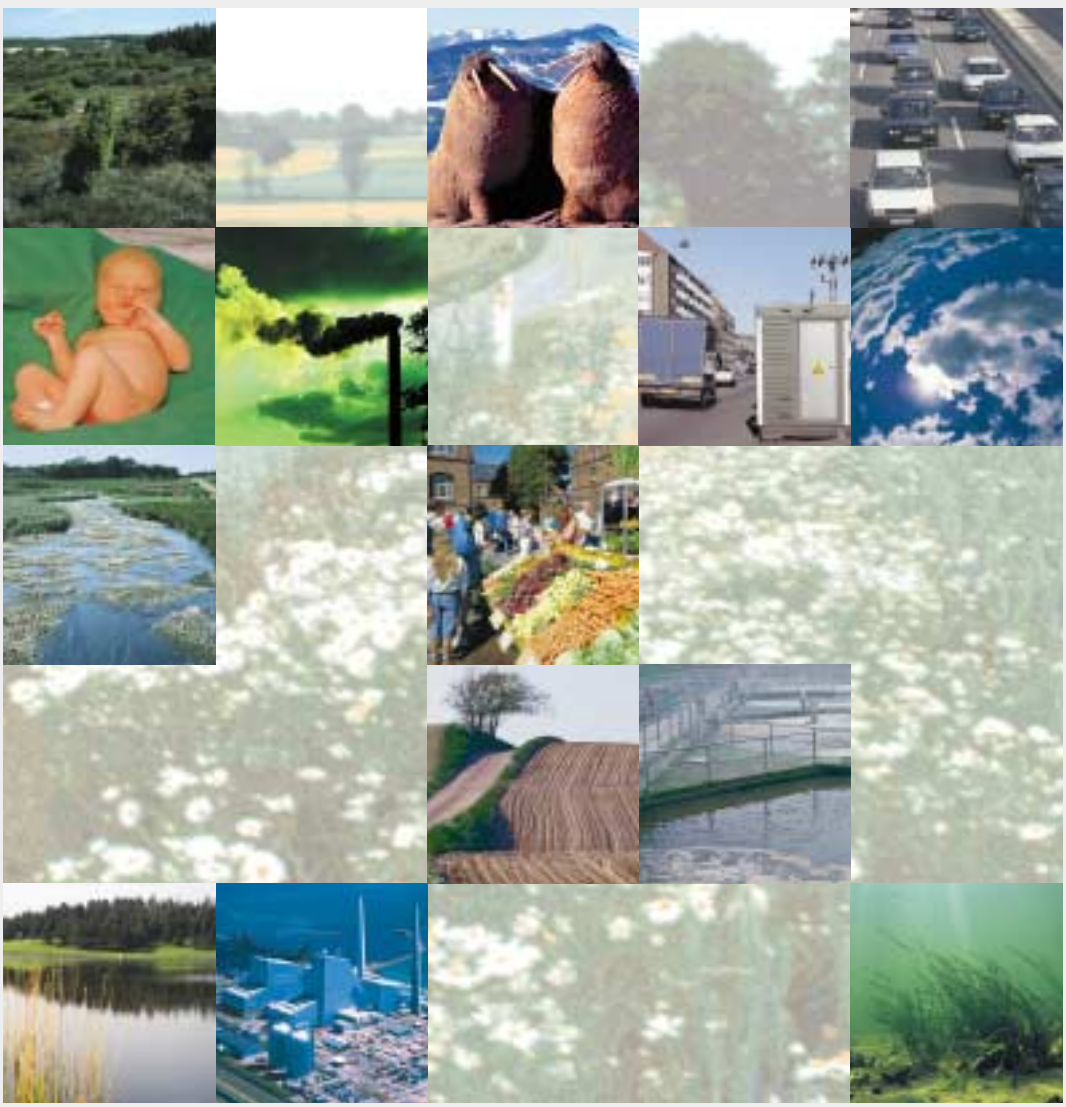
MILJØMINISTERIET

MINISTRY OF THE ENVIRONMENT

The State of the Environment in Denmark, 2001



NERI Technical Report No 409

Ministry of the Environment

National Environmental Research Institute (NERI)

The National Environmental Research Institute – NERI – is a research institute affiliated to the Danish Ministry of the Environment. NERI's tasks encompass research, monitoring and scientific consultancy in the nature and environment areas.

Enquiries to:

URL: http://www.dmu.dk

National Environmental Research Institute
Frederiksborgvej 399
P.O. Box 358
DK-4000 Roskilde
Denmark
Tel: +45 4630 1200
Fax: +45 4630 1114

Management and Administration
Research and Development Section
Department of Atmospheric Environment
Department of Marine Ecology
Department of Environmental Chemistry and Microbiology
Department of Policy Analysis
Department of Arctic Environment

National Environmental Research Institute
Vejlsøvej 25
P.O. Box 314
DK-8600 Silkeborg
Denmark
Tel.: +45 8920 1400
Fax: +45 8920 1514

Monitoring Section
Department of Freshwater Ecology
Department of Terrestrial Ecology

National Environmental Research Institute
Grenåvej 12-14, Kalø
DK-8410 Rønde
Denmark
Tel.: +45 8920 1700
Fax. +45 8920 1515

Department of Landscape Ecology
Department of Coastal Zone Ecology

Publications:
NERI publishes Technical Reports, Technical Instructions, Theme Reports and annual reports.
A catalogue of NERI's current research and development projects is available on the Internet at www.dmu.dk.
The annual report contains a list of the year's publications.

The State of the Environment in Denmark, 2001

NERI Technical Report No. 409

Editors:

Hanne Bach, Niels Christensen and Peter Kristensen

Department of Policy Analysis

National Environmental Research Institute

Ministry of the Environment

Data sheet

Title:	The State of the Environment in Denmark, 2001
Authors:	Hanne Bach, Niels Christensen, Peter Kristensen (Editors)
Department:	Department of Policy Analysis
Translation:	David I Barry
Serial title and number:	NERI Technical Report No. 409
Publisher:	Ministry of the Environment National Environmental Research Institute©
URL:	http://www.dmu.dk
Date of publication:	August 2002
Layout/illustrations:	Britta Munter, Linda Fischlein, Kathe Møgelvang, Juana Jacobsen, Tinna Christensen
Cover photo:	Anna Bodil Hald. Other photos: see credits in report
Please cite as:	Bach, H., Christensen, N. & Kristensen, P. (Eds.) 2002: The State of the Environment in Denmark, 2001. National Environmental Research Institute, Roskilde, Denmark. 368 pp. – NERI Technical Report No. 409
	Reproduction permitted with clear reference to source
Abstract:	The report summarizes the existing knowledge of some of the central trends in the state of the Danish environment, and links these trends to the trends in those sectors of society exerting the greatest pressure on the environment
Key words:	State of the environment, nature quality, environmental impact, pollution, environmental initiatives, projections, sectors of society
Editing complete:	December 2001
Financial support:	No external financing
ISBN:	87-7772-689-8
ISSN (print):	0905-815X
ISSN (electronic):	1600-0048
Paper quality:	CyclusPrint, 100% recycled paper. Cover: CyclusOffset, 100% recycled paper
Printed by:	Scanprint, Certified under ISO 14001 and ISO 9002. EMAS registered No. DK-S-0015. Nordic ecolabel, printed matter
Printing inks:	Vegetable oil-based dyes free of organic solvents. Cover treated with water-based, vegetable varnish
No. of pages:	368
Impression:	1,500
Price:	DKK 200 (incl. 25% VAT, excl. postage)
Supplementary note:	This report is available in Danish entitled: Natur og Miljø 2001. Påvirkninger og tilstand, Faglig rapport fra DMU nr. 385
Internet version:	The UK and DK versions of the report are also available as PDF files via NERI's website at: http://technical-reports.dmu.dk
For sale at:	Miljøbutikken Information and books Læderstræde 1-3 DK-1201 Copenhagen K Tel.: +45 3395 4000 Fax: +45 3392 7690 E-mail: butik@mim.dk www.mim.dk/butik

Preface

The ongoing debate on nature and the environment necessitates that we continually update our knowledge on the state of the environment.

