assessed in the same way for the years prior to 1994. (Source: Statistics Denmark, Danish Energy Agency, Danish Environmental Protection Agency, 2000).

and that of all other factors, though, for example our lifestyle with too much smoking, too much food and too little exercise. This aspect is reviewed at the end of the chapter under the heading "Environment and health" (*Section 5.6*).

Man's perception of the health risk posed by environmental problems can considerably influence how we attempt to solve the problems through citizen involvement, including changing behaviour in a more environmentally sustainable direction. This understanding of pressures on and perception of the environment is also described at the end of the chapter under the heading "The risk society" (*Section 5.7*).

5.1.2 Towns in Denmark

The population of Denmark largely inhabits towns. Thus around 77% of the population lives in towns with over 1,000 inhabitants, and 85% lives in habitations with at least 200 inhabitants.

Urban growth

Urban growth during the 1990s has been relatively evenly distributed among the various sizes of town (*Table 5.1.1*). The town pattern is generally stable, although there is a tendency towards more rapid growth in the larger towns. Thus the major towns, defined as towns with over 20,000 inhabitants (including Greater Copenhagen), increased in population by 4.8% between 1990 and 2000, while population growth in the country as a whole was 3.8%. Conversely, population growth in towns with under 1,000 inhabitants and in rural districts is modest, only a good 1% over the decade. Only a few towns of over 1,000 inhabitants have declined in population over the past ten years, in particular fishing towns and towns on the island of Lolland.

Growth in the towns is mainly attributable to natural population growth and immigration from abroad. Migration from rural districts only plays a minor role today – perhaps with the exception of northwestern Jutland. Urbanization has also accelerated in the countryside. Farmers and their families presently account for less than one third of the rural population. The majority is accounted for by people with jobs in the towns (and their families), either migrants who have kept their jobs in the towns, or locals who have obtained employment there.

Urban area

The urban area has grown markedly, both for housing and business purposes.

Table 5.1.1
Population (in 1,000s) apportioned by town size 1990–2000. The figures for inhabitants are calculated on the basis of the 1990 town size groups.
(Source: Statistics Denmark, 1993 and 2000a).

	1990	2000	Growth 1990–2000
			%
Greater Copenhagen	1,337	1,393	4.2
Towns >100,000 inhabitants	453	482	6.4
Towns 20,000–100,000 inhabitants	777	814	4.8
Towns 5,000–20,000 inhabitants	590	614	4.0
Towns 1,000–5,000 inhabitants	787	820	4.2
Towns 200–999 inhabitants	413	418	1.2
Rural districts	779	790	1.4
Denmark	**5,135**	**5,330**	3.8

Table 5.1.2
Urban zone area (km²) 1974 and 2000 in municipal groupings based on the size of the largest town. Urban zone 1974 includes towns (>200 inhabitants) that have since been transferred to urban zone.
(Source: Town and Country Planning Agency, 1975; Spatial Planning Department, 2001).

	Urban zone	Urban zone	Growth 1974–2000
	1974	**2000**	**%**
Whole country	1,948	2,445	26
Greater Copenhagen	563	623	11
Municipalities with main town >20,000 inhabitants	675	801	19
Municipalities with main town 5,000–20,000 inhabitants	353	476	35
Other municipalities	357	546	53

Table 5.1.3
Urban zone area (km²) 1974 and 2000 apportioned by urban, suburban and other municipalities. Urban zone 1974 includes towns (>200 inhabitants) that have since been transferred to urban zone.
(Source: Town and Country Planning Agency, 1975; Spatial Planning Department, 2001).

	Urban zone	Urban zone	Growth 1974–2000
	1974	**2000**	**%**
Whole country	1,948	2,445	26
Municipalities >20,000 inhabitants	1,091	1,241	14
Surburban municipalities	412	585	42
Other municipalities	445	620	39

The urban zone, i.e. the area designated for urban functions pursuant to the town and country planning legislation, comprised a total of 194,800 ha in 1974, corresponding to 4.5% of the total area of Denmark (*Table 5.1.2*). By the end of the 1990s the urban area had grown to 244,500 ha or 5.7% of the country. Growth in the urban area thus amounts to 26% or approx. 1% per year on average. In general, the percentage growth in the urban area has been greater the smaller the town in question (*Table 5.1.2*).

The growth has been largely the same in the suburban municipalities of the main cities as in the other smaller municipalities (*Table 5.1.3*). The reason why the growth is greatest in the municipalities with the smallest towns is probably that they are thinly populated and hence can more easily designate new urban areas.

At the same time as the towns are spreading, changes are taking place in the existing urban areas. In several of the major Danish towns, urban concentration and urban sprawl are tending to occur simultaneously. New houses and business premises are being built in the town centres concomitantly with development of land on the outskirts.

Urban sprawl

Over the past couple of decades the Danish towns have undergone considerable changes in terms of distribution of different types of business and land use. During the past 30 years the major towns have lost large numbers of industrial workplaces, while industrial employment has grown in the smaller towns. Deindustrialization has been most evident on the island part of Denmark, whereas industry remains widespread in Jutland, where trade and industry has mainly grown in western, mid and southern Jutland.

Studies of commercial and institutional property development in six selected municipalities have revealed that such development continues to disperse away from the town centres to the outskirts of the towns. In Odense, for example, 8% of new commercial and institutional buildings were erected on docklands, 9% in the town centre, and 15% in the area between the town centre and the outskirts, while 46% were erected on the outskirts of the town. The pattern is the same in Aarhus. At the same time, the industrial, storage and transport sectors in the major towns have moved from the central parts of the towns and docklands to industrial estates in the town outskirts and suburbs, often close to the main road network.

The 1990s also saw growth in housing construction, especially construction of detached houses (*Figure 5.1.2*). Conversely, the number of newly built apartment blocks and terraced houses has decreased. Detached houses require more land than densely built-up, low-rise housing developments and apartment blocks, and are often constructed at the outskirts of town.

Urban sprawl has taken place despite the considerable possibilities for urban development within the existing urban zones. Several studies show that there are large centrally located areas in the major Danish towns that could be developed for commercial purposes such as offices and services, but possibly also for apartment blocks.

This urban sprawl is problematic for the environment for several reasons. Firstly, the majority of empirical studies indicate that a lower town density, greater distance to the centre and a greater distance to local service functions result in an increase in transport and hence in energy consumption for transport and in CO_2 emission. Both public transport and district heating

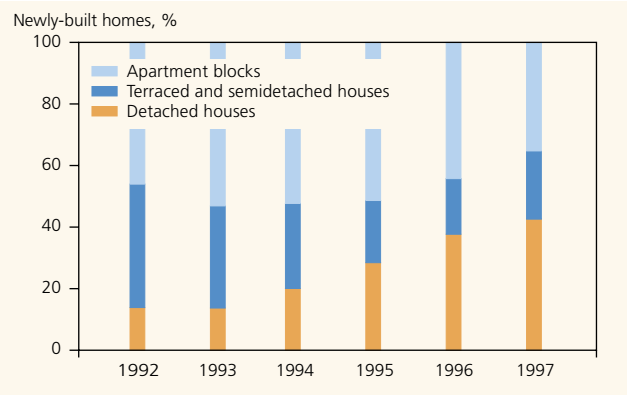


Photo: CDanmark

Figure 5.1.2
Detatched houses account for an increasing percentage of newly built homes.
(Source: Statistics Denmark, 1998).

depend on a certain density in order to be economically viable. Secondly, heat loss is considerable in the district heating network to peripheral buildings. Finally, urban sprawl means that land is developed that could otherwise have been used for developement of urban forests and other recreational purposes.

Urban concentration

The urban areas are becoming more concentrated, especially through the construction of new homes and the establishment of service enterprises in the existing urban zones, for example on former docklands and in old commercial districts. The tendency that many enterprises now pollute less or not at all enables towns to be concentrated to a much greater extent by mixing urban functions (*cf. Section 4.2.2*). Despite the fact that service enterprises do not pollute in the same way as manufacturing enterprises, urban concentration has some environmental consequences for the local environment and the cultural environment. Urban renewal of docklands, former military sites such as Holmen and old industrial districts can lead to loss of buildings worthy of preservation and destruction of cultural environments (*cf. Section 5.3*). With very large units, or for example by concentrating functions of a county to the major towns, the environmental problems are enhanced. Some service enterprises, for example wholesale firms or very large retail outlets, often stimulate considerable traffic in the immediate vicinity. Local pressure on the environment is therefore very dependent on the size of the retail trade. If an outlet serves a regional function, it will attract more traffic than say a retail outlet with a local service function. These urban concentration problems are typically local, whereas the environmental consequences of urban sprawl are regional and global. Urban restructuring and concentration also have environmental consequences. They can exert considerable pressure on the individual local area, for example resulting in local noise problems and air pollution.

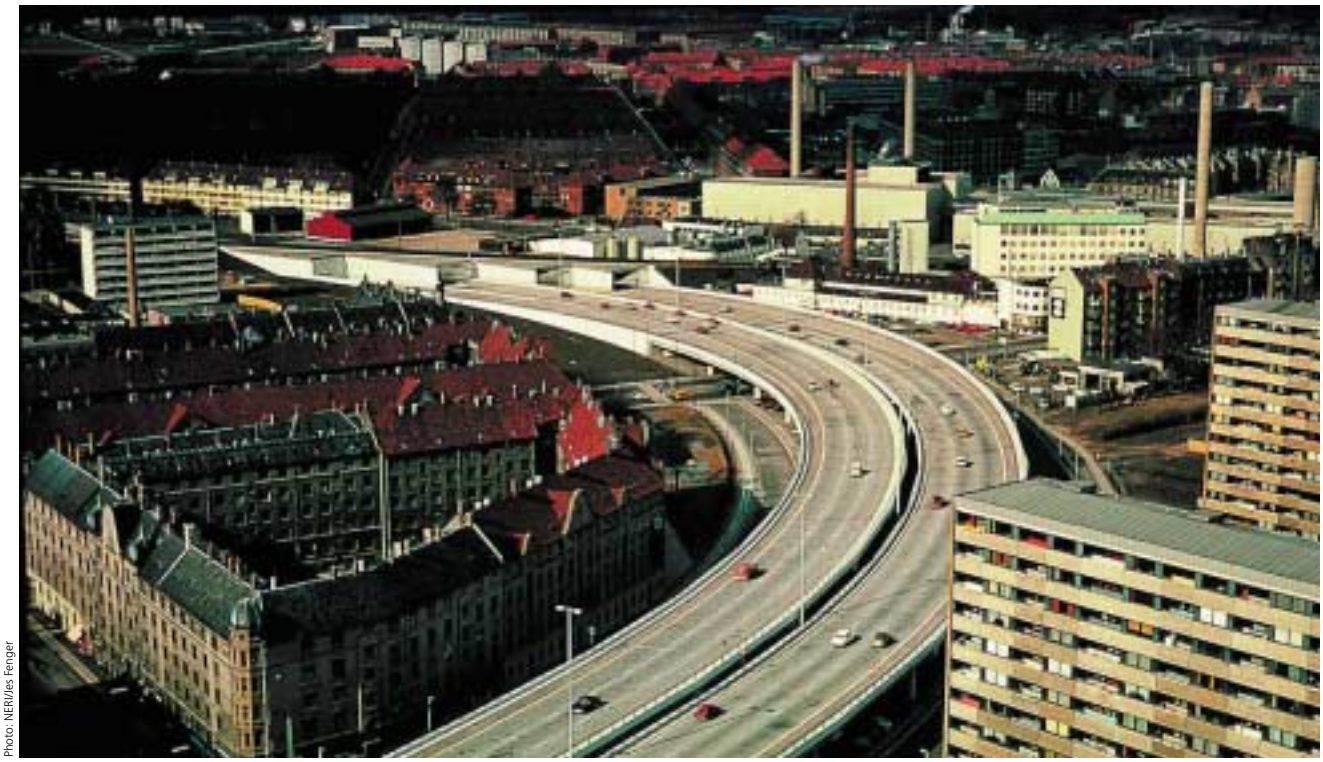


Photo: NERI/Jes Fenger

5.2 Urban traffic

Introduction

Traffic in the towns is considered a special problem because the pollution from traffic concentrates there, a large number of people are affected by the environmental impact of traffic, and queues and congestion can arise. In reality, approx. 70% of transport expressed in person-kilometres takes place in rural areas and between towns. Only approx. 30% is transport internally in the towns. It is thus the traffic out of the towns and in the countryside that accounts for the majority of traffic's share of CO_2 emissions.

Since 85% of the population live in towns, much of the traffic outside the towns must also be due to trips by town-dwellers. These trips are often subdivided into three categories when assessed in relation to the traffic they generate: Work, errands and leisure. Localization of the workplace and home in relation to each other and in relation to retail outlets, etc. affects the amount of transport expended in each category. Town structure, understood as the density of the different districts, the mutual location of town districts with different functions and their location in relation to the infrastructure, influences the amount of transport. The internal traffic in the towns is strongly affected by the mutual location of town functions. From the theoretical point of view, the situation is one where provided all homes are evenly distributed throughout a town, the functions that are located peripherally in the town will generate 40% more transport than if they were centrally located. Correspondingly, a centrally located address will, irrespective of the general localization pattern in the town, lead to less transport in the town than more peripherally located addresses. As short distances mean greater inclination to cycle or walk, and the public transport systems in all towns primarily run radially towards the centre and hence become more attractive for centrally oriented journeys, the environmental benefits of central localization will be even greater than indicated by the amount of transport *per se*.

The amount of transport between towns also varies depending on the size of the towns. Among other things, a large town often has a greater number of more specialized town functions than a small town, and is thereby better able to offer its inhabitants a broad spectrum of services and jobs. Thus the residents of smaller towns will be more inclined to travel to a larger town.

Analyses in Statistics Denmark's Transport Habits Survey (1995–99) show how transport and traffic depend on the location of the home, the size of the town and the location of the workplace. From an environmental point of view, it is important to reduce the amount of traffic and to shift the traffic from cars to public transport and light traffic (bicycle and pedestrian).

Photo: 2. maj/Sonja Iskov

Home location and town size

Town size considerably affects traffic behaviour. Thus the amount of transport per inhabitant increases with decreasing town size (*Figure 5.2.1*). The number of trips driven per person is largely the same for all sizes of town, although the number of trips is slightly smaller in the small villages and especially in the rural districts than in the towns. Time spent on transport is also largely independent of town size.

The distribution of means of transport shows that car use as the driver increases the smaller the size of the town the person inhabits, while use of both public transport and cycling/walking decreases. Three times as much of the transport is carried out by public transport in Copenhagen as in rural districts, and three to four times as much is conducted on foot and by bicycle. The distribution of means of transport and the generally lower speed of car travel in the towns mean that transport speed increases with decreasing town size and is 50% higher per person in rural districts than in Copenhagen (*Figure 5.2.2*). The result is that energy consumption and CO_2 emissions are 50% greater per person for rural inhabitants than for inhabitants of Copenhagen and the major provincial towns (*Figure 5.2.3*).

Both the amount of transport and pressure on the environment increase with decreasing town size. In Copenhagen City and the major towns, the lower amount of transport is primarily attributable to shorter journeys to work. Errands contribute most to the difference between large and small towns, mainly by being longer for towns of under 10,000 inhabitants. As the transport modality pattern for errands is the most problematic from the environmental point of view, errands are one of the main problems attributable to the town pattern. That it is not the most important problem, though, is due to the fact that the amount of transport used per person on errands is less than for the other types of trip.

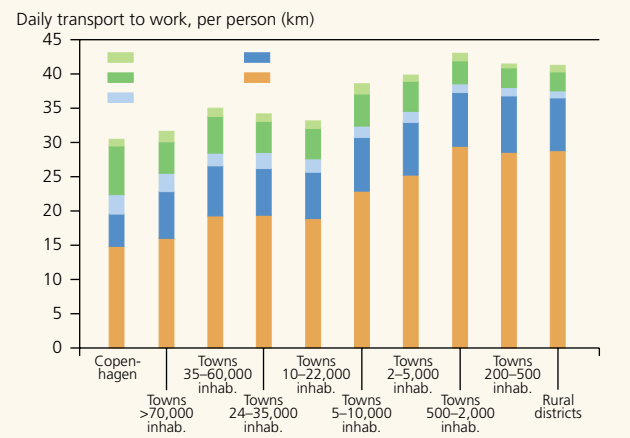


Figure 5.2.1

Transport per person per day in various sizes of town according to the Transport Habits Survey 1995–99. The columns are subdivided according to choice of means of transport.

(Source: Christensen, 2001).

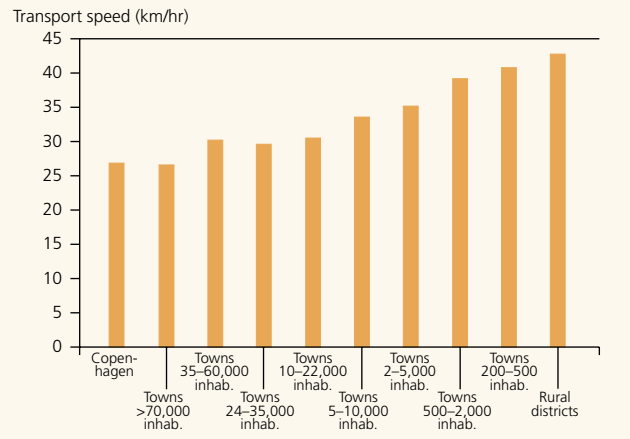


Figure 5.2.2

Transport speed in various sizes of town according to the Transport Habits Survey 1995–99.

(Source: Christensen, 2001).

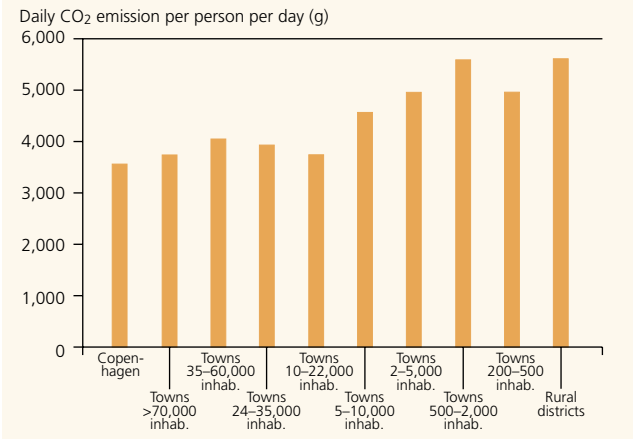


Figure 5.2.3

CO_2 emission per person per day from person traffic in various sizes of town during the period 1995–97.

(Source: Christensen, 2001).

Localization within the town

In the major towns, one third of transport takes place within the town. In Copenhagen City, the percentage is even greater. In these towns, localization within the town can affect the magnitude of total transport. In towns with between 35,000 and 65,000 inhabitants, one fifth of the transport takes place within the town. In this case the exact localization has only a modest effect.

In Greater Copenhagen, localization differences have a greater effect on both the amount of transport and the energy consumption by the traffic than in the provinces. In the provinces the difference ranges from 31 km per inhabitant in the largest provincial towns to 43 km per inhabitant in the countryside. In the central municipalities of Copenhagen, the amount of transport per inhabitant is only 26 km, while that of inhabitants of the rural districts and small towns of Greater Copenhagen averages 49 km, or almost twice as much.

