DATA ON THE ENVIRONMENT

2011 EDITION

ENVIRONMENT AND AGRICULTURE

Umwelt Bundes Amt
For our Environment

The brochure can be ordered free of charge from:

Address:
Umweltbundesamt
c/o GVP
Postfach 30 03 61
53183 Bonn | Germany

Service-Telefon: *+49(0)340 2103-6688*
Service-Fax: *+49(0)340 2104-6688*
Email: *uba@broschuerenversand.de*

CONTENT

PREFACE

Jochen Flasbarth,
President of the Federal Environment Agency

Man has used land for agriculture for thousands of years. Now as before far more than one million people work in agriculture in Germany. Agriculture serves, first of all, to feed the population - either directly by cultivating food or indirectly by producing fodder for livestock. Lately agriculture has also become an energy supplier producing energy plants for use in biomass power stations.

Yet, farmers do not only produce vital goods, they also use natural resources. Thus, more than 50 per cent of Germany's total area is used for agriculture and 60 per cent of this just for fodder production. The share of grassland is declining sharply, due also to the increasing cultivation of energy crops. Yet, grassland is an important sink for atmospheric CO_2 for climate protection and is also important for conserving biodiversity.

Modern agriculture without fertilizer would be unthinkable. Whereas organic fertilizers can be mostly obtained regionally mineral fertilizers have to be imported from other countries of the world to Germany over long distances to achieve optimum yields. Environmental problems also arise when nutrients are applied to fields in excess to then pollute water and soil. Undesired effects are algal blooms or oxygen deficiency in our rivers or lakes, but also elevated nitrate levels in drinking water. Increasing emissions of nitrogen oxide and ammonia, which make a major contribution to the overfertilization and acidification of waters and soils, are a further challenge for environmental protection.

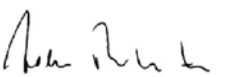
In the 20th century farmers perfected the fight against undesired wild herbs, fungi, insects, snails and other pests. Now as before many pesticides are used in conventional agriculture to ensure high yields. The authorisation of plant protection products

according to strict standards ensures that these products when used properly do not cause any environmental damage outside the area where they are applied and drinking water supply is not impaired either. But: the application of toxic chemicals results in the composition of species in waters and soil becoming more and more uniform. Buffer zones alongside water bodies and flower strips may help here to protect the important diversity of natural biocenoses.

And climate protection? According to rough estimates methane, nitrous oxide and carbon dioxide coming from agriculture account for about 15 % of Germany's total greenhouse gas emissions if - to be fair - all agricultural activities connected with emissions are considered and also diesel for tractors is not excluded. Worldwide agriculture's share of greenhouse gas emissions is even higher, at an estimated 30 percent. A very significant source is animal husbandry. Yet, agriculture alone cannot ensure climate protection, consumers, too, have to do their bit: People who eat more fruit or vegetables instead of animal-based food make an active contribution to climate protection and lead a healthier life.

And what does the European Union (EU) do to make agriculture greener? Already today the Common Agricultural Policy (CAP) of the EU requires a certain protection of environment in cultivating land. In the agricultural reform planned for 2013 it will be important to strengthen environmental requirements where they are not yet sufficient. This will also require reallocating agricultural funding, which has to give up lump-sum area premiums and should remunerate specific services of agriculture for ecosystems instead.

Agriculture is one of the most important uses of our environment. In future it will have to be rendered still more environmentally sustainable and nature-friendly. In this brochure you can find the most important figures, data and facts needed for a well-founded discussion on more environmental protection in agriculture.



Jochen Flasbarth

01

DATA RELATING TO AGRICULTURAL STRUCTURE

WORKFORCE

The intensity of agricultural use and thus its effects on the environment depends strongly on the degree of mechanization and the persons employed in agriculture. The number of people working in agriculture is sharply declining. In 2007 1 251 400 people were engaged in agriculture and thus 12.9 % less than in 1999. In western Germany the agricultural workforce declined by 13.9 % since 1999 to only just 1.1 million persons in 2007. In eastern Germany a reduction by 5.6 % to 159 400 persons occurred during the same period. The labour force in farms may be classified into members of the farmers` families and non-family workers. The following distribution was found for 2007: 728 600 family members, 522 800 non-family workers, of which 336 300 were seasonal workers. The declining numbers of employment are due mainly to the declining number of family labour. Due to its large share of family farms this refers especially to western Germany: Family labour predominated there in 2007, with 689 300 persons, which are 63.1 % of the agricultural workforce in that part of the country. As legal forms (associations and legal persons) are structured differently in eastern Germany, non-family labour predominates there: Of the 159 400 person workforce 75.4 % was non-family and only every 4th person belonged to the 39 300 family workers.