This report on the state of the Danish environment and nature is the third report of this kind since 1993. Denmark has published a State of the Environment Report every four years. Countries having signed the Aarhus Convention like Denmark commit themselves to publish an overall report on the state of the environment at regular intervals. The Danish Parliament has incorporated its interpretation of the Aarhus Convention into the Danish environmental legislation. This states that the State of the Environment Report is to be published every four years, and that preparation of the report is to involve the relevant national environmental, business and consumer organizations.

During preparation of the report, all interested parties have therefore had the opportunity to submit their comments to the Editorial Board, firstly to an annotated table of contents and subsequently to a draft of the full report. Thus 83 national organizations were directly invited to submit their comments. In addition, the National Environmental Research Institute issued a general invitation for anyone to submit comments on the report via the Internet.

I would like to take this opportunity to thank all the organizations and individuals who have taken the time to contribute their comments. Apart from the fact that the report has thereby been prepared in maximum openness, I am convinced that the final product has been improved by the many constructive comments.

The State of the Environment Report is one of the cornerstones of strategic environmental planning, and thereby contributes to the foundation for knowledge-based environmental policy.

The State of the Environment Report will be an important tool when Denmark prepares for the UN World Summit on Sustainable Development in Johannesburg in August – September 2002 – the follow-up on the 1992 »Earth Summit« in Rio de Janeiro. At the time of the World Summit Denmark will hold the Presidency of the European Union, and environmental issues are expected to be high on the EU agenda during the Danish Presidency. It is therefore natural that this report has been translated into English.

The report provides a broad description of the state of the environment correlated to the trends in those sectors of society having the greatest impact on the environment and nature, and thus comprises a reference work for anyone interested in the subject.

We have stressed the importance of describing both the state of the environment and the reasons for the trends, which are largely economic, social and political in origin. The report should therefore provide politicians, interest organizations and interested citizens with a clear overview – an overview that can be utilized to prioritize efforts to the benefit of the environment, nature and mankind.

The National Environmental Research Institute has compiled and edited the report on the basis of contributions from a large number of authors from both within and outside the Ministry of the Environment. I would like to take this opportunity to thank all those who have contributed to the report.

Henrik Sandbech
Director General

Authors

Editorial Committee:
Hanne Bach, Niels Christensen and Peter Kristensen

Translation: ***David I Barry***

The following authors have contributed to the individual sections of this report:

1.1 *Hanne Bach, NERI*
1.2 *Jesper S. Schou, NERI; Johnny M. Andersen, NERI; Pia Frederiksen, NERI; Peter Eigaard, NERI*
1.3 *Claus Andersen, DEA; Thomas C. Jensen, DEA; Poul Erik Morthorst, RISØ*
1.4 *Henrik Gudmundsson, NERI; Linda Christensen, NERI; Ulrich Termansen, DEA; Ole Kveiborg, NERI*
1.5 *Peter Kristensen, NERI*
1.5.1 *Peter Kristensen, NERI; Bruno B. Jørgensen, DFLRI*
1.5.8 *Peter Kristensen, NERI; Berit Kaae, DFLRI*
1.5.9 *Peter Kristensen, NERI; Berit Hallam, DEPA*
1.6 *Trine S. Jensen, NERI*
1.7 *Hanne Bach, NERI; Jesper S. Schou, NERI; Johnny M. Andersen, NERI; Henrik Gudmundsson, NERI; Trine S. Jensen, NERI; Thomas C. Jensen, DEA; Berit Hallam, DEPA; Frits M. Andersen, RISØ; Bruno B. Jørgensen, DFLRI*
2.1 *Jes Fenger, NERI*
2.2 *Jytte B. Illerup, NERI; Jes Fenger, NERI*
2.3 *Finn Palmgren Jensen, NERI*
2.4 *Helle Vibeke Andersen, NERI; Mads Hovmand, NERI; Niels Christensen, NERI*
2.5 *Jes Fenger, NERI*
2.6 *Jes Fenger, NERI*
3.1 *Peter Kristensen, NERI*
3.2 *Peter Kristensen, NERI*
3.3 *Peter Kristensen, NERI; Hans Jørgen Henriksen, GEUS; Walter Brüsch, GEUS*
3.4 *Peter Kristensen, NERI*
3.5 *Peter Kristensen, NERI; Jens Peder Jensen, NERI; Erik Jeppesen, NERI; Martin Søndergaard, NERI*
3.6 *Peter Kristensen, NERI; Ingela Dahllöf, NERI; Gert Asmund, NERI*
3.7 *Peter Kristensen, NERI*
3.8 *Ruth Grant, NERI; Peter Kristensen, NERI*
4.1 *Niels Christensen, NERI*
4.2 *Niels Christensen, NERI; Bernhard Brackhahn, SPD; Karsten Willenberg, DFLRI; Petra Rüberg, DFNA;*
4.2.2 *Petra Rüberg, DFNA; Helga Grønnegård, DFNA; Jesper Handberg, DFNA; Karsten Willenberg, DFLRI; Bernhard Brackhahn, SPD*
4.3 *Knud Tybirk, NERI; Niels Christensen, NERI; Bent Andersen, DFNA*
4.4 *John Jensen, NERI*
4.5 *Peter Sørensen, NERI; Walter Brüsch, GEUS; Niels Elmegaard, NERI; Kaj J. Madsen, DEPA, Betty B. Mogensen, NERI*
5.1 *Hanne Bach, NERI; Anne Skovbro, DFLRI; Bue Nielsen, SPD*
5.2 *Hanne Bach, NERI; Linda Christensen, NERI*
5.3 *Anne Skovbro, DFLRI; Eske Møller, DFNA; Martin Hvidberg, DFLRI; Hugo L. Nielsen, DEPA; Hans Skov-Petersen, DFLRI; Tove Hels, DFLRI; Axel Laursen, SPD; Helle Witt, DSP*
5.4 *Axel Laursen, SPD; Frederik Bo Madsen, SPD; Hanne Bach, NERI*
5.5 *Tilde Tvedt, DFLRI*
5.6 *Jens La Cour, DEPA; Kirsten Christensen, DEPA; Lea Frimann Hansen, DEPA; Irene Edelgaard, DEPA; Ulrik Torp, DEPA; Linda Bagge, DEPA; Martin Skriver, DEPA*
5.7 *Janus Hansen, NERI; Jeppe Læssøe, NERI*

In addition, the following persons contributed to preparation of the report:
Britta Munter, Linda Fischlein, Flemming R. Hansen, Kathe Møgelvang, Juana Jacobsen, Tinna Christensen, Jesper Møller, Heidi Jønch-Clausen, Lennart Emborg, Helle E. Schmidt, Lene Olsen and Ann-Katrine H. Christoffersen.

Abbreviations:

NERI *National Environmental Research Institute*
DEA *Danish Energy Agency*
DFLRI *Danish Forest and Landscape Research Institute*
GEUS *Geological Survey of Denmark and Greenland*
SPD *Spatial Planning Department*
DEPA *Danish Environmental Protection Agency*
RISØ *Risø National Laboratory*
DFNA *Danish Forest and Nature Agency*

Table of contents

Summary

1 Societal pressures

General societal development

Danish society has been characterized by growth over the past decade. Thus the population has increased by 200,000 (4%), production by 23% and consumption by 18%. The pattern of consumption has changed over the decade such that relatively less is spent on food, housing and durable goods, and more on transport and leisure activities. The expectations to the coming 10-year period are continued population growth and continuation of the trend in production and consumption. The population is expected to reach 6 million before the year 2040.

The most important sectors of the economy are industry and services, which account for 24% and 63% of production, respectively. The service sector's share of the economy has been growing at the expense of industry, mainly due to growth in the private service sector. Agricultural production has increased slightly, while production in the building and construction sector has increased almost 20% over the period 1994–1999. This trend is expected to continue until 2010, except in the building and construction sector, where the increase is expected to be somewhat lower.