The amount of transport is lower for people living near railway stations, probably because shopping centres and the like are concentrated there. In areas with apartment blocks the amount of transport is lower than average, even when the differences in population composition and car ownership are taken into account. In the towns of Greater Copenhagen the amount of transport is lower than the distance from the city centre would seem to indicate. This reflects a certain degree of local "town effect".

The greater amount of transport and increased motoring lead to a marked increase in energy consumption and emissions from the centre outwards. CO_2 emissions are thus 2.5-fold greater from the centre outwards in the provincial towns of Greater Copenhagen than in Copenhagen Municipality. In the rural parts of Greater Copenhagen it is 11% higher than in the rural districts of the rest of the country. In comparison, the amount of transport is 18% greater in Greater Copenhagen, i.e. due to the transport modality pattern, and in particular the better public transport service, pressure on the environment is actually less than with the same traffic in the provinces. Similar variation in transport and traffic with town structure is also seen in the newer habitations in Greater Copenhagen.

Transport and traffic per person also increase with increasing distance from the town centres in the provinces. The daily transport per person in Aarhus grows by 1 km for each additional kilometre one lives from the town centre up to a distance of 20 km. In Copenhagen it only increases by 850 m per kilometre. In Kolding, transport increases by 3.5 km for every additional kilometre one lives from the centre, but only until 6 km from the centre. With housing located on the outskirts, car traffic is 2.5–4-fold greater than for housing located in the centre.

All the studies undertaken thus show that central localization of housing, i.e. concentration of the towns around the town centres and previously abandoned districts such as disused industrial districts and docklands will reduce CO_2 emissions from traffic. In contrast, the significance for other environmental effects such as noise and air pollution largely depends on how the housing areas in question are designed and located in relation to existing housing and the main road network.

Workplace localization

The distance from the workplaces to the employees' homes varies very little with the size of the town in which the workplace is located. In general, there is considerable variation in the distance between home and workplace. While it is true that half of employees live within 6–8 km of their workplace, 5% live more than 50 km away. The workplaces in Copenhagen City result in slightly longer journeys than the workplaces of other towns. Workplaces in villages and small towns result in slightly shorter journeys than workplaces in the provincial towns. The latter is primarily attributable to the composition of businesses in the small towns, where a greater percentage of people work on their own farm, workshop, etc. The other types of trip made by persons who live very far from their places of work/education also involve a greater catchment and longer distances than those of people who live closer to their workplace.

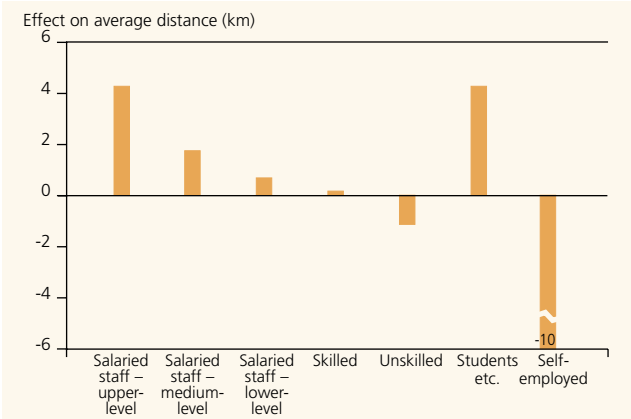


Figure 5.2.4
Effect of occupation category on the average distance (in km) between work and home. (Source: Christensen, 2001).

There are a number of other factors that affect the distance between work and home, for example branch, occupation, income, gender, etc. The group who travel furthest – the upper-level salaried workers – travel almost twice as far to work on average as the group of wage earners who travels least, and four times as far as self-employed persons, who travel the shortest distance (*Figure 5.2.4*). High-income groups travel further than low-income groups – also more than would be expected from their occupations. Finally, women work closer to their home than men.

The choice of means of transport to and from work depends on the localization of the workplace. With towns of under 35,000 inhabitants, the fraction of daily transport to work conducted by car is greater the smaller the town in which the workplace is located (*Figure 5.2.5*). This fits well with the fact that the level of public transport service decreases with town size. The difference offsets the shorter distance to the homes with the result that the average number of kilometres travelled by car to work is the same for all sizes of town.

Home-workplace balance

From the environmental point of view, it is appropriate to promote a pattern of enterprise localization that fosters a home-workplace balance in the smaller towns. A deficit of workplaces results in longer total travelling distances. If enterprises are located in the smaller towns, there is also a greater tendency for them to employ local inhabitants or people from the immediate vicinity. A workplace surplus in a town does not result in equally longer travelling distances, however. This is because workplace surplus is mainly seen in major towns, which have a large catchment, while workplace deficit is mainly seen in smaller towns. It is nevertheless clear, though, that there is an upper limit for how great the workplace surplus can be. The size of an enterprise and its requirements as regards worker specialization are decisive determinants of where it can be located in an environmentally sound manner. There is likely to be demand for workplaces in the smaller towns that are suitable for a not too specialized workforce, for example skilled workers (especially the traditional trades), medium-level salaried workers and unskilled workers. In contrast, specialized workplaces, and in particular workplaces that employ upper-level salaried workers, result in longer travelling distances. The town of Roskilde exemplifies how a workplace surplus coupled with major imbalance in enterprise composition results in greater average distances between home and work.

Workplace localization within the town

The location of the workplaces within the towns is of great significance for their environmental impact. The more peripherally a workplace is located in the town, the longer the journeys it creates. Workplaces in the town centre also have a greater catchment than workplaces in other densely built-up, more peripheral parts of the town. The effect of this is very modest in the provincial towns, but is considerable in the Copenhagen area. More important for the environmental impact than distance is the transport modality, however.

A location within 10 minutes walk (approx. 800 metres) from a station that comprises a major public transport hub, results in considerably lower car traffic and greater use of public transport. A central location near a station has the greatest effect in Greater Copenhagen, where the difference is from 4 km car traffic per workplace located centrally near a station to 18 km for a peripheral location in the suburbs far from a central station. In the medium-sized towns the corresponding range is from 5–6 km car traffic for locations near a station to 12–14 km for locations far from a station. In this case, the railway station as a traffic hub for both busses and trains has great significance for choice of transport modality.

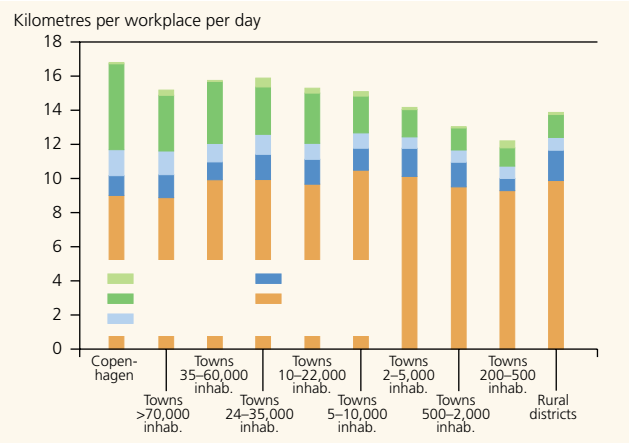


Figure 5.2.5
Daily transport per workplace apportioned by means of transport for various sizes of town.
(Source: Christensen, 2001).

Photo: Highlight

5.3 Urban environment

Resources in the town

The turnover of a number of important resources is concentrated in the urban areas. Their density means that energy and resources can be utilized more effectively, among other things because of collective solutions (*Figure 5.3.1).* At the same time, the average energy and resource consumption is typically lower per m² in densely built-up towns than in open urban areas and in the countryside.

Energy consumption for space heating has fallen by 10% from 1980 to 1999. The decrease has taken place in spite of the fact that the heated area has increased by almost 19% over the same period. Energy consumption for heating per m² has therefore fallen by 24% over the period 1980 to 1999 (*Figure 5.3.2*). This is due partly to improvements in building insulation and partly to the replacement of old oil-based central heating burners with more effective natural gas and district heating installations.

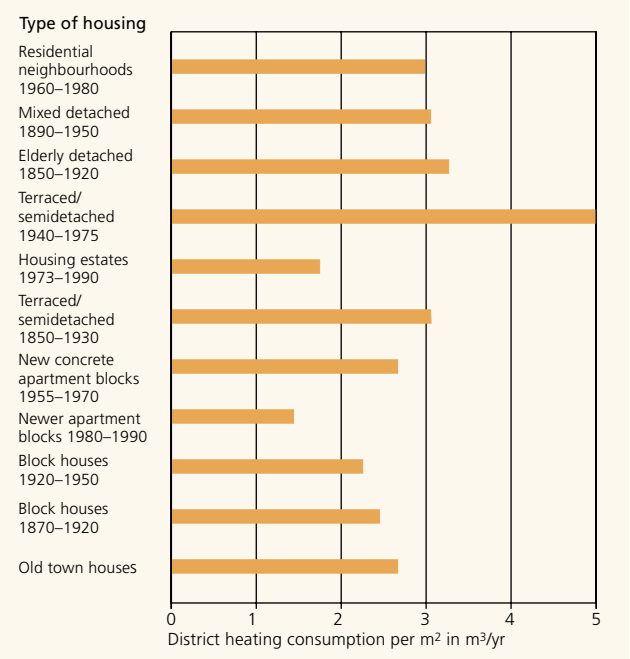


Figure 5.3.1

District heating consumption per m² in various types of housing.

(Source: Marling and Knudstrup, 1998).

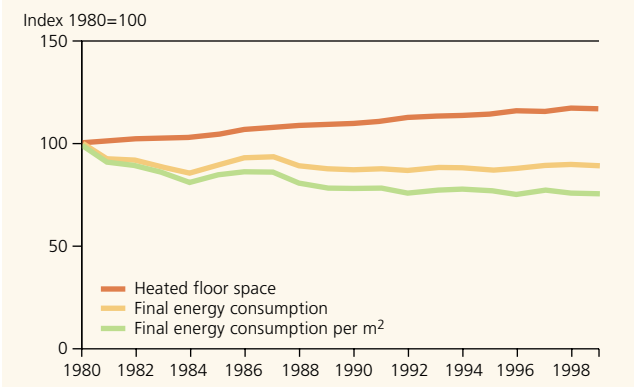


Figure 5.3.2

Net energy consumption for space heating.

(Source: Danish Energy Agency, 2000).

In the urban areas, district heating systems have become dominant, which has enhanced energy efficiency in these areas. Individual oil-fired central heating dominated until the mid 1980s, whereafter district heating became the most widespread source of heat. At the national level the 2.5 million heating installations are apportioned as follows: District heating installations 57%, oil-fired central heating 20%, natural gas-fired central heating 13%, and other systems, including electric heating, 10%. In cities such as Copenhagen and Odense, though, district heating accounts for as much as 85–90%.

Household waste production has increased slightly between 1995 and 1999. Waste production varies considerably from one urban district to another. In general, waste production per household is higher in the less densely built-up areas such as residential neighbourhoods and public housing estates than for example in districts where both young and old people live, e.g. apartment blocks. On the other hand, the greater number of persons per household in the residential neighbourhoods means that waste production per person is lower than in some of the apartment blocks.

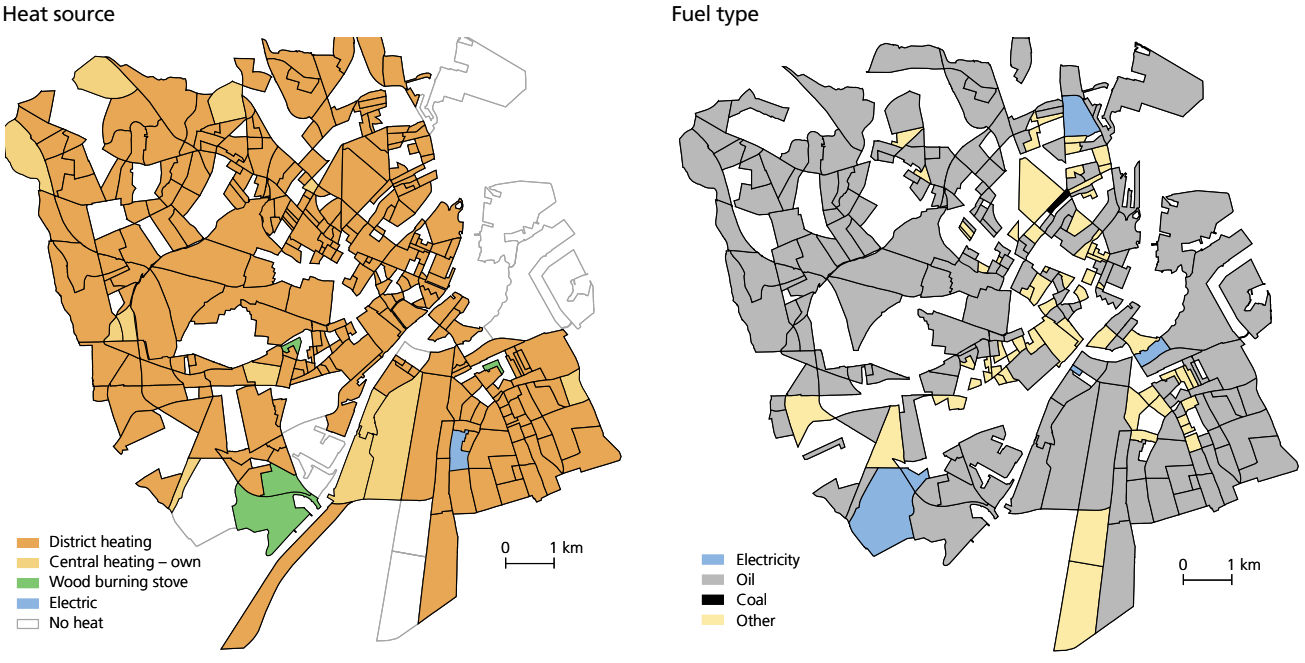
The characteristics of the public utility systems in highly urbanized areas are the invisible cycles as regards water, wastewater, waste and energy supply. While this has been sensible from the hygienic and rational points of view, it also means that we have large open cycles in our urban areas and low awareness of where the waste disappears to, and how much waste we actually generate.

At the same time, the urban areas are characterized by a high percentage of paved surfaces, which diminishes the possibility of water percolation to the aquifers. This intensifies the problem of a lowering groundwater table as a result of the overexploitation of the groundwater seen in some urban areas. In urban ecology experiments, attempts have been made to close the town's cycles locally, for example in connection with local waste management, stormwater percolation and local energy production using active solar heating, solar cells, etc. The experiments have shown that several of the cycles can be successfully closed locally, but that these local solutions can conflict with the public utility systems.

Active solar heating, which produces hot water with the aid of solar panels, is mainly of importance in the summer months. In areas with combined heat and power plants, the hot water is produced almost without costs as a waste product of electricity production. Some heating plants use waste to produce the heat. The desire for local recirculation of waste can thus lead to a conflict of interests.

The possibilities for establishing local cycles for water and organic waste depend on the natural resources present, also in the urban areas. Mapping of these resources is therefore decisive for the establishment of cycles that can contribute to the desired holistic solutions. Local soil and hydrological

Figure 5.3.3
In densely populated towns such as Copenhagen in this example, the expansion of the district heating system is almost complete. (Source: Danish Forest and Landscape Research Institute, 2001).



conditions, for example, are decisive as regards choice of solution for disposal of surface runoff. In addition, various possibilities in connection with waste management and waste processing have to be weighed up in order to identify the components that will provide the optimal solution. According to several studies, local treatment of organic waste requires a minimum of 4 m^2 free space per inhabitant. Local composting of organic waste will therefore typically be unrealistic in densely populated urban areas such as the Nørrebro, Østerbro and Vesterbro districts of Copenhagen.

Air pollution in towns

Air pollution in the towns is attributable to industrial emissions, including emissions from heat and power plants, and to traffic. In addition to the local sources of pollution, air quality in the towns is affected by air pollution transported from afar. In the towns, a distinction is made between air quality at street level and the urban background pollution at rooftop level. Traffic is the primary source of the pollution at street level, while that at rooftop level is a combination of all sources (*cf. Section 2.3*). At street level, meteorological conditions considerably influence air quality, and the orientation of the street (east-west or north-south) and the form of both the buildings and the street are therefore also of considerable importance. The quality of the air at one pavement can differ markedly from that at the other (*cf. Section 2.3*).

The quality of the air in the Danish towns is monitored through measurements made at both street and rooftop level in Copenhagen, Odense, Aarhus and Aalborg. The parameters measured are sulphur dioxide (SO_2), nitrogen oxides (NO_2 and NO), carbon monoxide (CO), hydrocarbons (including benzene), ozone, lead and fine particles. The measurements made in recent years reveal a general improvement in air quality in the towns (*cf. Section 2.3*). The improvements have primarily been attributable to improved flue gas abatement, the use of cleaner fuels (including "cleaner" petrol) and the introduction of catalytic converters on cars. Concerning NO_2, all the measured concentrations are below the current limit value of 200 µg/m^3 for the 98 percentile. The measured values are relatively close to the currently applicable guide values. The WHO guide value and a forthcoming EU limit value for the annual mean of 40 µg/m^3 was exceeded in Copenhagen in 1999. The NO level has decreased considerably since the beginning of the 1990s, when catalytic converters were introduced on new cars. Likewise, a slight decrease has been recorded for NO_2, but the reduction is not as great as for NO. This can be due to the fact that the formation of NO_2 at street level is mainly determined by the ozone concentration (*cf. Section 2.3*).

Pollution with SO_2 is clearly decreasing in Denmark. The measured concentrations are more than a factor 10 below the limit values and more than a factor 5 below the currently applicable EU guide value. The measured concentrations are also far below the forthcoming limit values. The greatest fall occurred in 1985–86, when restrictions were imposed on the sulphur content of oil. Improved flue gas abatement, the introduction of natural gas and a continued reduction in the sulphur content of oil products, etc. have also contributed to the positive development in sulphur pollution.

As has previously been the case, the ozone levels measured in 1999 were almost the same throughout the country. Ozone formation over Denmark is virtually insignificant. By far the majority of ozone detected is attributable to transboundary transport to Denmark from countries lying south and west of the country. The highest concentrations occur in the summer half year during periods of warm and sunny weather. An ozone concentration exceeding the threshold value for issuing a public ozone warning was only measured on one occasion in 1999.

The main worry as regards air quality in the towns is now pollution with particulates (*cf. Section 2.3.2 on "Particulates and air pollution"*). The particulates predominantly derive from traffic. They may consist of whirled-up dust and soil, but can also consist of sulphur and nitrogen compounds from exhaust gasses that are converted to particles by chemical processes in the atmosphere. The particles are of various sizes depending on their origin, the dust particles being large, and the chemically-formed particles small. The smallest particles, called ultrafine particles, are currently considered to pose the greatest health problem. They mainly derive from emissions from petrol- and diesel-driven vehicles. Catalytic converters on petrol-driven vehicles and filters on diesel-driven vehicles effectively reduce the emission or formation of particles, including ultrafine particles.

The concentration of particles has decreased over the past 10 years as a result of reduced emissions of sulphur and nitrogen compounds and the introduction of catalytic converters on petrol cars. The measurements for 1999 did not reveal any cases where the currently applicable limit values had been exceeded. The latter are under revision, however, and new limit values will apply from 2005 and 2010. In several cases the measurements taken in 1999 were higher than the limit values that will apply from 2005.