Source: Federal Ministry for Food, Agriculture and Consumer Protection (BMELV): Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten der Bundesrepublik Deutschland 2009

The farm labour input declined by nearly 14 % as compared with 1999. The manpower unit is used as a measure for the labour productivity of employees. One manpower unit corresponds to a full-time and according to his/her age fully efficient worker carrying out farm work in a certain period. The decrease in the number of manpower units related to area in agricultural use is an indication of the increase in productivity in the face of a declining workforce. 3.6 manpower units per 100 ha of agricultural land were calculated for 1999 while in 2007 the figure was only 3.1 manpower units (-13.9 %) [1].

NUMBER OF FARMS AND FARM SIZE STRUCTURE

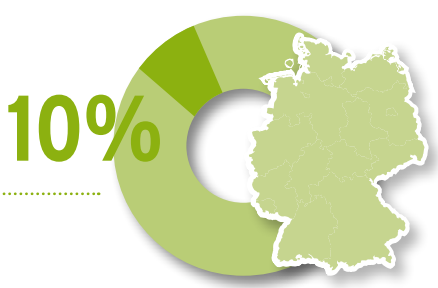
NUMBER OF FARMS AND TOTAL AREA IN AGRICULTURAL USE IN GERMANY

Source: Federal Ministry for Food, Agriculture and Consumer Protection (BMELV): Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten der Bundesrepublik Deutschland 2009

In 2007 374 500 holdings farmed about 17 million ha of agricultural land in Germany. Thus, the number of farms declined by 42.8 % as against 1991. The farm area in agricultural use declined only by 92 600 ha (0.5 %). The farm structure has changed in the last years notably in western Germany whereas the structural change in eastern Germany was comparatively insignificant. Between 1999 and 2007 the number of farms in western Germany decreased from 441 600 to 344 400 (-22 %) whereas the number of farms in East Germany declined from 30 400 to 30 100 (-1 %). The comparatively insignificant decline in the number of farms in eastern Germany is due to the fact that in this part of Germany large farms predominate (due to its historical development). In contrast, in western Germany small and medium-sized family farms predominate with the exception of the northwestern part of Germany.

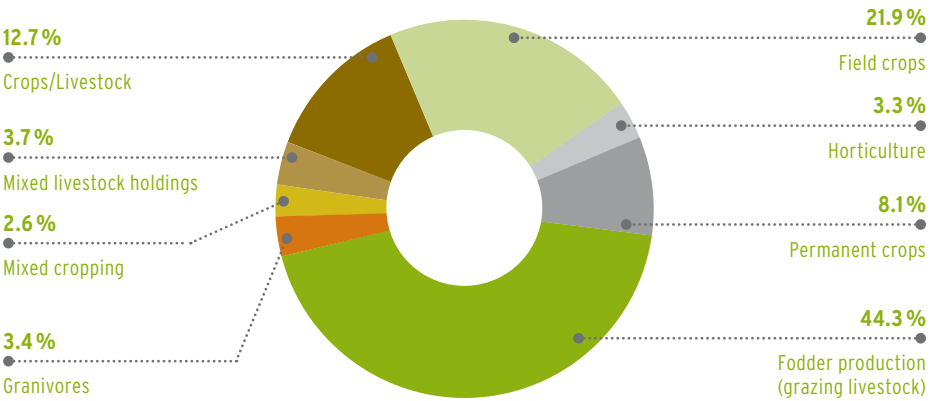
Less than 10 % of all holdings farm more than half of the area in agricultural use in Germany. Due to structural change the number of holdings is decreasing resulting, at the same time, in a continuous extension of the remaining farms. According to the agricultural structure survey of 2007 the growth threshold is at 75 ha, i.e. farms with a smaller area are no longer considered to be competitive. Compared with 1999 the number of farms with more than 100 ha of utilised agricultural land increased by 30.9 % to 31 900 farms; of these, 9000 farms were in eastern Germany and 10 300 farms in northern Germany (Schleswig-Holstein and Lower Saxony). This development causes an increase in farmed area by 9 % of farms, whose share of area farmed already amounted to 52.2 % in 2007. The result is a concentration of agricultural production and agricultural subsidies on few farms [2]. This development has effects on the environment in two respects: On the one hand, it is possible to cultivate big plots in an optimal way as regards e. g. fertilization management, and substance-related environmental impacts can often be avoided more effectively. On the other hand, intensive cultivation of large areas results in a loss of landscape diversity which may have negative effects on biodiversity.