The most important sectors from the environmental point of view are agriculture, energy and transport, which together account for 80% of Danish CO_2 emissions.

Agriculture

In real terms, agricultural prices have fallen since 1985 and costs have increased. Production and productivity have increased to maintain the level of earnings. Pig production has increased markedly, cattle production has decreased, and crop production has increased slightly. The increase in agricultural efficiency has influenced structural development within the sector. The number of holdings has decreased from 92,000 in 1985 to 55,000 in 2000, with the remaining holdings thus having become larger. The number of organically farmed holdings has increased markedly since the mid 1990s to 3,000 holdings in 2000. Together, they encompass nearly 160,000 ha of organically farmed land. The total acreage of conventionally farmed land has fallen by approx. 190,000 ha since 1985. In addition, part of the land has been taken out of agricultural production and set aside. Together with the increasing production, the decreasing agricultural acreage underscores the pressure that increasing agricultural efficiency is placing on farmland.

The nitrogen balance for the agricultural sector shows that the nitrogen surplus has fallen by approx. 20% since 1985. The corresponding phosphorus balance shows that the phosphorus surplus has decreased by just over 30%. The targets for reducing nitrogen and phosphorus loading of the aquatic environment from agricultural sources are stipulated in the 1987 Action Plan on the Aquatic Environment. This has been followed up by a number of supplementary action plans, the most recent of which is Action Plan on the Aquatic Environment II from 1998. The mid-term evaluation of Action Plan on the Aquatic Environment II in 2000 led to adjustment of the targets, which are now expected to be fulfilled before the end of 2003.

Agricultural consumption of pesticides has fallen since 1985, both in terms of the amount of active substance sold and of the application frequency. The targets stipulated for pesticide consumption were attained in 2000.

Agriculture is a sector characterized by complex trends. There is increasing focus on the sector's multifunctionality, i.e. agriculture's production of social benefits such as landscape and environmental quality, jobs, outdoor recreation, etc. Subsidies for agri-environmental measures were introduced at the end of the 1980s as part of EU Common Agricultural Policy, and it is expected that an increasing proportion of agricultural support will be redirected from actual price support to support of values such as activities that improve nature and the environment in agricultural land.

The projections of agricultural trends up to 2010 show that the acreage of conventionally farmed land will decrease by over 20%. The number of dairy cows and cattle is expected to fall by almost 2% per year, while production of slaughter pigs is expected to increase by 1.5% per year. The acreage of extensively managed farmland, forest and wetlands is expected to increase, which could benefit nature. Nitrogen consumption is expected to fall, as is leaching of nitrogen and emission of greenhouse gasses (CO_2 and methane) and ammonia to the atmosphere.

Energy

Gross energy consumption has remained virtually unchanged since 1972, despite considerable economic growth. This is attributable to a combination of energy savings in the household and business sectors and technological development in energy generation and distribution. Expansion of the district heating networks to enhance exploitation of heat from electricity generation and reduce heat loss has played a major role. The fuel mix used in energy generation has also changed markedly. At the beginning of the 1980s, oil and coal each accounted for half of the energy sources. Today, oil accounts for approx. 45%, while natural gas and coal each account for approx. 22%, and renewable energy accounts for approx. 11%.

Despite energy savings, energy consumption by the household, business and transport sectors increased during the 1990s by approx. 7% between 1990 and 2000, largely due to an increase in energy consumption by the transport sector. Energy consumption is expected to remain unchanged over the next 10 years in all sectors except the transport sector and the trade and service sector. The efficiency of the supply sector is expected to continue to increase, as is the trend towards increasing consumption of oil and natural gas at the expense of coal. The proportion of renewable energy, especially wind power, is expected to continue to increase.

The environmental impact of energy generation is mainly attributable to the emission of CO_2, sulphur dioxide and nitrogen oxides. The corrected emissions of CO_2 have been falling steadily since the end of the 1980s, and the total Danish emissions in 2000 were approx. 11% less than in 1988. The national target is a 20% decrease by the year 2005 relative to 1988. The target is expected to be fulfilled provided the adopted initiatives to reduce CO_2 emissions are implemented. Denmark's reduction target for greenhouse gas emissions in 2008–2012 is 21% relative to 1990. There is presently a shortfall of approx. 2.4% assuming that new agreements are entered into with the power plants on CO_2 quotas from 2003 onwards corresponding to Danish electricity consumption, and that the baseline year of 1990 used in setting the targets is corrected for Danish electricity imports and exports.

For the period after 2005, the Danish benchmark is to halve CO_2 emissions between 1990 and 2030. To approach this benchmark will require wide-ranging measures in the form of savings on consumption, the promotion of renewable energy and cleaner fuels. One of the means for obtaining these reductions under market conditions, and with greater cost-effectiveness than previously, is liberalization of the electricity market and introduction of a so-called "green certificate" market. The latter will ensure a settlement price surcharge for electricity generated from renewable energy sources, thereby ensuring the economic viability of this production form.

Transport

The environmental effects of transport are largely due to the interplay between growth in traffic and technological development of the transport systems (vehicles, infrastructure, fuels). Traffic has been growing, particularly road traffic, but also aviation traffic and to some extent train traffic. Since 1995, road traffic has increased by 10% for passengers and 13% for freight. In general, no redistribution has taken place to alternative forms of transport such as public transport or cycling. Motoring accounts for 72% of passenger transport.

A number of impacts on nature and health have been reduced despite the increasing traffic, for example through the introduction of catalytic converters on cars. The number of highly noise-plagued homes has decreased due to noise-proofing along roads and railroads. The number of traffic injuries and fatalities has been reduced. With a number of pollutants, growth in transport and emissions have been decoupled. Examples are nitrogen oxides and total particulates. In contrast, CO_2 emissions continue to increase in step with transport, and, in the case of freight transport, even more steeply. If CO_2 emissions from transport are to be reduced, energy efficiency will have to be increased or more transport will have to be switched to public transport, bicycle and pedestrian transport.

The growth in road traffic has hitherto been approx. 3.5% per year. Over the next 10 years it is expected to average approx. 1.6%, possibly entailing actual decoupling between economic growth and traffic. This is mainly attributable to an increase in the price of petrol.

The projection of the trend in transport sector emissions of nitrogen oxides shows that a 60% reduction relative to the 1988 level can be attained by 2010. The corresponding projection of traffic CO_2 emissions indicates a 40% increase in 2030 relative to the 1988 level. The latest CO_2 action plan is expected to result in stagnation of CO_2 emissions. It is therefore expected that the Danish targets for 2005 and 2010 can be attained. The Danish benchmark for 2030 for transport sector CO_2 emissions is a 25% reduction relative to 1988. To achieve the target, wide-ranging measures will be required, including changes in the amount of transport and in transport technology.

Forestry

One tenth of Denmark is covered by forest. During the 20th century, the area of forest has almost doubled. The political decision has been taken to double the area of forest within a tree generation, i.e. within the next 80–100 years. Given the present afforestation plans for the period 2000–2006 it seems unlikely that the desired level of afforestation will be achieved, however.

Around 60% of Danish forest is conifer forest, while the remainder is broadleaf forest. The December 1999 hurricane mainly affected the conifer stands and toppled a total of approx. 3.7 million m^3 of timber, corresponding to more than 1 year's annual increment. Danes use approx. 1.5 m^3 wood per person per year, of which approx. 30% is produced in Danish forests. The majority of the imported wood derives from the other Nordic countries.

The subsidy schemes for afforestation are designed to promote afforestation with broadleaf species and mixed stands in order to create more robust forests with a greater nature content. As an alternative to the use of the land for agricultural production, afforestation can protect the groundwater since only very small amounts of nitrogen leach from the soil beneath forest. Forests store CO_2, and doubling of the forest area will result in annual storage of approx. 5% of the present Danish CO_2 emissions. In addition, the forests are of great significance for biodiversity in Denmark.