Figure 5.3.4

The contaminated sites are congregated in certain areas of the town, for example in old business districts.

(Source: Danish Forest and Landscape Research Institute, 2001).

Contaminated sites

Around 63% of all the registered contaminated sites in Denmark are located in the urban zone. There is a high density of contaminated sites in the densely built-up urban areas with multi-storey buildings, both in the former and the present business districts and in areas where there are both houses and business centres (*Figure 5.3.4 and Figure 5.3.5*). However, there are also relatively many parks and playgrounds built on registered contaminated sites.

The registered contaminated sites are typically old industrial sites, landfills, petrol filling stations, etc. (*Table 5.3.1*). The most common types of soil contaminants are oil and petrol residues, tars, organic solvents and heavy metals. Some contaminants, for example petrol and organic solvents, are mobile. These contaminants spread easily in soil and water and therefore pose the risk of contaminating the groundwater and surface waters. Other contaminants are more or less immobile, for example tars and heavy metals. These contaminants tend to remain in the soil at the site where they were spilt. If humans come into direct contact with the contaminated soil, these substances can pose a health risk. The organisms in the soil can also be at risk. Finally, some contaminants, especially organic solvents, can evaporate and cause indoor climate problems.

Apart from the registered contaminated sites, contamination of the surface soil in urban areas takes place from diffuse sources, e.g. traffic and deposition from smokestacks. In Copenhagen, the lead and benz-*a*-pyrene content of the soil has been investigated in selected districts. It turned out that the soil quality criterion for lead was exceeded in over half of the soil samples examined. In towns such as Copenhagen, a further source of soil contamination is the construction filler that has been used in connection with the development of various town districts.

The soil contamination in the urban areas comprises an environmental problem, for example in relation to the groundwater. The health implications also encompass direct contact, however, since there are houses located on the site of former gasworks, allotment gardens on former waste deposits and child care centres and playgrounds on land affected by soil contamination. In Copenhagen municipality there are 35 child-care centres and 11 public playgrounds located on former industrial sites.

Around 1,000 contaminated sites are remediated each year (*Table 5.3.2*). The term "Newly contaminated sites" is here understood to mean contamination that took place after the early 1970s. These sites were not encompassed by the publicly financed remediation efforts carried out pursuant to the Waste Deposits Act. A large part of the newly contaminated sites that have been remediated are relatively small incidents of contamination, for example from household heating oil storage tanks. Since 1 January 2000, when the Waste Deposits Act was superseded by the Contaminated Sites Act, the newly contaminated sites have also been encompassed by the public remediation efforts, but not until the authorities have exhausted all possibilities of ordering the polluter to remediate the site.

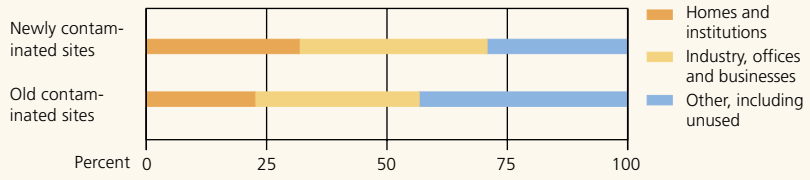


Figure 5.3.5
Newly contaminated and old contaminated sites apportioned by land use.
(Source: Danish EPA, 2001a).

Type of enterprise	Old contamination		Newly contaminated	
	No.	%	No.	%
Landfills and waste deposits	2,039	33.0	169	6.6
Petrol filling and service stations	643	10.4	212	8.3
Other enterprises with stores of oil, etc.	560	9.0	1,212	47.2
Automobile repair shops	342	5.5	158	6.2
Dry-cleaning shops	329	5.3	27	1.1
Gasworks	172	2.8	4	0.2
Scrap yards and scrap merchants	207	3.4	48	1.9
Iron and metal foundries and industry	221	3.6	78	3.0
Machinery industry	228	3.7	63	2.5
Asphalt factories	133	2.2	9	0.4
Metal plating shops, etc.	136	2.2	9	0.4
Electricity, gas and heat utilities	171	2.8	30	1.2
Chemical industry	107	1.7	33	1.3
Wood and furniture industry	58	0.9	33	1.3
Total	5,346	86.5	2,085	81.6

Table 5.3.1
The most frequent sources of contamination of sites encompassed by the Contaminated Sites Act ("old" contaminated sites) and newly contaminated sites (only 1996–1999). Excludes contaminated sites registered under the Danish Oil Industries' Environmental Clean-up Association.
(Source: Danish EPA, 2001a).

Table 5.3.2
Number of sites where remediation work has begun apportioned by remediation scheme. (Source: Data notified to the Danish Environmental Protection Agency's ROKA database by the Counties and Municipalities, as well as information from the Danish Oil Industries' Environmental Clean-up Association, the Danish National Railway Agency and the Armed Forces Buildings Division).

Scheme	1997	1998	1999	1997-1999
Publicly financed under the Waste Deposits Act	87	81	53	221
Depreciation Protection Act	27	18	16	61
Voluntary remediation under the Waste Deposits Act	88	64	66	218
Newly contaminated sites	408	486	374	1,268
Danish Oil Industry*	315	340	500	1,155
Danish State Railways/Danish Railways Agency	4	2	2	8
Armed Forces	11	7	4	22
Total	**940**	**998**	**1,015**	**2,953**

***Danish Oil Industries' Environmental Clean-up Association**

Noise

Noise is unwanted sound and is experienced as one of the greatest environmental pressures in the towns. Studies have shown that a considerable percentage of citizens feel greatly or very greatly bothered by noise from external sources in their homes. Noise is the environmental factor that affects the greatest number of people, and which causes greatest public concern. Since the first Environmental Protection Act entered into force in 1974, efforts have been made to combat noise in the external environment. While such noise is not normally so strong as to provoke hearing impairment, it can be a nuisance and cause stress and other ailments such as tiredness, headache, ear pressure, dizziness, concentration difficulties, etc., disturb sleep or rest and make communication difficult. Moreover, the noise can cause hypertension with the resultant risk of sequelae such as cardiovascular disorders.

Under certain circumstances, noise can be bothersome even at very low levels (e.g. the sound of a mosquito in the bedroom). Different forms of noise do not pose the same nuisance, and the noise level considered to pose a nuisance varies from person to person. Human beings have different noise sensitivity – and tolerance. The experience of noise as a nuisance is not solely dependent on the loudness of the noise. A whole series of both objective and subjective factors also influence the experience of noise. Among the objective factors can be mentioned the character of the noise and its variation over time. The subjective factors are mainly associated with the individual person's attitude to the source of the noise, the possibilities for controlling the source of the noise and the person's problem tackling abilities.

In urban areas the main noise problem is road traffic. Approximately 70% of the noise-plagued homes in Denmark (>55 dB) are located in towns with more than 20,000 inhabitants, while only 55% of all the homes in the country are located in towns of this size. If one solely focuses on severely noise-plagued homes (>65 dB), half are located in Greater Copenhagen. In comparison, just under a third of all homes in Denmark are located in Greater Copenhagen. Approximately 10% of the severely noise-plagued homes are located in towns with less than 20,000 inhabitants. In comparison, 45% of all homes are located in this category of town.

Nationwide noise surveys have been conducted in 1982 and 1993. Comparison of the two surveys reveals a fall in the number of noise-plagued homes. In 1982, 33% of all Danish homes were noise-plagued. In 1993, the figure had fallen to 20%. The number of severely noise-plagued homes is calculated to have decreased from 225,000 to 145,000. The calculations take into account that traffic has increased. In the 1993 survey it was assumed that the amount of noise emitted by the individual type of vehicle had not decreased during the interim period. As the two surveys were not conducted using the same method, comparison is subject to some degree of uncertainty. The reduction in the noise problem is attributable to several factors:

- Traffic-related changes due to traffic and town planning. The traffic is concentrated on a smaller number of larger roads in the towns, ring roads have been constructed, and traffic has been reorganized.
- The speed limit has been reduced from 60 km/h to 50 km/h in the towns and from 90 km/h to 80 km/h on the main roads.

	Housing roads	Branch roads	Main roads	Highways	Motorways	Total
55-64 dB	37,876	90,050	158,564	80,130	8,044	**374,664**
> 65 dB	2,391	31,965	80,575	11,058	3,629	**129,618**
Total	**40,267**	**122,015**	**239,139**	**91,188**	**11,673**	**504,282**
55–64 dB, %	10	24	42	21	2	**100**
>65 dB, %	**2**	**25**	**62**	**9**	**3**	**100**

Table 5.3.3
Number of homes affected by traffic noise apportioned by road category. Number of homes and distribution in percent. (Source: Danish Environmental Protection Agency, 2001b).

Traffic noise and noise of other types

The nationwide noise survey carried out around 1990 showed that:

- Approximately 485,000 homes were exposed to road noise exceeding 55 dB, which is the recommended limit value for road traffic noise. Approximately 145,000 homes were exposed to more than 65 dB.
- Approximately 39,000 homes were exposed to train noise exceeding 60 dB, which is the recommended limit value for train noise. Approximately 14,000 homes were exposed to more than 65 dB. The noise from the Copenhagen suburban railway is not included in the calculations.
- Approximately 40,000 homes were exposed to aircraft noise of more than 55 dB, which is the recommended limit value for major airports. Of these, approximately 3,000 were exposed to more than 65 dB. The majority of these homes are located in the vicinity of Copenhagen Airport at Kastrup.

There are no corresponding surveys for other forms of noise, but in autumn 2000 the Danish EPA estimated that:

- Approximately 40,000 homes are affected by noise from industry at levels exceeding the recommended limit values.
- Approximately 40,000 homes are affected by noise from other enterprises at levels exceeding the recommended limit values, e.g. craftsmen, shops and restaurants.
- Approximately 15,000 homes are affected by noisy recreational activities such as motor sports and shooting at levels exceeding the recommended limit values.

Box 5.3.1
Traffic noise (1993) and other forms of noise (estimated 2000).
(Source: Danish Environmental Protection Agency, 2001b).

- Construction of approx. 230,000 new homes and demolition of approx. 35,000 homes during the period 1982–93. It is assumed that the new homes comply with the recommended limit level of 55 dB measured at the exterior facade (or at minimum with the 30 dB maximum for indoor noise in living areas specified in the Danish Housing Regulations).

In 1995, an updated nationwide noise survey was conducted based on more precise surveys of a number of towns (*Table 5.3.3*). The decrease in the number of severely noise-plagued homes from 145,000 in the 1993 survey to 130,000 in the 1995 survey is attributable solely to the greater precision of the survey method.

By far the majority of the homes exposed to a noise level exceeding 65 dB are located along the main town arteries. This is due to a combination of relatively heavy traffic and the high density of the housing districts in close proximity to the traffic arteries.

Urban nature and green spaces

The number of green spaces in the major Danish towns varies markedly. The availability of green spaces in the various town districts also varies, especially if one considers the area of green space per inhabitant in the different districts.

Many of the oldest town parks were established at the beginning of the 20th century, initially as promenade parks and later as flower gardens and lawns. Wear on the central town parks is considerable as they are used by many people who live and work in the central parts of the towns.

In some urban areas the number of green spaces has increased over the past 25 years. However, the growth in park area has mainly occurred in the medium-sized municipalities (8,000–30,000 inhabitants). These new green spaces are typically green community spaces in residential neighbourhoods or housing estates where the inhabitants already have their own garden in connection with their home. At


Photo: CDanmark

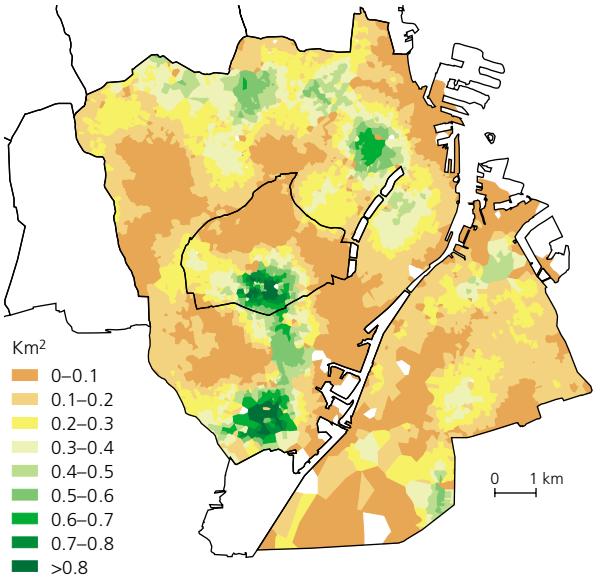


Figure 5.3.7
Map of the availability of green spaces in Copenhagen and Frederiksberg Municipalities. The map shows the number of km² green space available within approx. 15 minutes walking distance from a random point in the municipality.
(Source: Danish Forest and Landscape Research Institute, 2001).

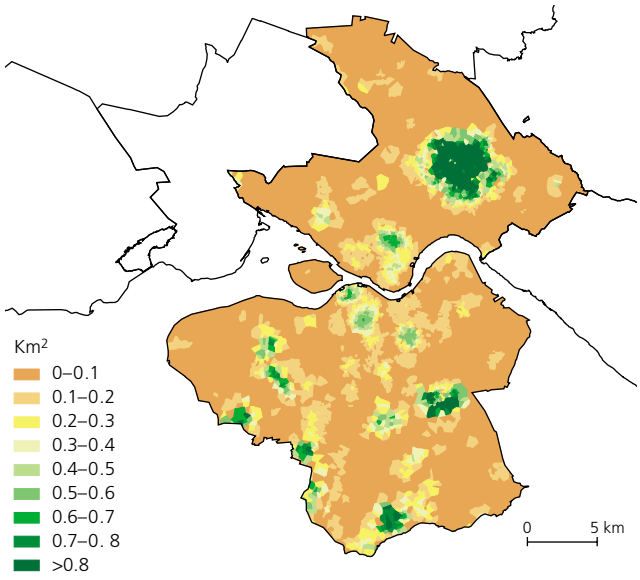
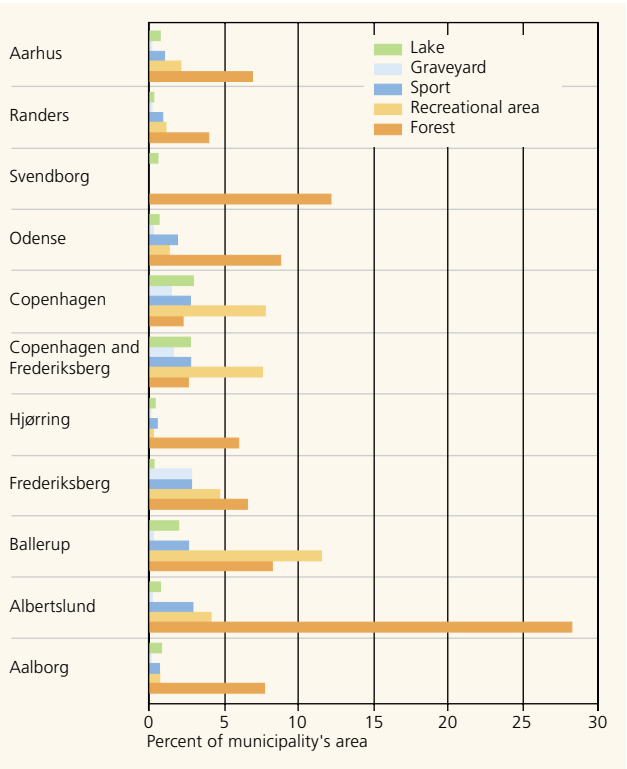
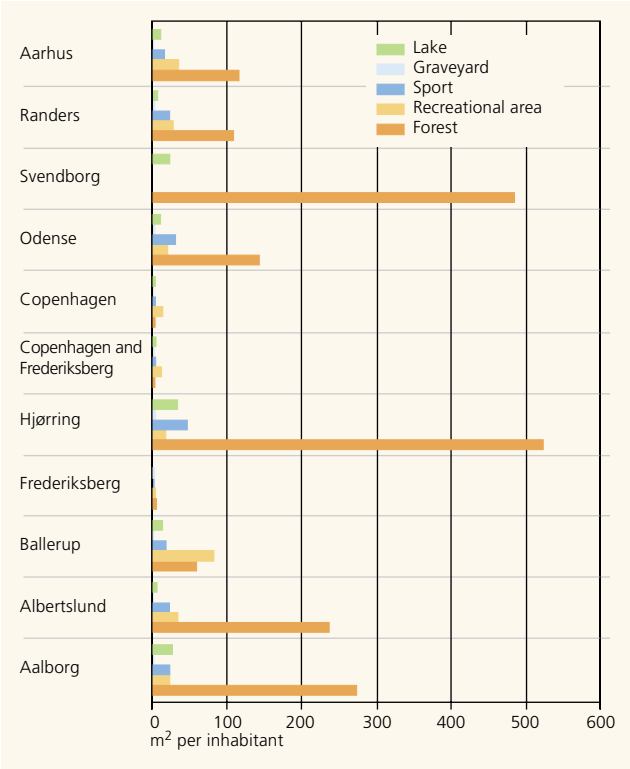


Figure 5.3.8
Map of the availability of green spaces in Aalborg Municipality. The map shows the number of km² green space available within approx. 15 minutes walking distance from a random point in the municipality.
(Source: Danish Forest and Landscape Research Institute, 2001).

Figure 5.3.6
Green spaces in various Danish urban municipalities.
(Source: Danish Forest and Landscape Research Institute, 2001).





the same time as the area of parkland in these medium-sized towns has increased, the green spaces in the town centres have come under increasing pressure. In some places buildings have been erected in the town parks, for example the State Museum of Art in Østre Park in Copenhagen and the Concert Hall in Esbjerg City Park. The pressure is most apparent in the case of locations used more informally as green spaces, however, for example the undeveloped spaces and green spaces in less built-up districts.

In Copenhagen and Frederiksberg Municipalities there is far less green space per inhabitant than in other municipalities (*Figure 5.3.6*). On the other hand, the local availability of green space in Copenhagen is good compared with Aalborg (*Figures 5.3.7 and 5.3.8*). There are more local green spaces in the town districts of Copenhagen than in Aalborg, where the green spaces are predominantly located on the outskirts of the town or as large isolated enclaves.

Parks

Parks are of great recreational significance. Studies have shown that in six of the largest Danish towns, 98% of the inhabitants have visited at least one green space during the preceding year. On average, the town dwellers visit the parks 2.7 times a week, with the people aged 7–16 being the most frequent visitors. Institutions and associations are also frequent users. Schools, sports associations and other associations pay an average of 100 visits to green spaces each year. The majority of people come on foot, and the shorter the distance to the nearest green space, the greater the number of visits. The forests are also very popular recreational facilities, attracting more visits than libraries and cinemas. Distance also plays a role here in that two thirds of all forest visits are payed to the forest located nearest to the home. The forests located near Copenhagen and Aarhus only comprise 2% of the total forest area, yet attract 20% of forest visitors at the national level.

Many town dwellers want alternatives to the traditional well-manicured town parks. In recent years the Municipalities have developed differential park management in order to ensure a varied biological content, thereby ensuring visitors a variety of possible experiences and concomitantly rationalizing park management.