Less than 10 % of all holdings farm more than half of the area in agricultural use in Germany.



TYPES OF FARMING (FARM FORMS)

FARMS IN 2007 BY TYPE



Source: Federal Ministry for Food, Agriculture and Consumer Protection (BMELV): Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten der Bundesrepublik Deutschland 2009

The most frequent type of farming is fodder production. This category mainly covers dairying, but also cattle rearing/fattening and sheep and horse farming.

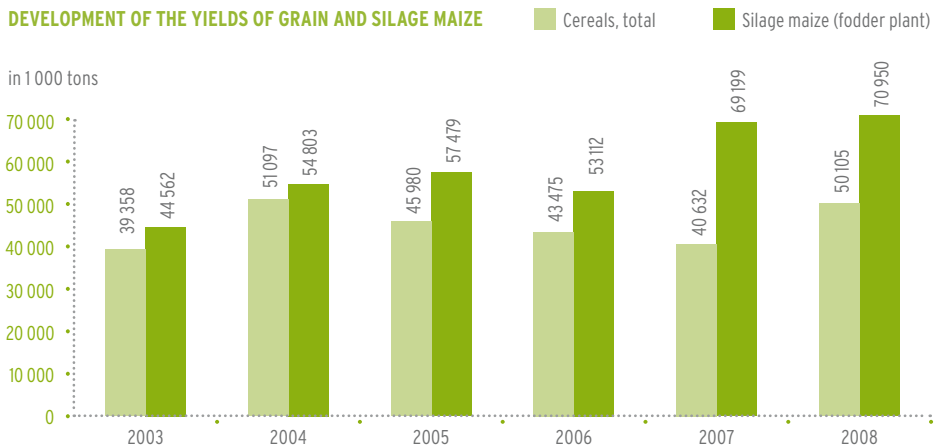
Farms growing field crops are mostly specialized on the cultivation of cereals, oil seeds and protein crops. Mixed farms combine cropping with grazing cattle more often than with granivores (pig or poultry fattening). In the category of permanent crops, wine cultivation predominates over fruit cultivation.

A share of only 3 % for granivore farms (e.g. pig or poultry fattening) makes this sector appear very small. This is due to the fact that only area use and not what is grown on it is used for classifying farm forms.

PLANT AND ANIMAL PRODUCTS

In 2008 German agriculture produced plant products valued at more than EUR 25 billion. The plant products include cereals, legumes, root crops, oleiferous fruits, fodder plants and grassland, special cultures such as fruits, wine, flowers, ornamental plants and nursery products. The crop types with the highest yield are cereals with 50 105 000 tons and silage maize with 70 950 000 tons in 2008.

DEVELOPMENT OF THE YIELDS OF GRAIN AND SILAGE MAIZE

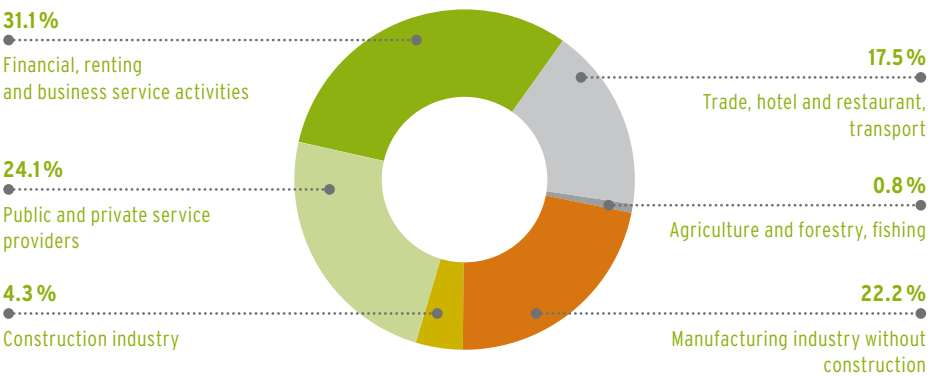


Source: Federal Ministry for Food, Agriculture and Consumer Protection (BMELV), Federal Statistical Office 2010

In 2008 agriculture in Germany produced animal products valued at EUR 22.1 billion. The most important products include: milk (EUR 9.5 billion), pigs (EUR 6.6 billion), cattle (EUR 3.8 billion) and poultry (EUR 1.9 billion). In particular, the production of pigmeat increased sharply, by 35.4 %, and poultry production by 34.2 % in the period between 2000 and 2008. Though in Germany approx. 60 % of the agricultural acreage is already devoted to fodder production, large quantities of fodder have to be imported. The global transport of fodder is accompanied by a global redistribution of nutrients. For instance, in 2005 alone, about 370 000 tons of nitrogen were imported to Germany in the form of fodder. The dominant types among fodder imports to Germany are cereals with 5 164 000 tons and soya with 4 884 000 tons.