Fishery

Danish human consumption landings have fallen from approx. 500,000 tonnes in the mid 1990s to around 350,000 tonnes. Industrial landings fluctuated between 1.2 and 1.6 million tonnes per year over the past 10 years. The fishing fleet has changed such that the total tonnage has remained roughly the same, but the number of vessels has decreased. Fishery for human consumption species in the North Sea, the Skagerrak and the Kattegat has fallen since the mid 1980s due to a fall in cod and plaice landings and a marked fall in herring landings. In the Baltic Sea, the herring catch has remained roughly constant over the past 20 years, while the cod catch has fallen markedly. The decrease in these fish stocks is attributable to overexploitation. In the case of cod, international efforts have been initiated to restore the stocks. Among other things, the total allowable catch has been reduced markedly for cod.

The fish stocks are also affected by by-catch. In human consumption fishery, by-catch amounts to 10–25% of the target species catch. Industrial fishery can entail large by-catches of herring and thereby affect the herring stocks. Technical changes to fishing gears should be able to reduce these unwanted by-catches. Trawls and other fishing gear that are towed along the seabed can affect the marine environment.

The environmental impact of marine and freshwater aquaculture has been markedly reduced over the past 10–15 years despite constant production. This has been achieved through improved feed quality and utilization. However, the watercourses downstream of 30% of the freshwater fish farms are still affected.

Building and construction sector

Activity in the building and construction sector is highly dependent on the state of the market. Whereas the sector accounted for 10% of the total economic growth and employment 20 years ago, the figure is now approx. 5%. The building and construction sector is responsible for some of the largest and most important material streams in Denmark. The sector thus consumes most of the raw materials produced in Denmark, the majority of which consists of sand, gravel and stone. Around 75% of the raw materials extracted in Denmark are extracted on land, while the remainder are excavated from the seabed. Extraction increased during the 1990s due to expansion of the infrastructure, e.g. roads, harbours and large bridges. Extraction on land amounts to approx. 5 km^2 per year, and results in the disappearance of original landscapes despite the requirement that the quarry areas are re-established following cessation of excavation. At sea, extraction is only permitted within designated areas (totalling 1,000 km^2), and only with the permission of the Danish Forest and Nature Agency. The building and construction sector produces a considerable proportion of all Danish waste (24%). Around 90% of the waste is recycled, among other reasons because recycled waste is exempt from the waste levy.

Industry

Industry comprises approx. 20% of the Danish economy expressed in terms of employment and value added. Over the past 20 years the chemical industry and the electronic industry have grown considerably, while other branches, e.g. textiles and clothing, have declined. To some extent industrial growth has been decoupled from the environmental impacts of the sector expressed in terms of energy consumption and CO_2 emissions. Energy consumption has increased less than value added, and CO_2 emissions – which amount to 12–15% of Denmark's total CO_2 emissions – have remained virtually constant. This trend is expected to continue for the next 10 years since energy consumption and CO_2 emissions are expected to remain constant despite growth in the economy. SO_2 emissions from industry have fallen by approx. 80% between 1988 and the present day as a result of the use of low-sulphur fuels and the introduction of flue gas desulphurization. Discharges of pollutants via industrial wastewater have been reduced considerably through implementation of the Action Plan on the Aquatic Environment. Discharges of organic matter, nitrogen and phosphorus thus now only amount to around 10% of the levels at the end of the 1980s. No decreases have been recorded in the generation of waste or the use of hazardous chemicals, however. There is thus no sign of any decoupling of growth and environmental impact in these areas.

Attempts are increasingly being made to reduce the environmental impact of industry by encouraging companies to draw up green accounts and through the use of environmental control and environmental management. A registration and certification system has been introduced for environmental management under which 160 enterprises are presently registered. It is expected that environmental certification and the other "green" measures will in future provide Danish enterprises with a competitive advantage.

Service sector

The service sector comprises an increasing proportion of the economy. The private and public sectors each employ equally many persons, namely approx. 950,000. The public sector has accounted for around 31% of value added each year since 1993. In comparison, the private sector has grown by approx. 35%. This trend is expected to continue for the next 10 years such that the public sector remains constant, and the private sector grows by approx. 2.4% per year. Energy consumption in the service sector accounts for approx. 12% of the total energy consumption in Denmark, and has remained nearly constant for the past 10 years despite the economy having grown by 2–3% per year. Growth and energy consumption in the service sector have thus been decoupled. The sector accounts for approx. 8% of all waste generated in Denmark. One of the environmental goals of the public service sector is to purchase more green products. In many cases the State, Counties and Municipalities have thus drawn up a green procurement policy and stipulate green requirements when purchasing goods and services. The proportion of green purchases is estimated to be approx. 50% in state institutions and approx. 25% in the Counties and Municipalities.

Household sector

The household sector accounts for more than half of the total consumption of goods and services. Over the past 10 years, average private consumption has increased by 19%. The proportion of families owning dishwashers, microwave ovens, tumble dryers, video recorders and computers, etc. has increased markedly since the beginning of the 1990s.

Household energy consumption accounts for approx. 30% of the total energy consumption. Of this, approx. 85% is used for heating, and the remainder for operating electrical appliances. Energy consumption has remained almost constant over the past 20 years, but there has been a shift from oil to district heating and natural gas. Energy consumption per square metre has fallen by approx. 25% over the same period. Electricity consumption has remained constant despite the increasing number of household appliances due to improvements in their energy efficiency. CO_2 emissions attributable to the household sector have decreased by approx. 1/3 between 1980 and the present day, and household water consumption has decreased by 25% since 1989, mainly due to a two-fold increase in the cost of water during the same period. The 1987 Action Plan on the Aquatic Environment resulted in a marked decrease in discharges via household wastewater. Thus phosphorus discharges from the household sector are now only approx. 20% of the level at the end of the 1980s. Annual consumption of chemicals amounts to approx. 50 kg per household. This is comprised of cleaning agents, detergents, paint, varnish, etc. The household sector accounts for 24% of all the waste generated in Denmark.

In order to advise consumers and enhance the consumption of cleaner products, ecolabels (the Nordic Swan and the EU Flower) have been developed that are given to products in accordance with specific guidelines. The energy label is obligatory, whereas the other ecolabels are voluntary.

Tourism

The tourism sector makes a considerable contribution to the Danish economy. Tourism is concentrated in sparsely populated areas of great natural value. Coastal tourism accounts for 69% of the bednights, and 97% of the summer cottages are located in the coastal areas. Thus 15% of the coastal protection zone is built-up or reserved for summer cottages. Tourist facilities and tourists affect nature and the landscape, and the increase in tourism has led to increased use of the coastal areas in particular. Through spatial planning it has been possible to curb the impact of the consequences of the growth in tourism and preserve the naturalness of the countryside and hence its attraction value for tourism. A number of initiatives have been implemented to reduce the environmental impact of tourism, among others the "Green Key" ecolabel for hotels, Destination 21 for tourist localities that focus on sustainability, and Environment 2100, whereby the Association of Hotel, Restaurant and Tourism Industry in Denmark has developed tools for environmental work in tourism enterprises.

Waste

In 2000, approx. 13 million tonnes of waste were generated in Denmark. The main sources were the household sector, the building and construction sector and industry, each of which generated around 3 million tonnes of waste. The amount of waste generated has increased by approx. 17% over the period 1994–2000. Around 65% of all waste is recycled, 24% is incinerated, and approx. 12% is disposed of by landfill. Between 1994 and 2000, the proportion of waste recycled increased by 10 percentage points while the proportion incinerated increased slightly, and the proportion disposed of by landfill has been halved. Projections of waste volumes up to 2020 indicate a 27% increase, which is lower than would be expected from economic growth. In addition, the projections indicate that the proportion of waste recycled will decrease by a few percentage points, while the proportion incinerated will increase correspondingly. The Government's waste action plan "Waste 21" contains a number of initiatives for the period up to 2004, among others the separation and recycling of cardboard and paper. As a consequence, the relative proportion of waste recycled and incinerated in 2020 is expected to be the same as in 2000.