Most people visit the parks to go for a walk, to get some fresh air and/or enjoy nature. The things they accord highest priority are basically the same (*Figure 5.3.9*). Associations and institutions are mainly interested in sensory experiences: To enjoy nature, the changing seasons, fresh air, the weather, etc. Actual activities are accorded lower priority. Nursery schools like to build dens, though, and both nursery schools and day nurseries accord importance to being able to play with things from nature. The wishes of the schools are more education-oriented, in the direction of learning something about nature. In the urban forests, people are mainly

Table 5.3.4

Geographic distribution of allotment gardens (2000) and coverage: Number of allotment gardens expressed in percent of the number of flats in apartment blocks. (Source: Spatial Planning Department, 2001).

	Overnighting permitted	Day use only	Allotment gardens total	Coverage %
Greater Copenhagen	22,209	8,478	30,687	**6**
Aarhus municipality	3,327	61	3,388	**5**
Odense municipality	3,713	5	3,718	**9**
Aalborg municipality	2,329	97	2,426	**6**
Other municipalities	13,210	8,721	20,931	**7**
Whole country	44,788	7,362	62,150	
Whole country, %	**72%**	**28%**	**100%**	

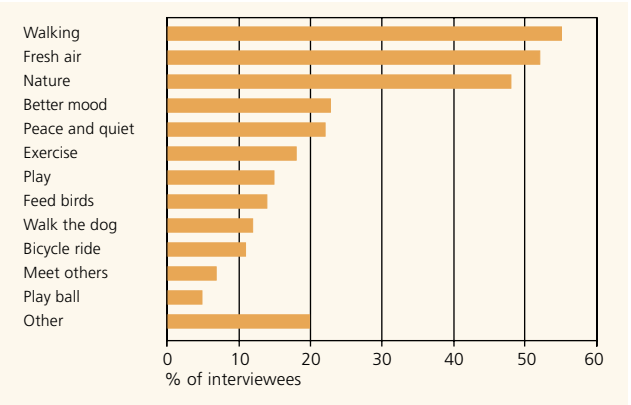


Figure 5.3.9
Motivation for the last visit to a green space.
(Source: Jensen & Koch, 1997).

attracted by the peace and quiet, and hence would rather have the forest for themselves and not meet any other forest visitors. The fewer people one meets, the better. If one has to meet other people, visitors prefer to meet families on picnics, people on horseback and joggers. Cyclists and hunters are just about acceptable too, but motorists and moped riders are at the bottom of the list.

Allotment gardens

Allotment gardens are the town's substitute for small household gardens. The allotment garden supplements the apartment. The number of allotment gardens in Denmark has fallen, many have short-term leases, and many are located far from the apartment blocks.

There are 62,150 allotment gardens in Denmark. They are shared between 1,019 associations or allotment garden districts, and approximately half of all allotment gardens are located in Greater Copenhagen (*Table 5.3.4*). Allotment gardens are to be found in 192 of the country's 275 municipalities. Around 16% have a lease of up to 1 year, and 32% have a lease of up to 10 years. 55% of all allotment gardens are located in the urban zone.

Animals in the towns

The towns are the habitat of many different animals. Of the species on the Danish Red List, i.e. species that are endangered, vulnerable or rare, 4.7% live in the towns. Many animal groups are represented – for example, there is no reason why certain amphibians cannot thrive in urban settings provided there is an adequate supply of good breeding ponds, natural habitats and green spaces for them to inhabit. Many amphibians, e.g. toads, thrive in private gardens, where they can often be found. Moreover, the green toad is specially adapted to life in urban environments. It breeds in paved ponds/canals and forages in sparsely vegetated areas. The special efforts made to aid amphibians in towns have naturally benefited them. A good example is Valby Park close to Copenhagen, where ponds have been dug for the green toad. This project succeeded: The toad now breeds there, and the population that was present in the area has been saved.

According to the Danish Ornithological Association's bird censuses, more than 100 bird species inhabit Danish gardens, of which 82 breed there, corresponding to half of all the bird species that breed in Denmark. The populations of animals and birds are not constant, and there is no clear sign of either an increase or a decrease. A bird such as the house sparrow is on the decline and has been so for a number of years. In contrast, the wood pigeon, the magpie and the crow are on the advance.

As regards mammals, the bat populations in the towns are firmly entrenched and have been so ever since buildings started to be constructed of solid materials. The badger has declined near towns, primarily because of disturbances resulting from increased recreational pressure on urban forests. Conversely, the fox has prospered. It can thus be concluded that animals able to adapt to the special environment of the towns (e.g. certain bird species, the bats and the foxes) are doing well, while animals that require peace and/or large undisturbed green spaces (e.g. the badgers) are not doing so well.

Urban space and the local environment of housing districts

The quality of towns correlates with the quality of the local environment in the housing districts and the public urban spaces. Over the past 20 years, much has been done to improve the local environment in the central parts of towns via urban renewal. In most major towns the housing that was in the worst condition with the poorest facilities has been improved. At the same time, many building courtyards have been renovated to ensure better local open spaces in even the most densely built-up town districts. In Copenhagen, for example, 125 building courtyards have been renovated since 1990. The concrete and asphalt paving is typically removed and the courtyard renovated with lawns, playgrounds, benches, barbecues and washing lines.

At the same time, the quality of the public spaces, promenades and squares has been improved in many towns. Pedestrian streets have been established in the town centres, market places and squares have been renovated, and roads with special speed restrictions have been established in the more open residential areas to ensure a safe and secure local

Photo: Highlight

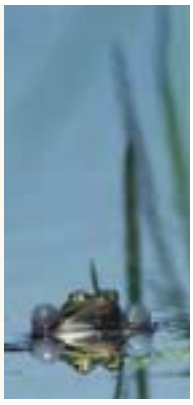


Photo: NERI/Lars Maltha Rasmussen

environment. In Odense there was only half a kilometre of pedestrian street in 1969, but over 3 km at the end of the 1990s. At the same time, the pedestrian streets are no longer solely used for shopping. A survey conducted in Sønderborg showed that 72% of the town's inhabitants go for a walk in the centre of the town at least once a week. The quality of the town's pedestrian streets and squares and the possibilities for pausing there are decisive determinants of how the urban environment is used.

Shop development

During the period 1987–95, half of all new shops were built in or near the few major towns. If this tendency continued, many small and medium-sized towns could eventually lose a good selection of shops. In order to counteract this trend, the Danish Parliament changed the retail trade provisions of the Planning Act in 1997. Since then, addenda have been drawn up to each County's Regional Plan detailing the overall retail trade structure. The Regional Plans have to ensure that the majority of the shops are located in the many town centres and not just outside the few major towns. This is achieved by designating central areas for use by shops, limiting the maximum size of stores and distributing the building of new shops throughout the town structure. The negotiations on Regional Plans for the retail trade sector will be completed in 2001. Supermarkets will be restricted to 3,000 m^2, and with few exceptions, other shops will be restricted to 1,000 m^2. The extent of planned retail trade developments has been reduced and distributed such that it will be possible to build new shops in many rather than just a few towns, that the shops are not larger than can blend in with their surroundings, and that they are built in areas located in the centre of the individual towns. As a result of the debate and the new Regional Plans, investments are once again being made in the town centres. In 2001, a relative increase in trade in town centres and a relatively weakened growth in trade in the peripherally located shopping centres have been detectable. All in all, the new plans reduce dependency on cars for shopping, but naturally also increase the need for careful environmental planning of the town centres.

Cultural environments in the towns

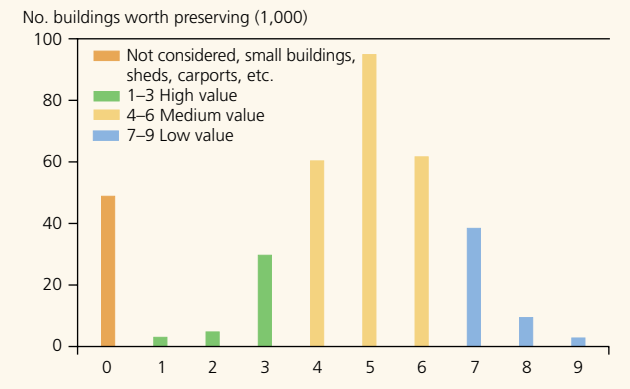
The cultural environments comprise an important part of the welfare society's wealth and hence of the Danish identity. Our physical surroundings are of great significance for our daily life and are decisive for our well-being.

The towns are large, complex cultural environments. The individual town can be perceived of as a coherent cultural environment, or one can separate out larger or smaller parts of the town and view these as individual cultural environments. The variety of buildings, streets, squares, market places and parks from various historical periods that together comprise a town are important factors for our daily well-being. Each town district has its own historical story value and is important for both our experience of the quality of towns and our understanding of our history and culture.

The old town centres with their historic street patterns, squares and older buildings with a known or recognizable history are easily understandable cultural environments worthy of preservation. It is more difficult to acknowledge newer, more modest suburban built-up areas, high-rise buildings, allotment garden areas, residential neighbourhoods, industrial districts, town boundaries, etc. as structures worthy of preservation. Nevertheless, they too comprise important historical layers of urban development and independent cultural environments that need to be safeguarded in order to maintain varied towns.

One of the important elements of urban cultural environments is the buildings. Thus preservation orders have been issued on approx. 9,000 buildings of special national interest, and a further 300,000 buildings have been designated as worthy of preservation. Cultural environments are also entities and coherence. Responsibility for care of urban cultural environments lies with the Municipalities as it is the Municipalities who define the guidelines for urban coherence through the Local Plans. In connection with the urban renewal currently in progress,

Figure 5.3.10
Preservational value of the buildings registered in the municipal atlases
(Source: Danish Forest and Nature Agency, 2000).



a conflict of interests can arise between urban concentration and preservation of the existing cultural environments.

In order to assist municipal urban planning, information on urban cultural environments has been collated over the past decade in the form of municipal atlases in which the individual buildings erected since 1940 are registered. Sixty Municipalities have so far drawn up such atlases, which together describe around 1,800 urban environments and approx. 350,000 buildings. On average, one third of the registered buildings have been designated as being of high preservational value (*Figure 5.3.10*). The result of the survey work is seen in the Local Plans, where approx. 20% of all Local Plans drawn up in municipalities with a municipal atlas contain preservation regulations as compared with 7% for municipalities without a municipal atlas. In 2000, 69 local preservation plans were drawn up encompassing 2,300 buildings. An example is illustrated in *Figure 5.3.11*.

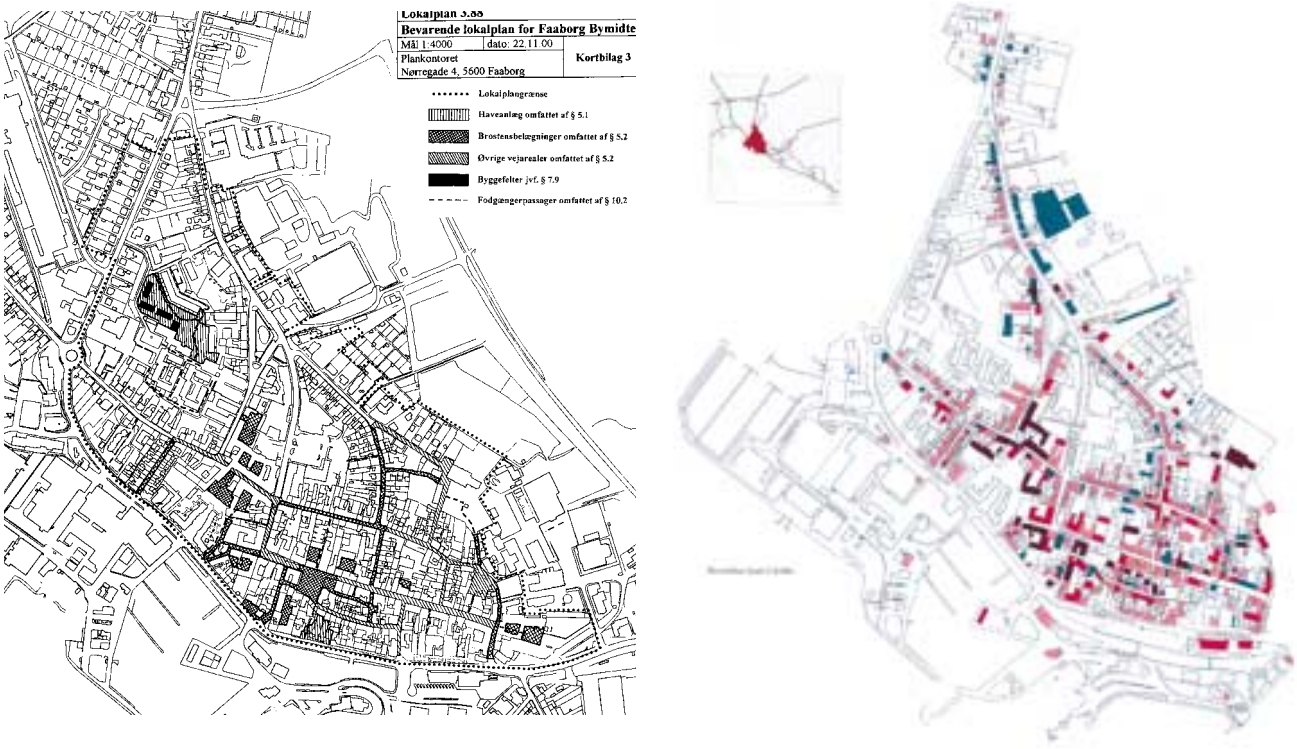


Figure 5.3.11
Preservational value of the town centre in Faaborg Municipal Atlas. The dark buildings are encompassed by preservation orders, the red buildings have high preservational value, the pink buildings have medium preservational value, and the grey buildings have low preservational value. Annexe to the preservation section of Faaborg Local Plan based on the buildings registered in the Municipal Atlas supplemented by paving, gardens and street structures that are also encompassed by the preservation regulations.
(Source: Faaborg Municipality).

Photo: Highlight

5.4 Urban environment – objectives and measures

Sustainable development

Town and country planning aims to ensure that societal development takes place in a sustainable manner. In recent years, the environmental dialogue between Municipality, County and State has become more effective. Environmental standards have led to less air pollution in the towns and a cleaner car fleet. At the same time, environmental management is becoming more common in public and private enterprises, and Agenda 21 initiatives in the towns are growing. The sustainable town unites a good overall environmental economy with a good monetary economy. The active Danish town exploits its possibilities in a network of towns in the neighbourhood, in the region and internationally.

Much is done internationally to attain a common understanding of the principles that promote the sustainable town. For example, several countries set specific goals for the share of the country's total urban growth that is to take place via reuse of the existing urban areas.

Inhabitants and users in the individual town and housing districts need to participate in this, among other means through a lifestyle whereby consideration for the environment and caution as to consumption of resources are integrated in everyday life. The town and its social life, buildings and infrastructure need to be organized and administered with the aim of considerably reducing resource consumption and pressure on the environment. The towns need to be vibrant and diverse, and the town centres need to be strengthened as centres of trade and culture. The individual parts of the town need to contain both homes, services, public institutions and sports facilities so that the town becomes more vibrant.

Areal growth of the towns needs to be restricted, and the older industrial districts and docklands need to be better exploited. Town functions that generate traffic need to be located such that the majority of people can advantageously use public transport. Moreover, the negative consequences of the increasing traffic in the towns need to be curtailed, and the environmental pressure in the towns needs to be reduced.

A varied range of homes needs to be available and efforts to combat urban decay need to be enhanced. Urban renewal should create a balance between new and old with the emphasis on quality, good architecture and urban ecology, while concomitantly safeguarding the cultural environments considered worthy of preservation. The quality of the recreational possibilities in the towns needs to be improved and allotment gardens safeguarded.

Photo: CDanmark

The increase in the standard of living and the division of labour have resulted in a marked growth in traffic, which is currently the greatest threat to the urban environment and hence to the overall quality of the towns. In order to limit growth in the amount of transport it is necessary to be very restrictive when it comes to incorporating rural land into the urban zone.

Instead, urban growth needs to take place on land that is already part of the urban zone. Development of the villages in the rural zone needs to remain possible, though, so that the local communities can be strengthened and preserved. The Government's principles in this area are specified in the Regional Plan statements.

Sustainable towns necessitate the formulation of principles for localization and traffic planning, among other reasons to ensure that an increasing part of the traffic is conducted by public transport, bicycle and on foot. In Greater Copenhagen this needs to be assured by such means as localizing new business developments in the vicinity of the railway stations.

The reports of the Industrial and Urban Policy Committee and the Government's Urban Policy Report contain a number of proposals for new initiatives and legislation intended to strengthen sustainable urban development as regards localization and land use. Among other things, demonstration projects will be used to stimulate the development of new urban structures that reduce demand for transport and promote public transport. This places demands on cooperation between and within the Municipalities and Counties. Strategies need to be developed for localization of shops, offices, institutions and homes in the towns in a way that reduces the impact of transport and ensures high-quality green spaces.

Expertise concerning sustainable building needs to be enhanced among the parties in the building sector, as does interest in and obligation to promote sustainable development. Moreover, the reports strongly recommend that efforts concerning urban ecology should be enhanced, including the development of sustainable products, environmentally sound project design, building material labelling and green accounts. The building regulations will be tightened, including further requirements concerning energy consumption and healthy buildings. The Building Panel's Action Plan for Environmentally Sustainable Building will be published in 2001. The so-called "acceleration fund" for the promotion of green building will support a number of development projects.

Approx. 1 million people or 20% of the Danish population inhabit towns in less densely populated regions. Increasing traffic mobility and access to information concomitantly promotes migration to the towns, urban sprawl and new divisions of labour. Many small towns survive as dormitory suburbs for a more centralized labour market.

While the Municipalities reserve very large areas of land for urban expansion, reuse of urban land progresses very slowly when the existing activities in an area cease (*Figure 5.4.1*). The Industrial and Urban Policy Committee has shown that several Municipalities reserve space sufficient for the future 40–100 years, and that the Municipalities base their projections of land use in 40 years time on the predominant present-day habits, for example within housing.

On the housing side, there is a need to create a wide selection of available homes. These have to meet the needs of younger population groups, who want to live in the central parts of the towns. They also have to meet the needs of young families with children, middle-aged couples and pensioners, who either want to stay in or move back to the central parts of the towns. At the same time, the most dreary housing districts need to be revitalized through partial conversion of the present housing stock to sheltered housing for the elderly, communal housing and young people's housing, etc., and through blending in new types of housing.

On the business side, the negative environmental impacts of enterprises have decreased so much that it is now possible to locate many of them in the town centres or housing districts. The Industrial and Urban Policy Committee has therefore examined the barriers to reuse of the urban area (former industrial districts and docklands). The Committee's six recommendations are together intended to eliminate the barriers to attainment of sustainable land use:

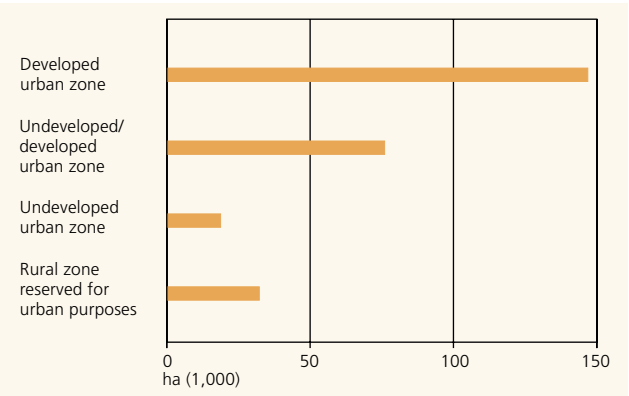


Figure 5.4.1
Area of Denmark used or designated for urban use, 1998.
(Source: Spatial Planning Department, 2001a).