THE IMPORTANCE OF AGRICULTURE FOR THE NATIONAL ECONOMY

GROSS DOMESTIC PRODUCT 2009 IN %



Source: Federal Statistical Office: Deutsche Wirtschaft, 2. Quartal 2010

German agriculture's share of gross domestic product is insignificant, with 0.8 % in 2009, compared with other economic sectors. German agriculture achieved sales proceeds of EUR 38.4 billion in 2008, of which approx. 42 % were achieved in plant production and approx. 58 % in animal production.

Sectors of manufacturing industry	Sales in EUR billion
Mining	16
Manufacturing industry	1 720.1
↳ Production of agricultural and forestry machinery	11.5
↳ Production of machines for food industry and tobacco processing	4.9
↳ Wood industry	17.8
↳ Food industry	156.3
↳ Tobacco processing	14.1

SALES PROCEEDS OF AGRICULTURE AS COMPARED WITH THE MANUACTURING INDUSTRY IN 2008

Source: Federal Statistical Office, Federal Ministry for Food, Agriculture and Consumer Protection (BMELV) 2009

Agriculture and forestry	Sales proceeds in EUR billion
Agriculture	38.4
↳ Plant products	16.3
↳ Animal products	22.1

With its "primary production" agriculture provides the basis for a strong domestic food industry. It not only ensures the supply of high-quality products to the German population but is increasingly developing into an important export sector. Germany is now the world's fourth largest agricultural exporter. Furthermore agriculture is a main pillar of the so-called bio economy. This comprises all processes aimed at producing biomass-based products in in a competitive and sustainable manner.

SUBSIDIES

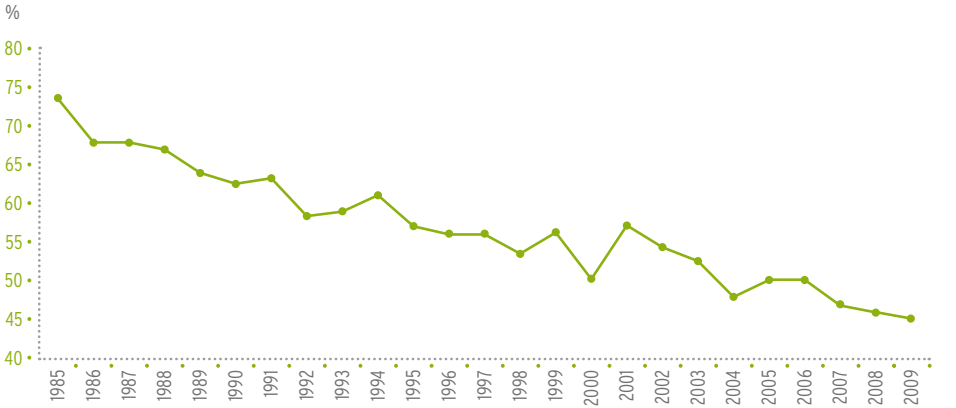
State transfers and their further development

German agriculture is granted substantial public assistance. In addition to subsidies to the tune of about EUR 6 billion it receives approx. EUR 4 billion in federal benefits for agricultural social policy. This compares with a net value added of approx. EUR 12 billion (net value added per worker approx. EUR 21 000).

Other countries also subsidize their agriculture, and partly substantially more than the European Union (EU), e.g. Norway and Switzerland. There approx. 60 % of agricultural income is financed by taxpayers' money. Furthermore, the European Commission has pointed out that the share which the Common Agricultural Policy (CAP) has in the budget of the Community is constantly declining. It is still about 42 %, however.

Even though this share is still high it has to be considered that agricultural policy was the first fully integrated common policy and that the EU's agricultural expenditure is supplemented only by comparatively small amounts of funds from national budgets. The situation is completely different in other policy fields such as e.g. in transport policy.