Chemicals

There are around 20,000 chemical substances on the market in Denmark. They are used in approx. 100,000 chemical products, which in turn are used in the manufacture of approx. 200,000 industrial goods. The total consumption of chemical substances and products for industrial purposes amounts to approx. 8 million tonnes per year. Substances that are used in amounts exceeding 100 tonnes per year and whose use is considered especially problematic or whose use Denmark is committed to reduce pursuant to international agreements, are collated on an official list called the "List of Undesirable Substances". The list contains 68 chemical substances and/or groups of substances, including a number of metals, organic solvents, industrial greenhouse gasses and substances that are persistent and/or suspected of having hormone-like effects. The three main product groups containing chemicals are cleaning agents, toiletries and paints/varnishes. The chemical industry is the sector that has registered the greatest number of chemical products, followed by the building and construction sector and the iron and metals industry. Expressed in terms of weight, consumption of undesirable chemical substances is by far the greatest in the iron and metals industry.

In Denmark, special attention is accorded to chemical substances that are persistent and to those that have permanent effects. The persistent chemical substances can be transported over long distances. Among other things, this means that chemicals from industry and pesticides can be detected in places where they have never been used. This global dispersal is one of the newer problems associated with our increasing consumption of chemicals.

The present initiatives in the chemical areas are based on a strategy concentrating on the assessment of individual substances or groups of related substances. The relationships between the use of the chemical substances and their effects on the environment and health are very complex. Efforts are made to take into account the uncertainty and inadequate knowledge of these relationships through application of the precautionary principle. Among other things, this served as the basis for restricting the use of phthalates.

2 Air

In Denmark, much of the air pollution derives from sources located several thousand kilometres away. This long-range transport leads to acidification and eutrophication of the environment and to photochemical air pollution. The human activities have now reached an extent where changes in the composition of the atmosphere lead to global changes in the form of depletion of the ozone layer and enhancement of the natural greenhouse effect with resultant changes in the climate. The substances of significance for ambient air quality are sulphur dioxide, nitrogen oxides, carbon dioxide and carbon monoxide, ammonia, methane and nitrous oxide, other volatile organic compounds and heavy metals. To this should be added emissions of particlulates, for example from road traffic, which are of significance for ambient air quality in the towns in particular. Regulation of emissions of these substances largely takes place through international agreements. The two most important agreements are the UN Convention on Long-range Transboundary Air Pollution and the UN Framework Convention on Climate Change. New emission ceilings for sulphur dioxide, nitrogen oxides and ammonia have recently been agreed upon under the latest protocol to the former Convention. These ceilings have to be complied with by 2010.

The majority of the sulphur dioxide emissions derive from combustion of fossil fuels. This has decreased markedly since 1985, partly because the sulphur content of the fuels has been considerably reduced, and partly because flue gas desulphurization has been im-

plemented at power plants. The existing overall target for the reduction in sulphur dioxide emissions has been fulfilled. The target for 2010 is a slightly lower level than the level for 1999. Emissions of nitrogen oxides derive partly from combustion of fossil fuels and partly from traffic. The current target for the overall reduction in emissions of nitrogen oxides has been fulfilled, among other reasons due to a reduction in emissions from energy generation and the requirement for catalytic converters on cars. The target for 2010 entails an approx. 40% reduction relative to 1999. The CO_2 emissions mainly derive from combustion of fossil fuels in energy generation, industry and households, and from traffic. CO_2 emissions are decreasing due to energy savings and technological improvements, although emissions from traffic continue to increase. It is expected that the national reduction target for 2005 can be fulfilled. Methane and nitrous oxide are greenhouse gasses like CO_2 and are encompassed by the same target under the Kyoto Protocol.

The agricultural sector's contribution to air pollution consists partly of ammonia and methane from livestock and partly of nitrous oxide released during denitrification in the soil. In addition, ammonia is released from nitrogen fertilizer and from the crops. The only other major source of emission of these three substances is nature, which, for example, accounts for approximately half of total emissions of methane. Methane emissions have remained virtually constant over the past 15 years, while emissions of nitrous oxide and ammonia have been decreasing. The target for ammonia is that emissions in 2010 should be roughly the same as in 1999.

Emission of volatile organic compounds occurs during combustion or through evaporation of organic solvents from industry, etc. The total Danish emissions are decreasing, among other reasons due to catalytic converters on cars, which have reduced emissions from road traffic. The current target of a 30% reduction relative to 1985 has been fulfilled. The target for 2010 requires a further 30% reduction.

Local ambient air quality

Recent measurements of ambient air quality in towns indicate a general improvement. Lead has virtually disappeared, sulphur dioxide pollution has fallen, and the levels of carbon monoxide and hydrocarbons have been reduced. Total emissions of nitrogen oxides have also decreased, although the decrease in the most harmful compound – nitrogen dioxide – is modest. The concentrations of total particulates in ambient town air is also decreasing, and the current limit values for ambient air quality in the towns have been met. However, the more stringent EU limit values to be introduced in 2005 and 2010 could entail exceedance of limit values in the case of a few substances unless additional measures are implemented to reduce emissions. The negative impact of particulate pollution on health is one of the major air pollution problems in Denmark. The size of the particles differs considerably, ranging from coarse soil dust to ultrafine particles 1,000 times smaller. Studies have shown that the smaller the particles, the greater the harmful effects on health. The limit values currently in force are based on measurements of large particles. From 2010 onwards, these will be supplemented by measurements and limit values for smaller particles. Traffic is the most important source, especially of the ultrafine particles. Particle filters able to effectively remove part of the particles are available for vehicles, and catalytic converters on petrol-driven cars also have some effect.

Regional air pollution

The main substances contributing to regional air pollution are sulphur compounds, nitrogen compounds and ozone. Due to the marked reduction in sulphur emissions and hence deposition, acidification effects have decreased in Denmark and the remainder of Europe since the beginning of the 1990s. The limit for harmful effects on sensitive natural and semi-natural ecosystems (heaths, dry grasslands, raised bogs, lobelia lakes) is determined by calculating the so-called critical load. The critical load is exceeded in a large proportion of these ecosystems, including all lobelia lakes and raised bogs. Moreover, the critical load is exceeded in more than half of the forest acreage.

Ammonia is released to the atmosphere from agriculture and especially from livestock holdings. Apart from the possibility of increased odour nuisance to neighbours, expansion of pig farming can thus lead to enhanced nitrogen loading of natural ecosystems. Ammonia is mainly deposited close to the source, but the remainder can be transported over long distances. There is considerable geographic variation in ammonia deposition because it is so dependent on the location of the sources. Ammonia emission from the Danish land area exceeds ammonia deposition on Denmark, and net export thus takes place. If Danish marine waters are included in the calculation, however, the amount of deposition becomes so great that Denmark becomes a net importer of ammonia. Despite the fact that ammonia emissions have been reduced, there has not been any detectable fall in the concentration of ammonia above natural ecosystems, and hence in deposition on them.

The greenhouse effect

The greenhouse gas primarily responsible for the anthropogenic effects on the global heat balance is CO_2, although methane, nitrous oxide and the so-called industrial greenhouse gasses also contribute to global warming. Over the past century, the atmospheric concentration of CO_2 has increased by approx. 30%. It is now acknowledged that a certain degree of climate change is unavoidable, and that we risk serious anthropogenic changes in climate if we do not considerably reduce greenhouse gas emissions. During the 20th century, the global mean temperature increased by 0.6°C. The temperature in Denmark has increased correspondingly. A number of projections of greenhouse gas emission have been made based on different scenarios. These show that the global mean temperature is expected to increase by 1.4–5.8°C by 2100. Even the most optimistic scenario indicates that the global mean temperature will increase. The consequence for the environment and nature can be changes in the vegetation and in living conditions for the fauna. Moreover, raising of the sea level caused by melting of inland ice and glaciers will affect the coastal areas and lead to infusion of saltwater into the aquifers. The climate changes in the form of temperature changes and changed precipitation patterns can affect agricultural production and runoff of nutrients to water bodies.