	On currently undeveloped zone sites	In areas where building density can be increased	Total
Businesses, m^2	12 million	24 million	36 million
Houses, No.	40,000	30,000	70,000

Table 5.4.1
Space availability on undeveloped and partially developed building sites in Greater Copenhagen, 1998.
(Source: Greater Copenhagen Development Council, 2000).

- The possibility for establishing urban renewal associations within special urban renewal zones designated in the Municipal Plan.
- The possibility to exceed noise limits for a few years while the planned changes in the urban renewal zones are implemented.
- Amendment of the regulations so as to enable more ownership forms, homes and businesses to be mixed in the same buildings.
- Inspection of the construction potential in urban areas and undeveloped sites in urban and rural zones designated for development in the Municipal Plans, and stipulation of the sequence of urban development.
- Development of regional and joint municipal localization strategies that concomitantly minimize transport needs and promote use of public transport.
- Improving the data on which the Municipal and County Plans are based.

Noise

One of the general urban and environmental policy goals is to reduce the number of noise-plagued homes. This particularly applies to noise from traffic, railways and businesses, but also to noise from shops, recreational facilities, bars, discotheques, etc. The 1993 traffic plan "Traffic 2005" stipulates that the efforts so far made to combat noise should be continued and the objective tightened such that no more than 50,000 homes will be affected by noise levels exceeding 65 dB in the year 2010. As part of the follow-up on this objective, the Danish EPA and the Ministry of Transport in 1997 began paving the way for a national noise action plan focusing on noise from urban road traffic. This work will be coordinated with implementation of a coming EU directive on assessment and control of external noise.

Air pollution

In the EU, limit values for air quality have been in effect since 1980. These have subsequently been incorporated into Danish legislation in the form of Statutory Orders. Limit values exist for nitrogen oxides, sulphur dioxide, particulates, carbon monoxide, benzene, lead and ozone (*cf. Section 2.3, Table 2.3.2*). The measures to limit air pollution to ensure compliance with the limit values are implemented as restrictions on atmospheric emissions of the relevant substances (*cf. Section 2.2*).

Transport

In the transport area, the goal of the national sustainability strategy is to uncouple growth in the environmental and health impact of the transport sector from economic growth. The transport system shall provide the population with good access to work, shops, public services and recreational activities.

The station proximity principle is fundamental to regional planning in for example Greater Copenhagen. Localization of enterprises with intensive employment, other activities with a high visitor frequency or densely populated housing complexes near traffic hubs enhances the possibilities for reducing traffic problems such as:

- Air pollution
- Noise
- Safety
- Congestion

Success here requires continuous planning efforts.

Aarhus Municipality has calculated that it will be possible to locate all the urban growth anticipated for the next 12 years near railway stations in the existing town if the tram lines are extended appropriately. The barriers to the application of this principle are partly economic and partly that reuse of the existing urban area for urban development will be considerable. Aarhus County Council has nevertheless decided to apply the station proximity principle. In order to limit the amount of transport, housing and business areas will henceforth have to be localized where an effective public transport service can be assured, and most importantly, transport-generating urban functions with many employees or visitors will have to be sited near public transport hubs.

Many towns want large sites for new transport centres, but these wishes often lack coherence, especially with sustainable development. They seldom aim to improve coherence between transport forms and do not take into account how development on the IT front can change transport needs. Work has started on drawing up a strategy for a unified structure for transport along the Aarhus-Vejle-Padborg axis. The intention of the strategy is to reduce transport needs and increase the incentive to trans-ship goods between different means of transport. This will make the total transport more sustainable and will reduce the associated CO_2 emission. In addition, the strategy shall ensure that transport centres are only established where really needed.

Allotment gardens

In 2001, Parliament passed new legislation on allotment gardens. This essentially makes it difficult to terminate existing allotment gardens in both urban and rural zones.

Allotment gardens on state land and new allotment gardens have to be established on a permanent basis, and the number of allotment gardens is to be increased, especially in Greater Copenhagen, where expansion of allotment gardens is to be assured through incorporation into the Regional Plan. In the remainder of the country, expansion is to be assured through the Municipal Plans. By no later than 1 November 2001, the Municipalities are required to have notified which allotment garden sites are to be designated as permanent. Moreover, replacement sites have to be designated for those allotment garden sites that are not designated as permanent. Upon sale of allotment garden sites that are being terminated, the site tenants must be given the first right of purchase. Allotment gardens may only be terminated with the permission of the Municipal Council. Permanent allotment gardens may only be terminated under exceptional circumstances of vital interest to society that justify using the land for another purpose. This does not apply, for example, to a desire to establish new housing districts.

Strategy and municipal planning

In 2000, Parliament adopted an amendment to the Town and Country Planning Act that takes effect from 2003 and requires each Municipality to draw up a municipal development and planning strategy at the beginning of each election period. The aim is to stimulate cross-cutting collaboration within the Municipality and to better enable the Municipal Council to prioritize the main principles and measures for developing the municipality and to present these to the general public and other potential partners. The strategy must contain the Municipal Council's decision on the content and extent of the subsequent revision of the Municipal Plan. The amendment of the Act thus strengthens the requirement for sustainable development. At the same time it provides the individual Municipality with greater freedom of approach when planning, drawing up and implementing the strategy.

Local Agenda 21 up to Rio+10

Nowadays, virtually all populous urban municipalities are actively engaged in Agenda 21. This development has taken place since 1994. Moreover, it is anticipated that half of the municipalities and counties will be involved in Agenda 21 activities before the Rio+10 Conference in 2002.

With the above-mentioned amendment of the Town and Country Planning Act in 2000, the strategic side of the Agenda 21 activities has been strengthened. From 2003 onwards, each County and Municipal Council must draw up a strategy for the local Agenda 21 activities for each election period.

The authorities thereby hold a special responsibility for involving the local community in the efforts to ensure sustainable development. The strategy for Agenda 21 activities must contain an evaluation of the municipality's development towards sustainability.

Photo: CDanmark

5.5 Well-being in the towns

5.5.1 Introduction

The 1999 urban policy and perspective action plan "Town of the future" focused on "healthy, beautiful and exciting towns". One of the chief urban policy goals is "to promote development that highlights welfare, living conditions and quality of life in the towns". At present, though, well-being in the towns does not appear to be unconditionally good. Taking Copenhagen as a yardstick, people consider their health to be poorer than in the remainder of the country. The general quality of life is also slightly lower in both Greater Copenhagen and other major towns than in villages and in the country. One of the positive factors for well-being in the towns is the green spaces, which play an important role to the inhabitants. The spaces are well used, and are of significance for both physical and mental well-being.

5.5.2 State of health

The Danish Institute of Public Health studied the state of health of Danes in 1987 and 1994. A major new study is currently being carried out, but the results will not be available until the end of 2001/beginning of 2002. Figures are already available for Copenhagen based on a 1999 interview survey, however. A similar study was carried out in 1991. Together with Copenhagen Municipality's health profiles for the year 2000, this material provides a picture of the state of health in the country's largest town compared with the situation at the national level.

In 1999, almost three quarters (74%) of Copenhagen inhabitants rated their health as good or very good. The situation has not changed since 1987, when 75% rated their health as good or very good. The figure is still slightly below the national average, however. Thus in 1994, 79% of all Danes rated their health as good or very good.

In general, a higher percentage of citizens feel that their health is bad in Copenhagen than in the rest of the country. Around 11% of Copenhagen inhabitants often feel stressed in daily life, while the corresponding figure for the rest of the country is only 5%. Moreover, more people suffer from nervous disorders, angina, asthma, stomach ulcers and gynaecological diseases. In addition, male citizens of Copenhagen aged between 30 and 40 years have a considerably higher incidence of acute mortality (suicide, infarcts).

Copenhagen citizens have a shorter mean lifetime than the Danish population as a whole. This is chiefly attributable to illness caused by an unhealthy lifestyle combined with poor living conditions. The lifestyle factors involved include the consumption of alcohol and tobacco, the amount of exercise and being overweight.

There are considerable difference in lifestyle between the various districts of Copenhagen, however (*Table 5.5.1*). In the Inner Østerbro district, a greater than average percentage of inhabitants have a healthy lifestyle. Among other things there are fewer smokers and fewer overweight people than in Copenhagen as a whole.

At the other end of the scale lies the district Kongens Enghave, where many people have an unhealthy lifestyle. Thus the percentage of smokers and overweight people is higher than in Copenhagen as a whole. There is nothing to indicate that the inequalities have become greater since the latest survey in 1991.

In 1999, a greater percentage of Copenhagen inhabitants had been ill within the previous 14 days than the

Lifestyle		Attachment		Satisfied with home	
Town districts with a high percentage of inhabitants with either a healthy or unhealthy lifestyle – above and below the average of a number of lifestyle indicators, respectively		Town districts where inhabitants are strongly or weakly attached to the district – above and below average, respectively		Town districts where inhabitant satisfaction with their homes is high or low – above and below average, respectively	
Healthy	**Unhealthy**	**Strong**	**Weak**	**High**	**Low**
• Inner Østerbro	• Kongens Enghave	• Christianshavn	• Kongens Enghave	• Christianshavn	• Kongens Enghave
• Copenhagen City	• Southern Sundby	• Inner Østerbro	• Outer Nørrebro	• Inner Østerbro	• Outer Nørrebro
• Brønshøj-Husum	• Vesterbro	• Vesterbro	• Bispebjerg	• Brønshøj-Husum	• Bispebjerg
• Outer Østerbro	• Northern Sundby		• Outer Østerbro	• Northern Sundby	
• Valby	• Outer Nørrebro		• Vanløse	• Vesterbro	
	• Inner Nørrebro			• Copenhagen City	
				• Southern Sundby	

Table 5.5.1

In the Inner Østerbro district of Copenhagen the percentage of inhabitants with a healthy lifestyle is high, the inhabitants are strongly attached to the district, and they are satisfied with their homes. Conversely, in the Kongens Enghave and Outer Nørrebro districts a high percentage of inhabitants have an unhealthy lifestyle, they are only weakly attached to the district, and they are not very satisfied with their homes. (Source: Health Administration, 2000).

national average. Conversely, there is nothing to indicate that a greater percentage of Copenhagen inhabitants suffer from protracted illness than other Danes. Around 34% of Copenhagen inhabitants suffered from a protracted illness in 1999 as compared with 33% in 1987. Nationwide, the percentage of citizens with one or more protracted illnesses increased from 33% in 1987 to 36% in 1991 and 38% in 1994.

Inhabitants of Copenhagen more rarely have headaches and muscle and skeletal pains. On the other hand, they are more afflicted by tiredness, depression and digestive disturbances. Absence from work due to illness is also greater.

Photo: CDanmark

Inhabitants of Copenhagen also use more medicine than other Danes, but consumption remained almost unchanged between 1991 and 1999.

5.5.3 Quality of life

The Quality of Life Research Institute investigated the quality of life of Danish citizens by means of a population study in 1995. The quality of life was measured both in relation to subjective factors (how do people think they feel?) and objective factors (do people have the things and the status the culture suggests that they should have?).

Among other things, the quality of life is measured relative to whether people live in the capital, a major town or a suburb, a village or in the countryside. The results show that people who live in a village or in the countryside generally have a slightly better quality of life than people who live in major towns. Thus the quality of life in Copenhagen is an average of approx. 5% lower than in the countryside or in villages.

In major towns and suburbs, the quality of life is only slightly lower than in the countryside and in villages. Thus there is only a limited difference between the quality of life in the towns and in the countryside. The study also shows that the type of housing is of greater significance for the quality of life than whether one lives in the countryside or in a town. A weighted average for the quality of life shows that inhabitants of Copenhagen lie 3.7% below the national average, and that the weighted figure for villages is 2.5% above the national average. The deviations are generally so small that it is difficult to talk about an actual trend, however.

There is virtually no difference in the quality of life from one county to the next. Only Bornholm County lies significantly below the national average, while Copenhagen County, which has the characteristics of a city, lies slightly below the national average. Ringkøbing County lies slightly above the national average.

5.5.4 Importance of recreational possibilities

The green spaces seem to be an important positive factor as regards well-being in the towns. For example, the majority of inhabitants of Sønderborg think that the best thing their town has to offer is the nature, the water bodies and the forest. Only thereafter do they mention shopping possibilities, educational facilities, the harbour, the cafés, the pedestrian street and the theatre.

The relationship to the nature in the local environment also plays a role for the quality of life. Those who state that they are very satisfied with the nature in the local environment have on average a 5% better quality of life than the national average. Conversely, those who are very dissatisfied feel on average 7% worse. Moreover, there is a correlation between quality of life and the time that has passed since a person has last been out in nature. Those who have been out in nature within the previous few days lie a good 15% higher as regards overall quality of life than people who were last out in nature more than a year ago. In the studies nature is interpreted as something like "to be away from the town" or "to be away from one's home".

The green spaces provide attractive experiences. A number of Swedish and American studies show that they are also of direct significance for our physical and mental well-being. One can actually measure an effect on blood pressure and muscle coordination. American scientists conclude that even short contact with somewhere green can help compensate for the stress of urban life.

It appears that a view of somewhere green is of such great importance that it can help hospital patients to recover more quickly. An American study shows that patients with a green view can be released from hospital an average of one day earlier following an operation. The scientists' theory is that a view of somewhere green has both a soothing effect and is experienced as familiar and homely relative to the more alien hospital environment.

In the workplace, a green view can help employees to feel less stressed and irritable. A Swedish and an American study have found that employees with a view of trees and flowers were more satisfied and thought that their job was less stressful than those who could not look outside, or who could only see buildings. Moreover, these employees were less frequently ill and had less headache.

Another Swedish study concludes that children who play in nature playgrounds are less ill, are better able to concentrate and have better motor function than children who play indoors a lot or in a traditional playground. Among other things, this is attributable to the fact that nature playgrounds provide good possibilities to be alone, to find a breathing space where one can relax.

The essence of the matter is that daylight ensures that our biological clock is correctly adjusted relative to the time of day and year. One therefore sleeps better at night when one spends a lot of time outdoors. Conversely, a lack of daylight can disturb the biological clock and cause depression. In the case of elderly people it is particularly important to get sufficient daylight. The ultraviolet light in daylight stimulates the formation of vitamin D, which helps prevent osteoporosis. A Swedish study shows that half an hour outside every day is sufficient to achieve this effect.

The effect on mental well-being is somewhat more vague. Among other things, studies show that green spaces are of importance for our mood and feelings of vigour and self-assurance. Urban life can be experienced as stressful because our subconscious experiences the rapid movements, strong colours and sudden noises as a sign of danger. We therefore use more energy on remaining alert when we are in towns. The brain has to continually process the many impressions. In contrast, green spaces can have a calming effect because they only impose upon our spontaneous awareness. The impressions here do not require the same degree of processing.

5.5.5 The development

As early as the mid 19th century, doctors became aware of the beneficial health effects of light, open air and green spaces. This led for example to the construction of hospitals with wards having large south-facing windows or with detached pavilions in park-like surroundings. During the same period, large areas of land in the towns were zoned as parks, allotment gardens and playgrounds.

Today it seems that the beneficial health effects of green spaces have been forgotten somewhat. Museums and concert halls have been built in several large parks, houses have been constructed with poorly used open spaces, and child-care institutions have been established virtually without playgrounds. Part of the explanation may be that the general state of health is fundamentally good.

In recent years, though, the tendency has been to use the green spaces, for example in the treatment of patients with senile dementia. General awareness of the beneficial effects of green spaces on health is not very great, however.

Photo: CDanmark

Photo: CDanmark

5.6 Theme – Environment and health

Human health and well-being are affected by a large number of factors in everyday life. These include composition and quality of the diet, lifestyle, indoor climate, conditions at the workplace or pollution of the surrounding environment and the products we use. In recent years, increasing attention has been focused in Denmark and abroad on the effects of environmental factors on human health. It can be very difficult to isolate the significance of the state of the environment for the state of human health, however.

5.6.1 Introduction

The intention of this theme is to summarize our present knowledge of the effects of environmental factors on human health. Much of this knowledge is conjecture that can to some extent be substantiated by the trend in the state of public health. At the international level in particular, new knowledge is being accrued on the effects of environmental factors on human health that will hopefully contribute to a better understanding of the issue.

In the present context, environmental factors are subdivided into chemical, physical and microbiological factors. Chemical substances can occur in soil, water and air, as well as in foods and the products we use. Examples of physical factors are noise, particulates in the air, radiation and the nature of the physical surroundings, including the distance to and extent of nature and recreational areas. The microbiological factors include naturally occurring and introduced micro-organisms such as bacteria and vira.

Man comes into contact with environmental factors in so many different ways that it is difficult to assess and describe the significance for health of the individual factors in detail. Among other means, man is exposed to environmental factors through pollution of the air, soil and water, through foods, waste or chemical substances and products used at work and at home.

The areas in which it is acknowledged that human health is affected by environmental factors are summarized in *Table 5.6.1* and include allergy, respiratory disorders, cancer and fecundity problems.

The health effects of chemical environmental factors include hormonal disturbances, abnormal development, damage to the nervous system, cancer, allergy, multiple chemical sensitivity ( ), fecundity problems and harmful effects on the immune response. hysical environmental factors can cause cancer, including skin cancer (

Health impacts	Associations with some environmental exposures
Infectious diseases	• Water, air and food contamination
	• Climate change
Cancer	• Smoking and environmental tobacco smoke (ETS)
	• Some pesticides, e.g. phenoxy herbicides
	• Asbestos
	• Natural toxins
	• Foods, e.g. low fibre, high fat
	• Polycyclic aromatic hydrocarbons, e.g. in diesel fumes
	• Some metals, e.g. cadmium, chromium
	• Radiation (incl. sunlight)
	• Several hundred other animal carcinogens
Cardiovascular diseases	• Smoking and ETS
	• Carbon monoxide (CO)
	• Lead
	• Inhalable particles
	• Foods, e.g. high cholesterol
	• Stress
Respiratory diseases, incl. asthma	• Smoking and ETS
	• Sulphur dioxide
	• Nitrogen dioxide
	• Inhalable particles
	• Fungal spores
	• Dust mites
	• Pollen
	• Pet hair, skin and excreta
	• Damp
Skin diseases	• Some metals, e.g. nickel
	• Some pesticides, e.g. pentachlorophenol
	• Some foods (allergies)
Diabetes, obesity	• Food, e.g. high fat
	• Poor exercise
Reproductive dysfunctions	• Polychlorinated biphenyls (PCBs)
	• DDT
	• Cadmium
	• Phthalates and other plasticizers
	• Endocrine disruptors
Developemental (foetal and childhood) disorders	• Lead
	• Mercury
	• Smoking and ETS
	• Cadmium
	• Some pesticides
	• Endocrine disruptors
Nervous system disorders	• Lead
	• PCBs
	• Methyl mercury
	• Manganese
	• Aluminium
	• Some solvents
	• Organophosphates
Immune response	• UVB radiation
	• Some pesticides

Table 5.6.1
Health impacts associated with environmental factors.
(Source: EEA, 1999).