3 Aquatic environment

Nutrients, organic matter and hazardous substances are input to the aquatic environment from agricultural sources via atmospheric deposition, runoff from fields and leaching to the groundwater, as well as from urban wastewater, separate industrial discharges and sparsely built-up areas. Nutrient loading affects water quality, among other means through eutrophication, and the hazardous substances affect the aquatic flora and fauna.

Discharges of nutrients to the aquatic environment have fallen considerably over the past 15 years, especially in the case of discharges from municipal wastewater treatment plants and separate industrial discharges. This is largely due to the fact that the majority of the wastewater is now treated biologically with phosphorus and nitrogen removal. Discharges of organic matter from point sources (wastewater treatment plants, industries, etc.) have decreased by approx. 74% between 1989 and 1999, while phosphorus discharges have been reduced by 81% and nitrogen discharges by 66%. Diffuse loading from the countryside depends partly on the agricultural nutrient surplus and partly on the precipitation. Between 1985 and the present day the agricultural nitrogen surplus has fallen by 37%, and the phosphorus surplus by 32%. Diffuse nitrogen and phosphorus loading of the aquatic environment from the countryside has fallen much less, however. Total annual nitrogen input to the sea is about 100,000 tonnes, while total phosphorus input is approx. 2,500 tonnes. Of this, 4/5 of the nitrogen and about half of the phosphorus derive from diffuse loading from the countryside.

Groundwater

The groundwater is our most important source of drinking water. Only approx. 1% of the Danish drinking water supply derives from surface water. The groundwater resource is more than sufficient when viewed nationally, but there are large regional differences. Thus the exploitable drinking water resource is greatest in southwestern Jutland and least on the island parts of Denmark. Water consumption has decreased by approx. 30% since 1989 due to the increasing cost of water as well as to a reduction in water consumption for irrigation, etc. in the wet years such as 1998 and 1999. Contamination of the groundwater, which poses an increasing problem, will reduce the available amount of drinking water. Over the period 1987–1999, around 600 water supply wells have been closed down due to anthropogenic contamination. About half of these were contaminated with pesticides, 20% with other hazardous substances and 30% with nitrate.

Watercourses and lakes

The environmental quality of watercourses has generally improved over the past 10–15 years, and the number of severely affected watercourses has therefore decreased. Moreover, the watercourses are now being maintained in a more gentle manner. The watercourse quality objectives were fulfilled in approx. 40% of the watercourses during the 1990s and in approx. 45% in 2000. A large proportion of the watercourses thus still fail to fulfil the quality objectives set for them.

Water quality objectives have also been established for the large Danish lakes. Only around one third of these fulfilled their quality objective in 2000. The poor environmental state is attributable to nutrient loading from wastewater and agricultural sources, which reduces both the clarity of the water and the diversity of the flora and fauna. Even though wastewater inputs have decreased considerably, large amounts of phosphorus in particular have accumulated in the lakes. Some improvement has taken place over the past 10 years in that the average phosphorus concentration has fallen by approx. 30%, and the Secchi depth has increased from 1.45 m in 1989 to 1.6 m in 2000.

Coastal waters

The majority of the Danish fjords, coasts and inner marine waters do not meet the environmental quality objectives stipulated for them by the Counties. The main hindrances to compliance with the environmental quality objectives are the occurrence of oxygen deficit, the large amounts of pollution-tolerant algae and phytoplankton blooms.

The marine environment is affected by eutrophication, discharges of hazardous substances and oil pollution from ship traffic. The nitrogen concentration in the fjords and coastal waters remained roughly constant during the 1990s, generally following the trend in nitrogen loading from the land. In contrast, the phosphorus concentration has decreased and is presently only about half that in the 1980s. Average annual phytoplankton production has fallen by approx. 30% between the early 1980s and the late 1990s. Oxygen deficit in the Danish marine waters varies from year to year, among other reasons due to the input of nutrients from the land and due to variation in the climate. No measurable improvement has occurred since 1989.

Hazardous substances are input to the marine environment via watercourses, atmospheric deposition and wastewater. Ship traffic can cause pollution with antifouling agents and together with oil rigs can cause oil spills. In addition, hazardous substances are transported over long distances in the air and in the sea. In many cases the sea is the final recipient of hazardous substances and heavy metals, irrespective of where the sources are located. Atmospheric emissions of most heavy metals have decreased by 20–50% over the past 10 years. Some of the substances are so stable that they are transported over very long distances and can, for example, be detected in mammals in Greenland. The concentrations of many hazardous substances and heavy metals in the Danish marine environment exceed the criteria for good environmental quality.

4 State of Denmark's nature and environment

Denmark is a distinctly agricultural country where 67% of the land mass is cultivated. Denmark is also one of the countries of the world with the most intensive land use. Around 10% of Denmark is built-up (towns, roads and other infrastructure), and only 23% thus remains for forest and natural countryside. Over the past century, land use has changed considerably as reflected by increases in the

area of both built-up and cultivated land. These changes have taken place at the expense of the natural countryside, and have affected the landscapes and the cultural environment.

Land use

The area of arable land has decreased over the past 15 years due to reassignment to urban development, recreational purposes, afforestation and set-aside. Apart from actual urban development, which has increased three- to four-fold over the past 50 years, an increasing amount of rural land is being used for infrastructure, including overhead high-voltage lines, roads and wind turbines. The trend is expected to be towards an increase in forest acreage and an increase in the area of natural ecosystems, among other means through nature restoration. All in all the proportion of forest and natural ecosystems will approach 30% of the area, while the proportion of arable land will decrease to approx. 60%. There are many plans and interests associated with how the land should be used, and much indicates that competition for land will increase in the future. In order to overcome this competition it will be necessary to develop the landscape in the direction of a multifunctional landscape where several different functions can co-exist within the same area, and of which multifunctional agriculture is an integral part.

Development of the landscape and cultural environment

There are a number of conflicting interests associated with land use. Urban development causes conflicts in relation to protection of the drinking water resources, and urban sprawl can erase the clear boundaries between town and country and thereby change the landscape. Correspondingly, the erection of wind turbines – even if done out of consideration for the environment – can spoil our perception of the landscape. The more appropriate location from the energy point of view, namely the coastal areas, is being replaced by offshore location of wind turbines far from the coast. In some areas, land use pressure is so great that it places limitations on both agriculture and urban development, for example in relation to conflicts between livestock density requirements and protection of drinking water resources.

The landscapes are an important facet of the cultural environment and are affected by societal development. Agricultural development over the past 3–400 years has resulted in a structural shift from a landscape comprised of small holdings and small fields that were united in owner associations with specific areas being used communally, to a landscape comprised of few farms and large fields. Land boundaries have gradually been erased through afforestation and removal of dykes, hedgerows and field tracks, which no longer serve any function within the large fields.

Biological diversity and nature quality

Protection of nature and biodiversity is not solely a question of protecting plant and animal species. It is just as much a question of safeguarding well-functioning ecosystems that serve a number of important functions for society, for example the water cycle, nutrient recirculation, degradation of waste products, climate regulation, etc. Another related term is nature quality, which indirectly states that not all nature is necessarily worthy of preservation just because it is diverse, and that species diversity does not necessarily tell anything about quality. By way of example, species-poor ecosystems such as heaths and raised bogs can have a high nature quality.

At the beginning of the 19th century, the amount of open natural habitat types such as dunes, heaths, meadows, dry grasslands and bogs peaked at about 75% of the total area of Denmark. Today they cover approx. 9%. The decline is partly explicable by the fact that they have lost their function as pasture. The small biotopes, which are defined as small restricted natural ecosystems such as hedgerows, dykes, field boundaries, ponds, small bogs, small tree stands, etc., cover 3% of the land area. The small biotopes vegetated by trees have been advancing over the past 25 years, while the number of biotopes vegetated with permanent grass and the suchlike continues to decline. The decline of the open natural habitats is due among other things to fragmentation of the landscape by roads and other infrastructure, to intensification of farming practice with drainage, fertilization and the use of pesticides, and to the habitats becoming overgrown. The decline among the plants has particularly affected the hardy plants associated with the nutrient-poor localities. A marked decline is evident in the total breeding population of the birds associated with the open natural habitats, although with considerable interspecies differences. For example, while the lapwing has declined, the common snipe has been gaining ground.

Both the forest management form employed and the tree mix are of decisive importance for forest biodiversity. The natural vegetation in most of Denmark is broadleaf forest, and half of the species native to Denmark are associated with forest. The proportion of undisturbed forest where continuity *per se* promotes biodiversity, is relatively small. Threatened animals and plants are included on the so-called Red List. The forests contain over half of the plant and animal species on the Red List. The majority of the species on the Red List inhabit old forest, broadleaf forest and undisturbed forest. The large mammals such as the red deer are advancing, while the bat is declining. The total breeding population of forest birds has remained largely unchanged over the period 1976–1999, although with inter-annual fluctuation and inter-species variation. The populations of predatory birds are stable or advancing.

The main threats to biodiversity in the marine waters are discharges of nutrients and hazardous substances and oil pollution. In addition, the marine and coastal ecosystems are affected by physical intervention such as raw materials extraction and coastal straightening. During the summer period, nutrient loading causes phytoplankton blooms. Eelgrass is the dominant macrophyte in Danish fjords and coastal waters. Its depth distribution decreased markedly during the 20th century, but has now stabilized. The benthic faunal biomass has increased in the Kattegat and the Skagerrak, mainly due to eutrophication. The harbour seal has been advancing, and the population has almost tripled over the past 25 years. In contrast, the grey seal, which was common in the 19th century, is now rare, with only an estimated 50 seals inhabiting Danish marine waters. The populations of aquatic birds have been advancing, largely due to the establishment of bird protection sites. Land reclamation,

structures and construction work increasingly occupy the shallow waters in particular, and have reduced the extent of marine biotopes, especially in the productive fjords and coves. Raw materials extraction also affects the seabed. Plant communities and spawning grounds for such species as the herring and sandeel can be destroyed due to changes in seabed conditions. Moreover, boulder extraction is estimated to have removed approx. 15 km^2 of hard seabed, including hole-forming stone reefs, which are now a rare habitat type.

The terrestrial environment

The terrestrial environment is affected by deposition of waste, by the application of commercial fertilizer, manure and sewage sludge, and by atmospheric deposition. The substances that contaminate the soil are heavy metals and various organic compounds, of which many derive from household use of detergents, cleaning agents and other chemical substances that enter the terrestrial environment via the application of sewage sludge. The quality standards for sewage sludge have reduced the amount of sewage sludge applied by 25% between 1995 and 1999, and new requirements that enter into force in 2000 will probably result in a further decrease in the proportion that is applied to fields. The use of growth promoters and pharmaceuticals in livestock production has aroused concern due to the risk that the pharmaceutical residues will disperse into the terrestrial environment. Consumption of growth promoters has decreased to virtually zero, while consumption of pharmaceuticals is increasing.

Enhanced recirculation of nutrients in society and safer utilization of the soil necessitate reducing the copper and zinc content of pig feed and establishing a basis for assessing the significance of pharmaceutical residues. The consumption of chemicals by society also needs to be reduced so that sewage sludge produced at the wastewater treatment plants contains less hazardous substances that are harmful to health.

Pesticides

Pesticides are used to combat weeds, pests and fungal infections, especially in agriculture. They are also used in market gardens, on sports grounds, alongside roads and railroads and in private gardens. The pesticides can be harmful to a number of animals and plants, as well as to human health. At the national level, the majority of pesticide consumption is accounted for by herbicides. The existing targets for reducing the impact of pesticides were fulfilled in 2000. The need for pesticide treatment can vary considerably from year to year, though, among other reasons due to changes in climate conditions.

Pesticides have been detected in watercourses and ponds, especially during the spraying season and during periods of high runoff after storms. The most frequently detected pesticides are herbicides. No systematically collected data are yet available for the country as a whole. Based on observations made over a 10-year period, Funen County concluded that 200 km of watercourse in the county corresponding to 20% of the watercourses investigated have been exposed to acute damage due to high concentrations of pesticides.

Pesticides have been detected in the groundwater at water supply wells, in the groundwater monitoring programme and in the monitoring of subsurface groundwater under cultivated fields. Over the past seven years, pesticides have been detected in 26% of the abstraction wells, in approx. 10% of the cases in concentrations exceeding the limit value. The pesticide detection frequency is greatest in the youngest groundwater in the upper 10 m of the ground. The pesticides or pesticide residues most frequently detected in the groundwater have already been banned, but will continued to occur in the groundwater for a long time in the future. A new Pesticide Action Plan was drawn up in 2000.

5 Man and the urban community

Towns in Denmark

Around 85% of the Danish population live in towns. The urban population has increased by 3.8% over the past 10 years as a result of population growth, but actual migration of people from rural areas to the towns has not taken place. The urban zone now occupies 5.7% of the country and on average has increased by about 1% yearly over the past 25 years. The increase in the urban area is attributable to commercial development, including the construction of office buildings, especially on the edge of towns, and to the fact that an increasing proportion of new homes consist of detached houses. Urban sprawl is problematic for the environment in that it leads to increasing pollution from transport, including energy consumption. Both public transport and district heating depend on a certain density in order to be economically viable. In addition, urban sprawl means that land is developed that could otherwise have been used for urban forest and other recreational purposes.

Traffic in the towns is a special problem because pollution from the traffic is concentrated and the environmental impact becomes greater. In central Copenhagen, daily transport per person is only half that of inhabitants of the peripheral parts of Greater Copenhagen. In the large provincial towns, daily transport is 2–4 times greater for peripherally located residences than for centrally located residences. The central location that is attained by increasing the density of the towns reduces CO_2 emissions from traffic, whereas its effect on the other environmental impacts (noise, air pollution) is largely dependent on the specific design of the building development and location in relation to the existing buildings, road network and public transport. The principle of building near stations is an important way for urban development to decouple growth and the impact of the transport sector on the environment and health. Location of workplaces near stations and the utilization of existing urban areas for housing and businesses help reduce the environmental problems caused by traffic in the towns.

Urban environment

As the density of urban areas is high, energy and other resources can be utilized better in the form of collective solutions. Energy efficiency increases with the introduction of district heating, which now accounts for approx. 57% of the supply at a national level,

and 85–90% in towns such as Copenhagen and Odense. Energy consumption for heating per square metre has decreased by approx. 25% since 1980, while the heated area has increased by almost 20%. This is due partly to more effective supply of heat, including district heating, and partly to improvements in house insulation. The average consumption of energy and resources per square metre is lower in densely built-up districts of the towns than in the less densely built-up districts.

In recent years the quality of town air has generally improved, and the levels of pollution are now below the currently applicable limit values. The factor of greatest concern regarding air quality in towns is now the very fine particles, which mainly derive from vehicle exhaust fumes. Noise in towns is mainly caused by traffic. Around 500,000 homes are exposed to noise levels exceeding the currently applicable limit levels and just under 100,000 are exposed to noise exceeding the limit levels from other sources. The target is to reduce the number of severely noise-plagued homes from 150,000 to 50,000 by 2010. Around 63% of the 5,000 registered contaminated sites are located in the urban zone. The contaminated sites are typically old industrial sites, landfills and petrol filling stations. Of the registered contaminated sites, 25–30% are located in housing districts, approx. 30% in industrial and commercial districts and the remainder in areas used for other purposes or are unused.

Together with urban spaces and cultural environments, urban green spaces help counteract the negative effects (noise, air pollution, contaminated sites) of living in towns. Urban green spaces encompass forests, parks, sports grounds, graveyards and lakes. Copenhagen and Frederiksberg have far less green space per inhabitant than other large towns such as Aarhus and Aalborg. On the other hand, accessibility to green spaces is much better in Copenhagen and Frederiksberg than in Aalborg due to the fact that the green spaces in Aalborg lie on the outskirts of the town, whereas Copenhagen has many more green spaces in the town centre.