Over the past decades the incidence of allergy in the population has increased, and Denmark has a higher incidence of testicular cancer and a higher frequency of breast cancer in women relative to other OECD countries. This development is unlikely to be attributable to genetic disposition alone. The OECD estimates that 2–6% of disease in the OECD is attributable to environmental factors. The estimates for a number of diseases are shown in *Figure 5.6.2*. The figures show that environmental factors are of major significance for a number of diseases in non-OECD states, and that it is diseases coupled to biological environmental factors that predominate.

Environmental factors can play a role in the development of allergy and hypersensitivity. Approximately 5% of Danish adults and 6–7% of Danish children suffer from allergy in the medical sense, but up to 25% of the population experience hypersensitivity reactions. The latest figures for hypersensitivity derive from a 1994 study. It was estimated that 15–20% of the population suffer from contact allergy towards chemical substances. At the same time, the incidence of respiratory allergies has increased.

In Denmark, the number of new cases of cancer has increased from just over 9,000 per year in the 1940s to 28,222 in 1996. Throughout the whole period under consideration there has been a true increase in the number of new cases of cancer in Denmark (*Figure 5.6.3*). For men, the rate of new cases per 100,000 (age-standardized) for all types of cancer jointly has increased by 73% from the interval 1946–50 to the interval 1991–95. For women, the corresponding increase was 54% during the same period. Over half of the cases of cancer affect people over 65 years of

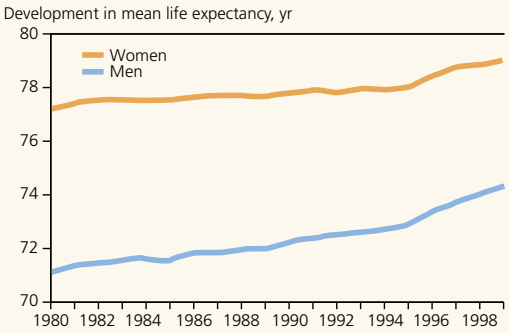


Figure 5.6.1
Development in mean life expectancy in Denmark over the period 1980–2000. (Note: Mean life expectancy is calculated in Denmark as an average of two calendar years. The mean life expectancy for the year 2000 is thus the average of the mean life expectancy for 1999 and 2000).
(Source: Statistics Denmark, 2000).

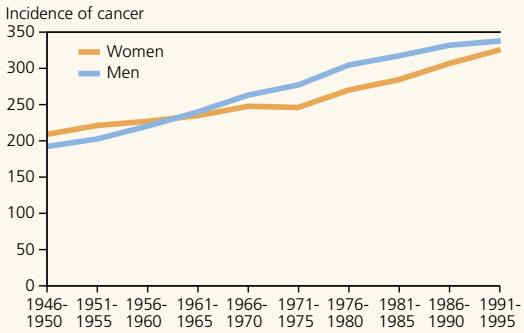


Figure 5.6.3
Incidence of cancer per 100,000 in Denmark over the period 1946–96 age-standardized to the world population.
(Source: Ministry of Health, 2000).

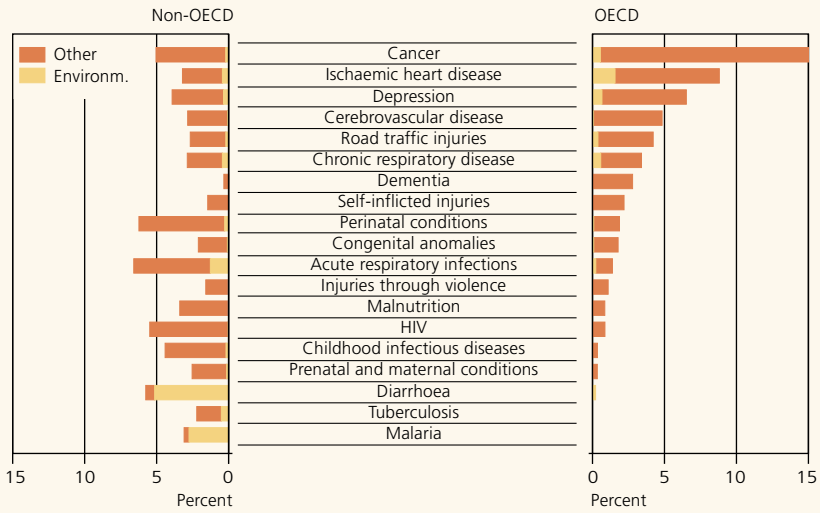


Figure 5.6.2
Patterns of disease burden with estimated environment-related shares.
(Source: OECD, 2001).

age. At the same time, cancer is the most frequent cause of death among persons aged under 65 years. Part of the increase, although far from all, is explicable by the fact that Danes are becoming older.

It is now known that environmental factors can play a role for the risk of developing cancer. It is not known with certainty how great a percentage of the increase is attributable to environmental factors, however. For example, it is known that the presence of (previously used, now phased-out) pesticides in human blood is associated with a higher risk of cancer, and that radioactive gasses from the subsoil can infiltrate into inhabited rooms and, if the ventilation is inadequate, increase the risk of cancer.

A number of substances can cause hormonal disturbances, primarily persistent organic pollutants and heavy metals. It is also suspected that hormone-like substances affect semen quality.

5.6.2 Chemical environmental factors

Chemical environmental factors include both the xenobiotic, man-made chemical substances and products, and the naturally occurring chemical substances and heavy metals.

At the European level, it is estimated that more than 30,000 different chemical substances are presently in use. Among other reasons, this is due to a trend towards increasing substitution of natural substances by synthetic chemical substances. It is estimated that there are approx. 20,000 different chemical substances on the market in Denmark, and approx. 100,000 worldwide. Analyses show that our knowledge of the various substances' properties is very inadequate, though. With about 70% of all substances in use, absolutely no information is available concerning their properties or effects on human health. Moreover, very little is known about how man is affected by exposure to mixtures of the many existing chemical substances.

The number of new chemical products notified to the Danish Product Register in recent years has been greater than the number of products that have been withdrawn. This means that there has been net growth in the number of chemical products. A rough estimate is that chemical substances are present in more than 200,000 different goods. As a consequence, chemical substances are transported from the chemical industry to other manufacturing sectors and from there via numerous consumer products to eventually end up in the waste streams. In all stages of this cycle, chemicals will be lost to the environment. Man is exposed to chemical substances from both the air, the water and the soil, as well as via direct contact with products, including foods (*cf. Section 1.6).*

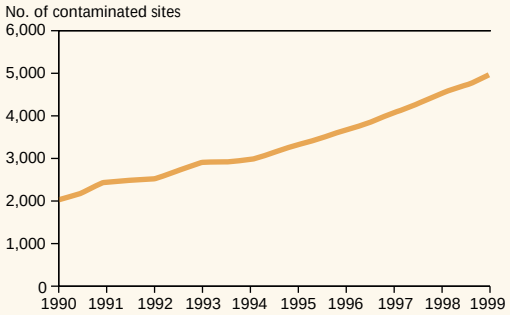


Figure 5.6.4
Development in the number of contaminated sites.
(Source: Danish Environmental Protection Agency, 2000).

Soil and chemical contamination

Soil is the habitat of the majority of the animals and plants that comprise our foods. The soil is constantly affected by human activity, and in many places is consequently contaminated (*Figure 5.6.4*).

In 1999 there were a total of 4,940 registered contaminated sites, of which 1,830 are designated as priority sites for remediation. Of the priority sites, 617 are presently used for habitation, 1,022 threaten the groundwater, and the remaining 191 are used both for habitation and threaten the groundwater. The contamination happened as a result of commercial activities, pesticide use, deposition of waste, intensive traffic, etc.

Human exposure to soil contamination depends on the use of the site. Exposure can occur by direct intake through the mouth, through the skin or by inhalation. Children are generally considered to be most exposed in that they are both the most sensitive to contamination and are often subject to the greatest exposure during play, for example by actually eating soil. Their size relative to their intake means that the effects can be relatively great. In the case of soil contamination with organic solvents, the contaminants often evaporate through the ground and foundations into houses, thereby detrimentally affecting the indoor climate.

Heavy metals, especially lead, and tars dominate diffuse soil contamination from traffic and construction filler in older town districts, while substances such as organic solvents and oil/petrol dominate in contamination derived from commercial activities. When the soil is contaminated with mobile substances, the contamination can spread to the groundwater and thereby threaten the drinking water supply.

Mercury, cadmium and lead pose the greatest health hazards among the metals because they accumulate in the body. The most critical health effects of mercury and lead are the effects on the development of the central nervous system. These manifest as learning and memory difficulties, etc. Short-lasting exposure to for example high levels of lead causes acute toxicity. With longer exposure, even at small doses, irreversible damage can result. Studies in


Photo: Highlight

Photo: Highlight

experimental animals and man indicate that unborn foetuses and young children are the most sensitive to heavy metals. Foetuses become exposed due to the metals load accumulated in the mother, while young children can be exposed to large daily intake, for example by inadvertently eating contaminated soil.

Heavy metals can also be taken in via foods. Small amounts of lead can occur in many different foods, especially as a result of air pollution. The main sources of lead intake are wine, fruit and vegetables, as well as cereal products. Compared with other countries, the daily lead intake by Danish consumers is low – 0.027 mg/day. This corresponds to approx. 10% of the permitted total weekly intake (PTWI set by JECFA – Joint FAO/WHO Expert Committee for Food Additives and Contaminants).

Dietary intake of mercury predominantly stems from fish and marine mammals as a result of their position in the food chain. Mercury largely derives from deposition of volcanic ash in the sea and from coal-fired power stations, but previously also derived to a considerable extent from industrial pollution. The intake of mercury is calculated to average approx. 0.005 mg/day, corresponding to approx. 10% of the PTWI set by the WHO. This PTWI value does not apply to women of childbearing age, however, as a lower limit for damage to the foetal brain could not be determined.

Cadmium primarily accumulates in liver and kidneys, and is mainly toxic to the kidneys. As cadmium accumulates in the kidneys over a span of many years, the effects are mainly seen in elderly people and can contribute to kidney problems. Intake of cadmium by Danes is high, and the safety margin is not very large. The intake of cadmium is calculated to average 0.017 mg/day, which corresponds to approx. 25% of the PTWI set by JECFA.

The level of protection against soil contamination is determined through risk assessments and the use of health-based quality criteria. The quality criteria are an expression of the level at which it is certain that effects harmful to health do not occur, and in the case of soil are set so as to take into account the most sensitive uses: Vegetable gardens, child-care centres and playgrounds (*cf. Section 4.4*).

Contamination of drinking water

The most frequent sources of contamination of water abstraction wells are pesticides and their degradation products, nitrate and thereafter microorganisms such as bacteria.

In recent years, pesticide residues and their degradation products have been increasingly detected in the groundwater. The health-based limit value for drinking water is 0.01 µg/l. The figures for pesticides and pesticide degradation products detected by the waterworks' in-house control during the period 1993–99 revealed that of the 5,774 wells tested, pesticides or degradation products were detected in 1,396 (24%). The limit value was exceeded in 509 (9%) of the wells.

As regards the 90,000 small private water supplies, which usually consist of one single abstraction well, the most frequent types of contaminant are bacteria or nitrate, and are often attributable to poor construction of the water supply system. The bacteria can also result from the water remaining in the pipes too long (*cf. Section 5.6.3*).

Pesticides are primarily used in agricultural production and encompass substances with very different effects on health. They can affect the nervous system, fecundity, hormonal systems, and a large number of different organs. A common feature of all the pesticides used in Denmark is that they are subject to an approval scheme whereby all active ingredients are tested thoroughly for up to three years to determine their effects on both human health and the environment (*cf. Sections 4.5 and 3.3*).

Pesticides can also occur in foods. For the average Dane, however, pesticide daily intake via the food is typically around or under 1% of the ADI (Acceptable Daily Intake), which is set internationally by the FAO/WHO Expert Group JMPR, and in Denmark by the Ministry of Food, Agriculture and Fisheries. It is estimated that 2/3 of this intake derives from foreign products. Since 1969, nationwide control studies of pesticide residues have been carried out with both Danish and foreign foods. The control studies primarily encompass fruit and vegetables. The limit value is complied with in 98–99% of the samples. This corresponds to the results of similar studies in our neighbouring countries and in the EU.

Air pollution

By far the dominant source of air pollution in Denmark is use of the fossil fuels, coal, oil and natural gas, including the petrol and diesel oil used in traffic. From the health point of view the main pollutants are SO_2, NO_x, NMVOC, CO and dioxin (*Table 5.6.2*). Another very important factor is particulates (*cf. Section 5.6.3*). Prior to the phase-out of leaded petrol the lead content of the air was also a major health problem. This has now been eliminated in Denmark, though.

The quality of the air in Danish towns and in the background areas has been monitored since 1982 under the Nationwide Air Quality Monitoring Programme (*cf. Sections 2.3 and 2.4*). The measured concentrations of NO_2 and NO are far below the applicable limit value for these substances. The same applies to SO_2.

The ozone concentration in Denmark is largely determined by transport from countries to the south and west of Denmark. In the case of ozone it has not been possible to demonstrate any lower threshold value for its harmful effects. An hourly mean threshold value of 180 µg/m³ has been introduced at which a public warning has to be issued. In 1999, this level was exceeded on one occasion in a rural district. Ozone and particulates are considered to be associated with a not insignificantly increased morbidity and mortality among the population.

Emission of dioxins from combustion processes comprises another health problem. Dioxins are extremely toxic substances that among other things cause weakening of the immune response and are carcinogenic. It is not the level in the air *per se* that is the problem, but rather the accumulation in the environment and in our foods. The Danish population is estimated to be exposed to dioxins and dioxin-like substances to an extent exceeding the tolerable daily intake (TDI) set by the WHO. As the WHO concomitantly states that their TDI value is unlikely to protect the population against certain mildly harmful effects, dioxins – despite falling concentrations in the Western world – are still considered to pose a problem.

Photo: CDanmark

Source	SO_2	NO_x	NMVOC	CO	Dioxin
Combustion in energy industry	37,145	55,964	1,699	13,325	
Non-industrial combustion plants	3,293	6,694	7,904	130,801	
Combustion in manufacturing industry	8,536	15,169	683	6,075	
Production processes	1,359	451	5,071	0	
Extraction and distribution of fossil fuels	0	0	5,539	23,799	
Solvent and other product use	0	0	38,535	0	
Road transport	1,267	69,258	46,071	269,391	
Other mobile sources and machinery	4,264	57,837	20,004	94,826	
Waste treatment and disposal	50	4,798	1,349	3099	
Agriculture	0	0	1,191	0	
Other sources and sinks	0	0	14,095	0	
Total	**55,912**	**210,171**	**142,143**	**541,316**	**95**

Table 5.6.2

Emissions of SO_2, NO_x (expressed as NO_2), NMVOC, CO and dioxin apportioned by type of source in 1999 in tonnes/yr except for dioxin, where the unit is g/yr. The two main sources of dioxin pollution are waste incineration and combustion of wood and other biomass. Together these sources are estimated to account for half of all dioxin emissions.

(Source: National Environmental Research Institute, 2000).

Chemicals and the working environment

The working environment is also affected by the consumption of chemicals. Exposure to chemicals during working life contributes to many serious injuries, both acute and chronic (*Figure 5.6.5 and Figure 5.6.6*). The Danish Working Environment Service's 1994 discussion paper "On the road to a cleaner working environment" states that there is a lack of awareness of the relationship between working conditions and the development of cancer. According to the Service, the number of work-related cases of cancer is underreported. Reporting of a number of other work-related ailments is also subject to some degree of uncertainty as regards the relationship between environmental factors and health effects.

Products and consumer goods

Many consumer goods are not generally considered as possible sources of environmental factors, despite the fact that chemical substances and products are used in the manufacture of consumer goods. Chemical substances can be present in products because they serve a specific purpose such as part of the material's structure, for stabilization purposes, for decoration, etc. Examples of chemical substances that were intentionally part of a product, but which are now unwanted and perhaps even prohibited, are cadmium and lead used to colour enamel and glazing, phthalates in plasticizers in PVC, and certain surfactants in detergents and cleaning agents.

Residual concentrations or contaminants from a substance in a finished product can also pose a health problem. The concentrations will often be so low that there is no worry of acute poisoning, but it is rather the long-term effects associated with exposure to the substances that might pose a problem.

The indoor climate can be affected by the choice of building materials due to long-term effects. Volatile substances are attracting particular attention as volatilization from walls and floors can result in high concentrations, especially in enclosed rooms with large surfaces.

Ecolabelled products provide users and consumers with the possibility to avoid products with hazardous effects on the environment and health (*cf. Section 1.6*).

Photo: NERI/Patrik Fauser

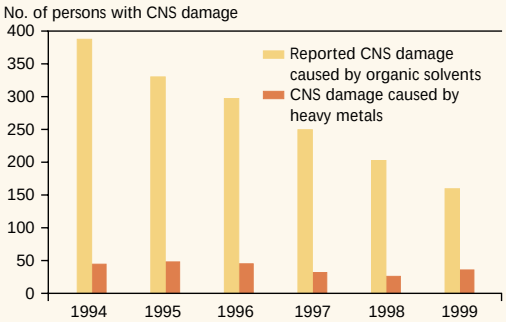


Figure 5.6.5

Number of persons with central nervous system (CNS) damage purportedly attributable to exposure to organic solvents and heavy metals.

(Source: Danish Working Environment Service, 2001).

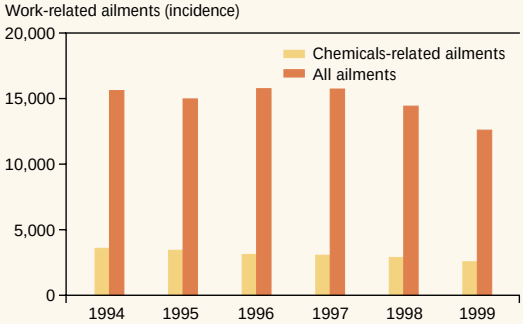


Figure 5.6.6

Work-related ailments indicating ailments related to chemicals. The ailments selected to represent chemicals-related ailments are cancer, neurological diseases, CNS disorders, allergic and non-allergic respiratory disorders, and skin diseases.

(Source: Danish Working Environment Service, 1999 and 2000).

5.6.3 Physical environmental factors

The physical environmental factors include noise, radiation and particulates, as well as the nature of the physical surroundings. Particulates can occur in harmful concentrations in urban areas.

Noise

In the modern society, people are exposed to noise at home, at work, during transport, and sometimes in their leisure time. Noise is the environmental factor that attracts greatest attention among the public. Many people complain about bothersome noise. Sometimes, especially in certain work situations, the noise can be so loud as to pose the risk of permanently damaging to hearing. In connection with some leisure activities (e.g. concerts), noise levels can also be so high as to cause damage to hearing. Noise disturbs conversation and communication, and interferes with rest and sleep. Noise can therefore cause both physiological symptoms (e.g. raised blood pressure and ischaemic heart disease), as well as mental and psychosocial symptoms. Noise affects people's performance, and reduces the learning ability of pupils. These health effects are diffuse, and they are usually only demonstrable after long-term exposure to noise. In connection with the external environment the nuisance caused by noise is usually used as an indicator of its effects on health – this is referred to as noise nuisance.

For most types of noise there is a reasonable knowledge of the relationship between the noise level and the percentage of the population who claim to be bothered by the noise. The recommended limit values are based on this relationship. The Danish EPA has published recommended limit values for most types of noise in the external environment. The noise limits are an expression of the level of nuisance considered to be environmentally acceptable, i.e. a balance between the effect the noise has on people, and practical considerations. Some of the recommended limit levels are based on comprehensive studies (traffic noise and firing noise in particular are well studied), while those of other types of noise are based much more on experience. The greatest noise problems in Denmark are attributable to the still growing traffic, especially road traffic (*cf. Section 5.3*).

Particulates

The airborne particles are less than 20–30 µm in size. It is unclear to what extent the primary factor responsible for their health effects is their physical properties and number, or their chemical content (or a combination of both).

Complete emission estimates for particulates are not available at present. Measurements are available for urban areas, however. The total particle concentration (TSP) in town air lies between a half and a quarter of the limit values. TSP consists of a mixture of particles from several different sources, of which whirled-up soil dust is the most important. TSP levels are tending to decrease, partly due to better control of particulate emissions from combustion processes, power stations and traffic. The new limit values for particulates will pertain to PM_{10} (i.e. particles with a diameter of less than 10 µm). In 1999, measurements in Copenhagen showed that the annual mean was close to the limit value of 40 µg/m³ that will apply from 2005, and that daily mean values exceeding 50 µg/m³ occurred more frequently than the permitted 35 times per year. From the health point of view, PM_{10} is hardly the most relevant particulate fraction. Everything indicates that the ultrafine particles (0.01–1 µm) play an important role as regards the hazardous effects of particulates.

The fine particle fraction $PM_{2.5}$ is considered to be the most important factor detrimentally affecting public health. Based on the knowledge accrued over the past ten years the effects on public health seem to be considerable, among other reasons because there does not seem to be any lower threshold below which the particles do not have harmful effects. The overall assessment is that as pollutants, ozone and particulates are associated with a not insignificantly increased morbidity and mortality among the population. The effects are expected to be particularly noticeable in vulnerable groups comprised of persons with respiratory disorders and cardiovascular disorders – two groups that together comprise a large percentage of the population.

In the Danish context it is estimated that a reduction of for example 5 µg/m³ $PM_{2.5}$ from 15 µg/m³ $PM_{2.5}$ will reduce mortality by 3.5%. Among a population of 1 million Danes with an annual mortality of approx. 12,000, this corresponds to a reduction in mortality by 400 deaths.

Nature of the physical surroundings

The physical environmental factors also include the nature of the physical environment in towns and around housing and businesses. There is thus a well-documented relationship between how much time people spend outdoors and the proximity of green spaces. Outdoor behaviour means increased physical activity and exposure to daylight and has a large number of positive psychophysiological effects on illness of both a preventative and curative nature. These primarily concern a number of lifestyle-related ailments, including obesity, maturity onset diabetes, cardiopulmonary disease, stress and learning and concentration difficulties.

5.6.4 Microbiological environmental factors

The microbiological environmental factors consist of a number of pathogenic microorganisms. Microorganisms encompass a broad spectrum of bacteria, vira, fungi, protozoans, algae, etc. The organisms are often naturally occurring, but can also be provoked through anthropogenic changes to the environment, e.g. by an excess of nutrients leaching from farmland. The microorganisms can also be released into the environment in discharges of untreated wastewater and through the application of manure.

Man can be exposed to microorganisms such as bacteria, vira and protozoans via bathing or drinking water and food. If taken in, these might cause disease. Airborne exposure (aerosols) is also known.

The well-known bacteria campylobacter and salmonella can occur in food, as well as in nature. Salmonella can occur in manure, and campylobacter can occur in surface waters (bathing water), but exposure typically occurs via food and drink. Microbial infection via drinking water has been recorded to a limited extent, whereas the cause of outbreak has only been identified in a few cases.

Manure application

Spreading of manure on farmland can cause possible health effects through inhalation of ammonia vapour or of the aerosols, which can contain pathogenic microorganisms such as salmonella and giardia. The aerosols are formed upon the spreading of slurry diluted with water using watering canons or overall spreaders. The use of watering canons for spreading slurry diluted with water has now been prohibited. The ban was implemented through an amendment to the Statutory Order on livestock manure, and entered into force on 1 August 2001. Overall spreading of liquid manure will be banned from 1 August 2002, primarily to limit ammonia volatilization. Together, these two amendments mean that all future spreading of slurry has to be based on techniques whereby it is inserted directly into the soil or applied beneath the vegetation using trailing hoses.

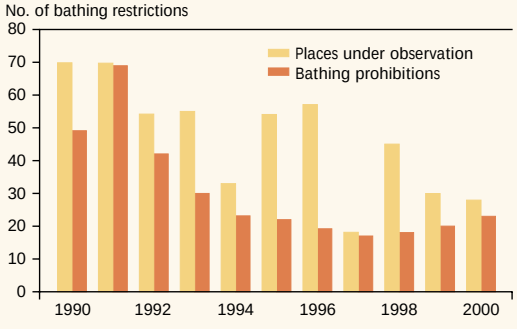


Figure 5.6.7 Development in the number of bathing prohibitions and number of beaches under observation. (Source: Danish Environmental Protection Agency, 2001c).

Wastewater and sewage sludge

Wastewater can comprise a health risk if it comes into contact with drinking water or bathing water because it might contain pathogenic microorganisms. In addition, the use of sewage sludge as fertilizer can have consequences for health. With the existing wastewater treatment system it has largely been possible to reduce exposure of the population to wastewater and hence to the pathogenic bacteria and harmful chemical substances it contains.

Sludge from wastewater treatment plants can pose a risk of infection, chiefly when spread on farmland. In recent years, attention has focused on ensuring that the sludge is applied in a manner that cannot result in the transfer of pathogenic bacteria to man. Sludge from wastewater treatment plants that is used in accordance with the regulations stipulated in the Statutory Order on sewage sludge does not lead to the transfer of microorganisms. Moreover, limit values have been introduced for four hazardous organic substances: PAHs, LAS, DEPHs and NPE (*cf. Section 4.4*).

Bathing water

The quality of the bathing water in Denmark has improved over the years and is now of a very high standard. This is reflected by the fact that the number of bathing prohibitions and observation orders issued due to inadequate water quality has decreased relative to previous years (*Figure 5.6.7*). The assessment of bathing water quality is based on more than 15,000 water samples from 1,300 monitoring stations distributed along the coastal beaches and lake banks.

Considerable efforts are still being made to eliminate those sources of pollution that deteriorate the quality of the bathing water. The means to achieve this end are county and municipal planning, design of wastewater systems, discharge standards for wastewater treatment plants, supervision and monitoring of bathing water quality, and, if necessary, closure of bathing beaches whose water quality is unsuitable for bathing. Despite these efforts, there are still a number of places where bathing is prohibited because the water is unsuitable for bathing, and there are a number of places where water quality is inadequate and bathing is therefore advised against and the beach is held under observation.

There are places where the bathing water is affected by discharge of untreated wastewater, which can contain infectious matter in amounts that can pose a health risk to bathers. This untreated wastewater derives from homes and summer cottages in rural areas outside sewerage catchments or from sewer overflows. These sources will be eliminated, partly through improved wastewater treatment for rural houses outside

sewerage catchments and partly through stricter requirements limiting the volume and frequency of sewer overflows.

Bacteria in hot water systems

Legionella bacteria are common in all wet and damp freshwater environments, both natural and man-made. The bacterium reproduces best at temperatures between 30 and 40°C, and therefore thrives well in hot water systems in which the temperature is not maintained at a sufficiently high level. If the temperature exceeds 50°C, the bacteria cannot reproduce and the population decreases.

Even though legionella is common and probably found in many water systems, there are only a few cases, of legionnaires' disease, which is a serious form of pneumonia. This is because it is not very infectious. In most cases, the infection is transmitted in atomized water (aerosols) that is inhaled. The sources of the outbreaks described in the literature are water systems that produce large amounts of aerosols, for example cooling towers or jacuzzis. Hot water in homes, hospitals and hotels have also been described as sources of outbreaks of legionnaires' disease.

In Denmark there are just under 100 cases of legionnaires' disease annually. Just over 20% of the cases are associated with travels, especially to southern Europe, just under 20% are cases contracted in a hospital, while 50–60% of the cases are contracted elsewhere. The probable source of the infection in the latter cases is showers, fountains, etc.

State of the environment and health

Considerable attention is currently being focused on the significance for human health of environmental factors. Among other reasons, this is because more knowledge is being accrued about the significance of environmental factors, although it must be admitted that there are areas where our knowledge is inadequate. The precautionary principle is therefore applied as the basis for assessment and regulation. Health aspects have been included in environmental regulation for many years.

A 2001 status report on environmental factors and health in Denmark has examined a number of central areas where a relationship might exist between environmental factors and health problems, i.e. soil, air, wastewater, drinking water, swimming pools, waste, noise and chemicals.

Information Centre for Allergy

Summer 2001 saw the establishment of the Information Centre for Allergy to Chemical Substances in Consumer Products. The information centre, which is financed by a government budget appropriation as part of the health service, will help strengthen efforts to prevent allergy. The information centre's sphere of activity will encompass both contact and inhalation allergy, and its documentation will help focus attention on the relationship between objectives and regulatory measures.

Box 5.6.1: Information centre for allergy to chemical substances in consumer products.

Photo: CDanmark

Photo: Klaus Holsting

5.7 Theme – The risk society is upon us

This chapter introduces some of the new themes that have entered the social science agenda over the past 10–15 years under the influence of the environmental debate.

In contrast to the more concrete accounts in this report, the present section is a more general presentation and discussion of a sociological perspective on the environment. The intention is to introduce some of the ways in which present-day sociology can contribute to the efforts to solve the problems facing society as a result of the pressure on the environment.

5.7.1 Introduction

The starting point is the sociological thesis that we now live in a "*Risk society*". According to this thesis, the way we deal with various forms of risk plays a central role in societal development. The following thus does not describe the environmental pressures in specific sectors, but rather examines some general traits in societal development in relation to the challenges that environmental pressures and risk management pose to modern society.

After the introduction, the meaning of the term *Risk society* is described together with some general features of the present society that are a precondition for being able to understand why the question of risk is now far more controversial than previously. An explanation is also provided of what sociologists mean when they state that risks are "socially constructed", and how various people comprehend risks and dangers differently depending on the nature of their life in general. Finally, the section examines how conflicts between experts and laymen can be understood sociologically.

Photo: Scanpix/Reuters

5.7.2 From environmental problem to risk sociology

For many years, science has helped elucidate the health and environmental consequences of society's activities. At the same time, politicians and citizens alike have expected that science should be able to procure the knowledge necessary to solve or minimize the problems that society creates. However, it has proven difficult to transform scientific knowledge about environmental pressures to definitive solutions – partly because many of the problems have proven to be more complex and global than previously believed and because new problems arise faster than sound knowledge can be accrued, and partly because society reacts sluggishly to new knowledge about environmental pressures. The problem is thus two-edged:

- Adequate knowledge cannot be obtained until after the problem has arisen – and in fact, the need for knowledge is often first acknowledged when the problems are discovered.
- Even though certain activities may be demonstrated to be harmful to the environment or man, it is far from certain that society can or will phase out these activities, as other needs than consideration for the environment have to be met.

These problems have resulted in an increasing interest in how the interplay between the environment and society functions, but also, and perhaps in particular, in what barriers and potentials society *per se* comprises as regards a more environmentally sound development. It is for this reason that the social sciences have become increasingly involved in environmental research. It would be ideal if the sciences could provide reliable and value-free knowledge that could support democratic decisions of a political and value-related character. The preconditions for taking action in relation to environmental problems are knowledge and that a political and ethical stand has been taken. When our knowledge is incomplete, however, the very basis for the decisions also becomes more open to interpretation and assessment, and will unavoidably be influenced by the views and values of the various actors involved. It is therefore becoming increasingly necessary and desirable that people other than the experts are involved in solving the environmental problems.

This has triggered questions to the social sciences about how one can establish a more effective "risk communication", i.e. how the experts can better communicate what they know and do not know to citizens and politicians so that the latter can individually and jointly make appropriate decisions about how the problems should be solved. In practice, this need has also resulted in attempts at citizen involvement. An example is the so-called consensus conferences held by the Danish Board of Technology, at which laymen listen to experts concerning a particular issue – for example about genetically modified food – and thereafter have to discuss their way to a consensus recommendation to the politicians. This reflects a growing understanding of the fact that people other than experts have relevant knowledge and competence to contribute when it comes to solving environmental problems in a democratic manner. Expanding upon this understanding, what is thus involved is not just better dissemination of information, but the conditions for dialogue between experts, decision makers and citizens making it possible for "ordinary citizens" to take an active responsibility for our common environment.

In parallel with this, the social sciences have themselves taken up the environmental issue and its significance for society. An increasing acknowledgement of the pressures on the environment has caused a societal dynamism that should be investigated by the social sciences. Examples of this are numerous. For example, the environmental movements have developed new political processes and action forms to get their views heard as a reaction to what they consider as traditional political institutions' inertia in relation to environmental problems. Patterns of consumption have partly changed in the wake of the green wave. Various risks to health and safety have made new

Real – unreal risks

Risks have a somewhat strange "reality status" – they are both real and unreal. Real because they (usually) concern something that really can go wrong, unreal because they concern something that has not yet happened.

We do not know what the future will bring (in detail), and when we refer to something being risky we mean that something can go wrong, i.e. unwanted events such as pollution can occur. On the one hand we thus do not know what will happen in the future, but on the other hand we are quite sure that what will happen depends on what we do in the present. One can thus say that we conceive of events in the future that we try to prevent. We thus need to make decisions based on more or less incomplete knowledge. Risks therefore comprise a problem for society irrespective of whether or not detrimental events actually occur.

Box 5.7.1
Risk and time.

Three perceptions of risk

Box 5.7.2
Three perceptions of risk.

One can differentiate between three different ways of understanding risk based on either an objective, a subjective or a sociological approach.

1 – Objective perception of risk

In the objective perception of risk, risk is a very well-defined term:

Risk = probability of damage occurring x the extent of the damage

According to this perception of risk it is properties of our surroundings that we can investigate that determine what is dangerous – and how dangerous it is. Probability and consequences of an unwanted event are determined with the aid of objective methods.

To the extent that reliable knowledge about the probabilities and consequences is available, it is possible to weigh up different risks against each other in a risk/benefit analysis. One can thus objectively weigh up different risks against each other, for example compare how dangerous it is to travel one kilometre by bicycle, by car or by aeroplane. In practice, such objective risk analyses are often complicated and are carried out by experts.

2 – Subjective perception of risk

The psychological perception of risk tries to understand risk subjectively. This does not just concern the objective risks "out in the world", but why the individual human being perceives some things as more dangerous than others, so-called risk perception.

Reduced experience of risk when the phenomena are:	Enhanced experience of risk when the phenomena are:	Factors decisive for the experience of risk:
Well-known	Unknown	Is it something one has experience with?
Visible	Invisible	Can one sense the dangers oneself?
Voluntary	Involuntary	Can one choose to subject oneself to a risk?
Controllable	Uncontrollable	Can one change one's mind later?
Just	Unjust	Is the way the hazards affect people just? (i.e. are the innocent affected?)
Chronic/complex/delayed	Catastrophic/immediate	How directly, rapidly, restrictedly and violently does the harm occur?
Nonlethal	Lethal	Does it cost human lives?
"Natural"	"Man-made"	Is anyone responsible?

demands on society's institutions in the widest sense, and societal conflicts have arisen such as protests against genetically modified foods and animal feed. These are all issues that stem from the interplay between nature and society, and which have attracted the attention of the social sciences. One can thus say that the environmental issue has initiated attempts at "ecological modernization", i.e. a process of societal change where the challenge of solving environmental problems is considered as the "engine" that drives our society forward through technological changes, institutional reorganization and cultural renewal. A branch of social research is currently in the process of investigating what ideas and changes this process has actually resulted in. On this basis – but also on the basis of social science's general knowledge about social development – this can lead to new critical as well as constructive contributions to help shape the process.

5.7.3 The risk society

The risk issue really sprang onto the social science agenda with the German sociologist Ulrich Beck's book "The risk society – moving towards a new modernity". It introduced the term risk society as a new type of society on par with such terms as the knowledge society and the leisure society. The term risk society does not necessarily imply that society has generally become a more hazardous society in which to live than previously, but rather that awareness and management of various risks decisively affect people's everyday life as well as societal development in general. However, we currently face other types of risk than was previously the case in that they are created by society, and in certain cases are unavoidable. Where one previously had to fear such things as natural catastrophes, famine and diseases that we can now easily overcome, the risks we now face include contamination of the groundwater, global climate changes and other problems that our civilization has itself provoked. Many of these risks are global in

Risk perception research has shown that human beings' assessment of risk depends on many factors not immediately connected to the objective risks. The reduced and enhanced experiences of risk listed in this box indicate some of the factors of significance for the way risks are perceived and assessed.

Despite these characteristics of the subjective perception of risk, it is widely believed that if "ordinary" people just knew more, i.e. had a greater insight into the objective risks, they would take a more rational view of the risks that surround them. This argument has proven not to hold water, however. For example, while it is known that Scandinavians generally know more about genetic engineering than southern Europeans, they are nevertheless more inclined to reject the technology, even though the experts cannot demonstrate that it poses any risk. Models and explanations have therefore been sought that could provide a more integrated understanding of the relationship between the experts' "objective" and the laymen's "subjective" or "irrational" perception of risk. One explanation is that risk management is always a part of the social context.

3 – Sociological/cultural perception of risk

The sociological perception of risk focuses on viewing risk in a social and cultural context. This entails firstly, that people's assessment of risk relates to their general conditions of life, secondly, that there are often certain values incorporated in the experts' objective methods and assessment of risk and that these values can either be identical with or different from the values of laymen, and thirdly, that conflicts concerning risk in modern society are always part of a broader context where society's various institutions mutually influence each other when risks have to be dealt with. One refers to this as social amplification of risk, i.e. that perception and interpretation of the danger posed by different things is either enhanced or diminished when they are communicated and dealt with in society. This can have both positive and negative consequences. The important point is that this process is not restricted to the objective dangers and subjective experiences, but also encompasses confidence in institutions, division of benefits and problems, politicization of research, etc.

This section will primarily focus on the sociological perception of risk. This does not mean that the other two perceptions of risk are considered to be less important or relevant. A thorough understanding of risk necessitates an understanding of all three dimensions.

character, moreover. They are not always connected to the localities that benefit from, for example, polluting production. There is thus a greater risk than previously that one will be the victim of other people's irresponsibility. A classic example of this is the Chernobyl accident, which had consequences (at least political and economic) throughout Western Europe.

New division problems

It is not just for environmental reasons that we cannot continue as before. Thus societal coherence is threatened in the risk society. One of Beck's fundamental points is that modern society has created so many environmental problems that these begin to control societal dynamism. Previously, social conflicts largely concerned the division of goods and welfare. Until the end of the 1960s society did not generally worry too much about pollution provided there was economic growth and the benefits were divided equitably. The side effects of the industrial society's production were no greater than could be ignored by the post-war growth optimism. Nature was something that should be controlled and exploited, not protected. Nowadays the environmental problems have taken a more prominent place on the public agenda, however, and many conflicts concern avoiding evils such as pollution, genetically modified foods, global climate changes, etc. Now nature and man must be protected against society's activities, and the privileged are no longer the haves (goods), but rather the have nots (risks).