Environment and health

While it is acknowledged that there is a relationship between the environment and health, it is very difficult to describe it precisely, and in particular to quantify it. A large number of environmental factors (chemical, physical and microbiological) affect health. However, it is difficult to determine to what extent the possible effects of environmental factors are also related to other factors, e.g. lifestyle factors such as eating habits, smoking and lack of exercise. Moreover, assessment is rendered even more difficult by the fact that some of the health effects can only be recorded over a long time horizon. The mean life expectancy has increased more slowly in Denmark over the past 20 years than in other high-income countries such as Sweden and Germany, where the mean life expectancy has increased by 3–4 years since 1980 as compared with only 1–2 years in Denmark. It is unclear what the reason for this is, and to what extent it is related to environmental factors.

The environmental factors considered to have health effects include the hazardous substances and heavy metals that human beings come into contact with through contaminated soil and drinking water, air pollution, through products containing chemical substances, and through the working environment. The main physical environmental factors are noise and particle pollution of town air, although factors such as outdoor recreation and access to nature and green spaces also play a role. The microbial environmental factors encompass pathogenic microorganisms. In the environment they can reach man through the application of manure slurry and sewage sludge on fields, and they can occur in drinking water, bathing water and hot water systems. Exposure to microbial pollution is greatest via foods, however.

The risk society

We live in a society full of risks, some of which are posed by environmental factors. 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 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.

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 proved 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. 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 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. In order to be able to take action in relation to environmental problems, knowledge is needed and a political and ethical stand has first to be 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.

Introduction

Aim and context

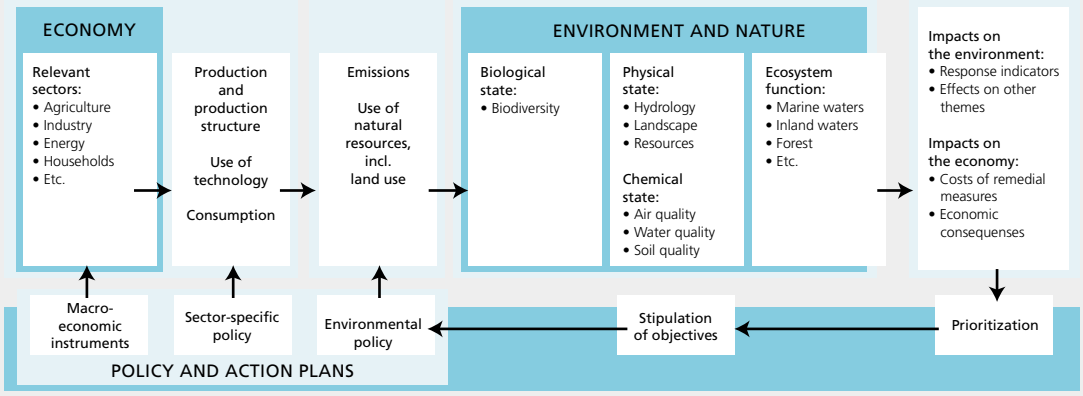
The State of the Environment Report is a scientific report on the current and long-term state of the Danish environment. The fundamental idea behind the report is to describe the interaction between society and the environment. The report provides an overview of the current state of the environment and nature, and contains descriptions of past and future trends. In addition, emphasis is placed on how to explain the trend patterns and assess the effect of environmental policy initiatives. Thus, in those cases where there is a scientific basis for doing so, the report describes whether the targets set in political strategies and action plans have been or can be expected to be attained.

The State of the Environment Report is published every four years, and is a cornerstone of Danish strategic environmental planning. It provides the scientific premises for prioritization within environmental policy issues, although suggestions for prioritization are outside the scope of the report. Prioritization is the other cornerstone of strategic environmental planning carried out at the political-administrative level.

A third element of strategic environmental planning is the Danish indicator report "Environment and Nature", which is published annually, and which provides an up-to-date status of the environmental situation through regular updates of key indicators from the State of the Environment Report.

Upon ratification of the Aarhus Convention, publication of the State of the Environment Report became legally mandatory. At the same time, the decision was made to include the public in the preparation of the report through a two-phase hearing process. The first hearing concerned the contents of the report, i.e. the selection of issues to be included. This took place before the report had been written aiming at evoking a discussion on the structure and choice of topics for the report. The second part of the hearing process was a more traditional hearing whereby interested parties could comment upon a draft of the full report. Apart from meeting the requirements of the Aarhus Convention concerning openness, the hearing process has been beneficial for the final result. From the comments it became clear that important topics had been omitted or, due to the report structure, were described too dispersed to provide the intended overview. Consequently, a number of corrections and adjustments were made, and in some cases the organization of the material was changed to present it more clearly.

During the period since publication of the last report in 1997, a large number of strategies and action plans have been drawn up to address key environmental issues. Apart from the National Strategy for Sustain-



Schematic diagram of the so-called DPSIR model describing the interaction between environmental states (S), anthropogenic pressures (P) and the underlying direct and indirect driving forces (D). Coupling between environmental state and society can be described through the environmental objectives and measures (R) implemented to counteract the unwanted impacts (I). (Source: National Environmental Research Institute).

able Development, these include Pesticide Action Plan II, the Ammonia Action Plan, Climate 2012, the Chemicals Strategy and, most recently, the work of the Wilhjelm Committee concerning a Strategy for Sustainable Development of Nature and the Forest Strategy. These strategies and action plans are discussed in the report, and the background material prepared in connection with formulation of the strategies and action plans is reflected in the relevant sections. However, it was not part of the aim of this scientific report to provide a detailed description and evaluation of these strategies and action plans apart from describing the targets set and, in relevant cases, describing whether the targets have been attained.

In an international context – especially in relation to the EU – the Danish State of the Environment Report serves as the basis for inter-country comparisons or for the preparation of a larger combined report on the state of the environment. For example, the report is part of the material used by the European Environment Agency when preparing the European State of the Environment Reports.

Topics encompassed by the report

The report is divided into five chapters. The first deals with societal pressures, especially the trend patterns for those societal sectors that have the greatest impact on nature and the environment. The description of society in this report is based on the division of society into a number of economic sectors. The next three chapters concern the three media: Air, water and the terrestrial environment/nature. The chapter on the terrestrial environment and nature contains a section on biodiversity that encompasses both the terrestrial and aquatic environments. The last chapter concerns the urban environment and man. The effects on human beings and conditions for human life are discussed in this chapter since 85% of the Danish population live in the towns.

Apart from the broad description divided into five chapters, each chapter contains selected theme sections. These provide a more detailed examination of some topical problems or represent new knowledge pertaining to either the Danish environmental debate or new environmental policy.

The report describes the interaction between society and the environment based on a perception of the relationship between societal activities and environmental pressures as illustrated in the so-called DPSIR model. This model illustrates both that societal activities affect the state of the environment, and that there is a feedback from the state of the environment to society in the form of environmental policy initiatives for the individual sectors (agriculture, transport, energy, industry, etc.). These feedbacks consist of the objectives and measures that society decides to set and initiate in order to counteract the unwanted changes in the state of the environment and the negative impacts these have on the ecosystems and on conditions for human life.

The report focuses on the environment and nature. The social environment and the working environment are not encompassed by the report apart from brief mention of the working environment in a theme section on the environment and health.

The report is restricted to Denmark itself, while the other parts of the Kingdom of Denmark – namely the Faeroe Islands and Greenland – are not included.

The report data

Preparation of the report was completed at the end of September 2001. The data on which the report is based are therefore the data that were available up to 1 October 2001. After that date, only selected data series have been updated. This means that the most recent data in the report mainly derive from 1999, although some time series also encompass 2000.

Website containing data: All the data on which the report is based are available on the Internet. The report figures and tables and the data upon which they are based, and the source documentation, etc. can be found in the National Environmental Research Institute's thematic database, where the data and figures will be regularly updated. The theme database containing the data for this report is available at: www.dmu.dk