Beck thus claims that the price of progress might no longer be commensurate with the benefits, that there is no longer a clear correlation between growth and welfare. The production of goods systematically produces risks – and these perhaps eventually overshadow the benefits. He thus speaks of a "side effects regime". This means that the attempts to control undesirable effects of the hitherto development of society might overshadow the positive visions for the future.

The experts' loss of authority

New technology has always affected society's development and man's living conditions. This is uncontroversial, though, as long as there is a fundamental societal consensus that technological change equates with progress. That is how it has been for many years in the Western world, but much indicates that this will change in the risk society. Not all technological advances prove to be progress. The confidence of the general public in representatives of this technological development – the experts – has therefore changed.

Photo: NERI/Jens E. Johansen

It is not possible to foresee all the consequences of the technologies that have been "let loose" in society and nature until at a late stage. This is because more and more of our knowledge can first be verified when it is "too late", i.e. after the decisions for example to permit additives or to release genetically modified organisms have been taken. Laboratory knowledge cannot foresee in detail what will happen when one releases things into nature's cycle.

From the political point of view, this uncertainty of knowledge concerning risks has led to introduction of the precautionary principle. This means that the authorities can take action (intervention, prohibitions, etc.) without having a solid data foundation on which to base such action, but based on the mere probability of pollution or other effects on the environment and health. The precautionary principle is as far as possible based on a scientific assessment of risk, but the final decision on how careful to be will chiefly depend on a political decision. Political risk assessments and decisions can be influenced, and hence are often debated in the mass media. Here the experts often come under cross-fire, either to underemphasize or overexaggerate the risks, and thereby influence the political decision-making process in a direction with which, for example, the business or environmental organizations disagree. A central theme in connection with risks is the concomitant distrust and trust of the experts. On one hand they are no longer trusted simply because they are experts. On the other hand, though, never before have we been so dependent on experts.

That the mass media are so occupied with covering the risk issue could be partly due to the fact that many of the problems have moved "closer" to people's everyday life. Nowadays the things we surround ourselves with can suddenly prove to be hazardous. For example, when there are chemicals in our clothes or harmful substances in our food. The things the experts argue about thereby become important for the individual's everyday life.

At the same time, the increasing specialization of scientific knowledge makes it difficult to form a general impression of the overall risk profile of modern man. No integrated scientific perspective exists that can address such different pressures as air pollution, additives, housing quality, noise at the workplace and all the other pressures man and nature are exposed to. It lies in the "nature" of science that it is specialized in areas that can be investigated through specific theories and paradigms. As the scientists have to fight for the funding that is available, they all try to make their fields interesting for politicians and the public – occasionally perhaps at the expense of an overall perspective that enables society's resources to be prioritized. There is thus a parallel tendency towards a politicization of science – research topics are selected that are politically in favour – and scientificization of politics – political choices are increasingly justified with reference to scientific knowledge.

This places citizens and society in a dilemma because one cannot do without the scientific expertise in relation to the risks that surround us. Many of the problems we face are not immediately available to our senses, and our everyday experience cannot assess which of the potential risks are serious, and which can be neglected. If we want to gain an insight into the conditions such as pollution of the groundwater, the greenhouse effect, depletion of the ozone layer, harmful substances in foods, etc., we are dependent on scientific theories and methods in order to be able to even identify many of these problems. Society is thus dependent on experts who citizens no longer fully trust to solve the problems. As a result, the environmental problems and the associated health risks also become a challenge to society's democratic institutions.

The reappearance of politics and ethics

The dwindling trust in experts has triggered politicization of areas that were formerly considered as unproblematic for experts to investigate and regulate. When the experts can no longer provide unambiguous answers as to what is dangerous and what is harmless – when nature so to speak does not itself set limit values – the question of which risks and hazards a society shall accept becomes a collective responsibility. As a consequence, the assessment and management of risks also become a political matter.

It turns out that there is rarely agreement in society and among the public concerning acceptance criteria for various risks – especially when various benefits have to be weighed in relation to each other. Conflicts therefore arise between various interests and values. These conflicts cannot be solved solely with the aid of science and expert competence because in the last analysis, they concern what type of life we want to

live, i.e. which values we want to control societal development. This means that when the experts can no longer provide unambiguous solutions, when these no longer win broad acceptance or cost "too much", the problems also spread to an ethical and a political level. This probably contributes to the fact that ethical issues have become firmly rooted on the public agenda during the 1990s – and will undoubtedly leave their mark on the agenda from now on. This also means that the environment often becomes politicized when politicians, experts and citizens have to reach an agreement.

On this background, among others, the idea that the risks that surround us must be understood as social constructions has won widespread acceptance in the social sciences as an alternative/supplement to the natural science-based risk research.

5.7.4 Risks as social construction

An important controversy in the discussions on the risk society is to what extent the risks that currently characterize/threaten society, should be perceived of as objective dangers or as social constructions. To perceive risks as objective problems or dangers in our surroundings, problems that threaten us irrespective of whether we acknowledge them or not, seems obvious. We become ill from harmful foods irrespective of whether or not we know that they contain harmful substances. It can sometimes be advantageous to perceive risks as social constructions, though, when one wants to understand why society reacts as it does in relation to the risks we presently experience. That something is socially constructed does not mean that it does not exist, that it is just a collective illusion. It means that we are only able to acknowledge the world through symbolic and cultural filters – a bit like the filters one can place on a camera lens. These filters help form our perception of the world around us in a way that we cannot "get around". In other words, we cannot see the world without filters. Sometimes it is easier to understand the social dynamism that different dangers trigger on the basis of such social constructions than with reference to the state of nature. To remain with the analogy of the camera lens this means that for the social scientist, the filter becomes just as important to understand as that which the lens is focused on (nature) when one wants to understand the societal dynamism in risk management.

When we as laymen observe, think and discuss environmental problems, we use ways of perceiving, conceptualizing and communicating about the environment that are rooted in and useful to the society of which we are part. Science plays an important role in the development of this interpretation readiness. However, not even science has direct access to acknowledge and describe the environment "as it is", only as it lets itself be described with the aid of the theories and methods that are available. Science is as such a social institution. The insights of the various disciplines are also characterized by many other conditions than indicated by the scientific fields. As a matter of fact, even the scientific fields are a construction in the sense that it is not nature that decides what is chemistry and what is biology, medicine, etc. The research is nevertheless carried on in a more or less stable manner within these demarcations. Our image of nature is naturally subjected to sensory impressions from our surroundings when we observe and act in the world. There is no guarantee that science records everything that can be of relevance to human safety and health, however – neither when the observations are controlled in a laboratory, nor when they have to be made out in nature.


Photo: CDanmark

In order to be able to describe something (for example how additives affect man) in an understandable way, we have to reduce the complexity of nature. One always has to choose to describe one thing rather than another. Descriptions of the environment, risks – and for that matter virtually everything in this world – thus entail choices based on more or less explicit criteria for what is relevant. These criteria do not derive from nature itself, but from society. But they are not necessarily the same for all people and all parts of society. They can be "constructed" differently all depending on what interests are at stake in a given situation. When one speaks of for example additives, these criteria can themselves be open to dispute, also among experts. But even if the experts are largely in agreement about the state of nature, their descriptions have to compete with other descriptions and topics of discussion in order to be relevant for all those who are not experts.

Put briefly, social constructivism states that in order for the state of the environment to be an environmental problem, it has to pose a problem for someone. Nature can be as "ill" as it likes – if it is not perceived of as a problem and is problematicized in society, no societal problem exists, and nothing will consequently be done about it. The crux of the social constructivistic perspective is therefore how man and society react to perceptions about the state of nature – and how various descriptions are viewed as either exaggerated, irresponsible, well-founded, confidence-inspiring or the suchlike. Social constructivism is based exactly on the question of how such perceptions are formed, constructed, in a social context that is never neutral or objective, but can naturally be scientific and well-documented, and can always be analysed in relation to interests, motives and assessment criteria.

These problem formulation mechanisms, i.e. what we designate to be a problem, are not objective in a

scientific sense. They are characterized by interests and values. An example of this is that just a single case of salmonella poisoning triggers considerable media coverage and public anxiety, while little notice is taken of the fact that 500 Danes are killed annually in the traffic and many more are injured. In order to understand such "peculiarities", it is not sufficient to look at the objective risks associated with eating eggs and travelling on the roads, respectively. It is necessary to examine what meaning people accord to food poisoning and traffic accidents, respectively – and what perceptions they have of being afflicted by the respective misfortunes.

Risk cultures

When one states that different people consider different things as hazardous, it is not just banal ascertainment that no two people are identical. It is rather that one's otherwise identical circumstances of life affect how one perceives different things in one's surroundings, including risks and environmental problems.

One of the social scientists who has most systematically examined how different people perceive different things in their surroundings as hazardous is the British anthropologist Mary Douglas. Douglas believes that it is our culture that colours our perception of the world and hence also of which things are hazardous and which things can be ignored. In turn, culture is coloured by the social relations that rule in a given society. In simplified form, Douglas's societal analysis can be summarized along two dimensions: Grid and Group. Grid denotes the strength of the hierarchy in society ("regulation density"), while group denotes how closely the individual people are associated to their social groups ("collective identity"). Schematically, one thus ends up with four cultures or four "myths of nature". The idea of such a cultural analysis is that there is a systematic relationship between the social relations one is a part of, and how the world looks. The diagram is intended as an idealized typology that can illustrate tendencies, not as a complete description of man. The idea is that when one lives in one of these cultures, one will be inclined to share its "myth of nature" and strive for the maintenance of exactly this culture's lifestyle as the natural one. Individuals can be influenced by elements of several cultures, however, and the influence of the different cultures can change during the course of time (*Figure 5.7.1*).

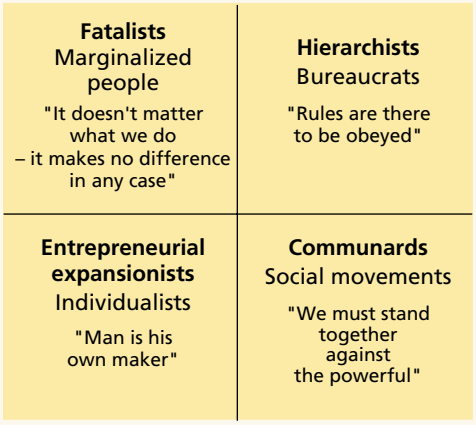


Figure 5.7.1
Four cultures or "myths of nature". (Source: Douglas, 1992).

This type of cultural analysis has among other things been used to determine how different people view nature, and the "filters" different people wear and through which they comprehend nature and environmental problems. This yields four different "myths" about nature's predictability (*Figure 5.7.2*).

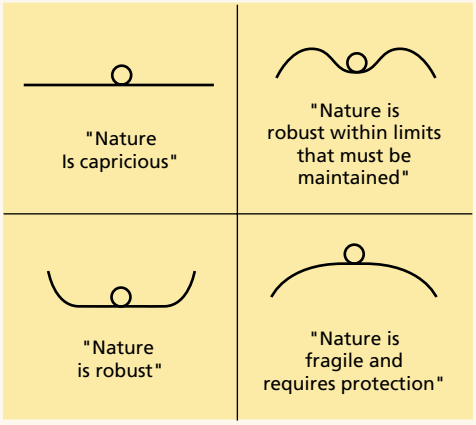


Figure 5.7.2
Four "myths" of nature's predictability. (Source: Douglas, 1992).

These general schematizations cannot be used to subdivide all people into four categories whereafter one can understand and explain all their actions and attitudes. They express tendencies (in the sense of statistical regularities) in groups of attitudes that can illustrate that when referring to nature, all people do not necessarily think about the same thing or in the same way. It can therefore be used to provide a feeling of why different people (and organizations) react differently to "the same" information and pressures. In part because the different cultures will not view the same pressures on the environment as problematic, and in part because the proposals for change that stem from organizations with another cultural orientation will appear strange, incomprehensible or unacceptable.

When environmental movements and the agrochemicals industry argue about whether GMO crops are "safe enough", it is not just a dispute about factual knowledge. A feature of such conflict is that the parties to the conflict perhaps have fundamentally different perceptions of nature. It is not certain, however, that such differences are explicitly apparent from the conflict. The opponent's arguments become not only wrong, but also incomprehensible or "suspect" because they threaten the whole of one's perception of the world. In this way, everyone believes that they are talking about "the same problem" when in reality

they may be talking at odds with each other. If one for example subscribes to "entrepreneurial expansionism", highly bureaucratic regulation of the environmental area will be perceived as unnecessarily limiting intervention in commercial freedom. One will, for example, tend to think that nature can manage to look after itself, and that consideration needs to be shown to the balance of payments so that we can afford to protect nature. For a "communard environmental advocate" regulation will perhaps be perceived as an inadequate, somewhat paltry compromise that mostly serves to preserve the power of the political/administrative system. On the other hand, the regulatory authorities will undoubtedly consider such a measure as a successful and well-planned intervention to the benefit of the environment.

One cannot say that the persons comprising the political/administrative system have a truer cultural filter than businessman or environmental advocates. From the social constructivistic point of view, it is not a question of who is right. The different actors can naturally attempt to pick holes in each others' foundation with reference to environmental changes. However, as the relevant knowledge is often incomplete, and the actual basis for procuring and interpreting knowledge differs, such discussions typically run into insoluble problems. Everyone has a filter, and such a filter is a unity that creates meaning and coherence in the perception of the world. Moreover, the dissimilarities between them can largely be maintained by the fact that they obtain their meaning in relation to each other.

In this connection it may well be that the experts have a "better" understanding of the state of the environment because they have the possibility to investigate it with advanced methods and theories. However, as they have to advise society, their statements are the result of both their concrete investigations and the fundamental perception of nature and values that characterize their expertise. As a consequence, conflicts can arise when observations have to be interpreted, and especially when they have to be transcribed into action in cases where there are conflicts of interest at play. In this context the social sciences can contribute by for example analysing why and how some understandings of environmental problems become dominant, while others become marginalized – without this (solely) happening with reference to the state of nature.

The challenge in a democratic society is to develop mechanisms that through mutual consideration and respect for the fact that others view the world differently than oneself can deal with the conflicts caused by environmental problems, etc. As a basis for this it is necessary to at least be aware that different people perceive nature differently, and that these perceptions cannot meaningfully be ranked. Otherwise dialogue becomes very difficult. Based on the desire for a democratic environmental administration it is therefore necessary to take into account our knowledge of nature, the limitations in our acknowledgement of both nature and society, and the fact that society is culturally diverse. In this connection the contribution made by sociology is the insight that the "right" solutions are not necessarily right for all those people who did not participate in formulating them. Different forms of environmental administration do not just have different consequences for the environment, but also have different social consequences. The conflict potential in the handling of environmental problems is therefore far from unimportant. An example of this is the Danish Aquatic Environment Action Plans.

5.7.5 Experts and laymen in conflict

In recent years, there have been numerous examples of how experts and "ordinary" citizens have disagreed markedly as to how various risks should be assessed, and which consequences this should have. One such example is GMO foods, which experts believe are harmless, but which are nevertheless blocked by activists, and which everything indicates will be boycotted by consumers if they are labelled. Another is the atomic power debate in the 1970s, where a popular movement grew up despite the fact that the majority of experts in the area attempted to ensure the population that it did not pose any risk worth mentioning. If one wants to understand and prevent such conflicts, it is not sufficient to establish expert knowledge and administrative precautions. Account must also be taken of the societal and social dynamism involved in such conflicts.

Based on a social constructivistic perspective of risk and the risk culture thesis, one can say that the objective/scientific approach that the experts use to assess various risks is only one of several means of perceiving the world. It does not necessarily hold precedence when laymen have to accord meaning and coherence to their everyday life. When laymen have to assess what is hazardous for them, they do not consider some or other phenomenon in isolation. To the contrary, they also incorporate everyday practical, ethical or societal considerations. Moreover, much research indicates that when ordinary people have to assess various risks, they do not so much consider the scientific content of the information they receive, but reflect more on the trustworthiness of the institutions that provide them with the information. The knowledge provided by the experts often appears impenetrable and difficult to relate to. On the other hand, we are all able to assess whether we find experts trustworthy.

In this connection, many criteria are incorporated that at first glance have very little to do with the content of the experts' investigations, namely whether they are attached to independent organizations, whether they have economic interests in the thing being assessed, etc. The environmental movements are often accorded high credibility in the public eye, and their experts therefore enjoy greater trust than the experts associated with private companies. Companies often have greater resources with which to carry out investigations and risk assessments, but they also have economic interests in the results. The trust-distrust balance means that it is not certain that the scientifically best knowledge will have the greatest influence when society makes decisions.

Occasionally it is claimed to be a problem that laymen do not have sufficient understanding of how experts conduct risk assessments, yet nevertheless reject the findings. In this way the public displays an irrationality that is inappropriate for society. For several reasons, efforts are now being made to do away with such an understanding of the relationship between experts and laymen.

One reason is that the experts are not neutral. Not in the sense that they necessarily look after the interests of particular parties, but that they have a special way of perceiving the world that influences how different risks are assessed and ranked. This objective scientific approach to describing the world is also coupled to some perceptions of value. One of the points of the risk culture theory is exactly that this type of filter is always present, but rarely acknowledged as bias in the case of the experts. At the same time, the strong focus placed on the experts' formalized knowledge means that the citizens' experience-based knowledge about how things are done, for example about nature conservation, is overlooked and with time is eventually undermined and lost.

Another and perhaps more important reason is that the scientific risk considerations help to determine what can be said in the public debate. They force people to express themselves in a risk language. For example, it is hard to be a legitimate opponent of GMOs if one cannot prove or render probable that they are harmful to health or hazardous to the environment. However, the anxieties upon which such protests are founded can concern something completely different, for example that one objects to multinational companies dominating the food market. There would be no place for these types of democratic anxiety in the public debate if all dialogue was based on an objective risk language that only the experts master. This is seen, for example, in the conflicts in the WTO, where only "sound scientific evidence" is acknowledged if one wants to ban something, and not, for example, arguments such as that one finds hormone treatment of animals to be ethically reprehensible. In that way, risk problems become a way of dealing with questions of political fairness without this being apparent from the conflicts.

Modern society has to make use of experts, but in a democratic society, democracy and expert knowledge are to some extent at odds with each other. One can say that expertise excludes. Not everyone can share the experts' knowledge, which is exactly what makes them experts. But if the experts are not to rule society, it must be possible to include other considerations than those "the wise" state to be the correct considerations. Expert knowledge can help ordinary people to orient themselves in their everyday lives and decision makers to make qualified decisions. This too is increasingly the case. The experts do not have a monopoly on telling people what they have to be afraid of, or how they should live their lives, however. Experts should not be considered as "judges" who have to make the final decisions, but rather as important "witnesses" whose information is to be used together with other "testimonies" in the solution of problems. If modern humans are to create harmony and meaning in their life, they must take an active responsibility for it. There is therefore a need for reflective institutions where experts, decision makers and citizens can enter into dialogue with each other.

The role and contribution of social sciences

In Denmark in particular, but also internationally, the "soft" social sciences such as sociology, anthropology and cultural studies have hitherto played only a minor role in the investigation and management of environmental problems. The intention of the present section has been to illustrate some of the ways that sociological analyses can hopefully contribute critically and constructively to the way we deal with environmental problems by focusing on aspects of the environmental problems other than the purely physical aspects.