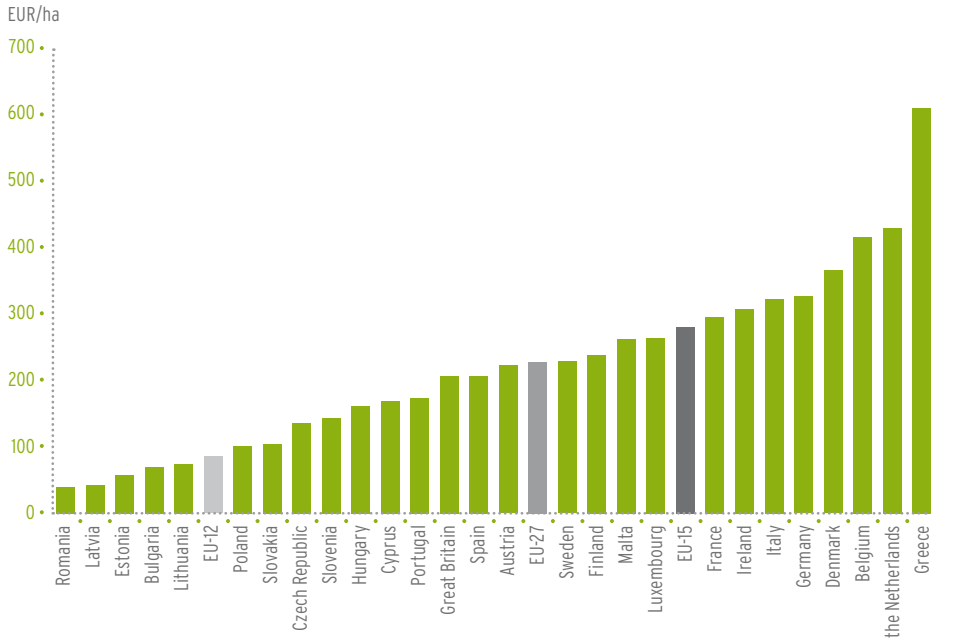
CAP EXPENDITURE AS A PROPORTION OF TOTAL EU EXPENDITURE



Source: European Commission, GG AGRI (updated by GD AGRI, Section L.1, on 5/3/2010)

Agricultural subsidies differ significantly within the EU. This can be shown with the direct payments from the so-called "first pillar" of the Common Agricultural Policy (CAP), the biggest pot by far.

DIRECT PAYMENTS IN THE MEMBER STATES, AVERAGE AMOUNT PER HECTARE IN 2009



Source: European Commission, GG AGRI (updated by GD AGRI, Section L.1, on 5/3/2010)

Farmers in Greece receive just under EUR 600 /ha. Their colleagues in Estonia, Latvia and Romania have to content themselves with EUR 50/ha and less. The approximation of these area payments in the period between 2013 and 2020 will presumably be one of the main contentious issues of the next CAP reform. Direct payments are granted at present either according to historic entitlements (single payment model), land area of the holding (area model) or a mix of the two (combined model). As a result of this big land owners such as food companies, lignite companies or the British Royals are among the recipients of the highest agricultural subsidies.

State transfers: cross-compliance

Direct payments were linked to compliance with binding regulations in the fields of environment, human health, animal and plant health and animal welfare as well as the requirement that farmland - in particular land no longer used for production - be maintained in good agricultural and ecological condition.

One per cent of all farms are checked each year for compliance with these criteria; in case of non-compliance payments may be reduced. However, the most frequent violations are not registered in the environment field but in preventative health care. Examples are lost ear tags from cattle which as a result of the BSE crisis were introduced to better trace production pathways, i.e. to ensure product quality.

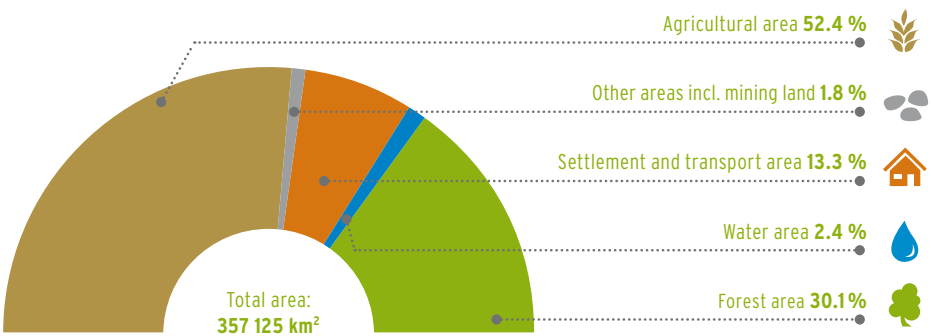
The effectiveness of the cross compliance regulations was strongly doubted by the European Court of Auditors [3]: It found that the aims and area of validity are not exactly defined, the requirements of the legal framework are difficult, coordination with rural development is unsatisfactory, the control and penalty systems applied by the member states are insufficient, data transmission is unreliable, and monitoring of the effectiveness is inadequate. All parties concerned have yet to make considerable efforts cross-compliance is to achieve its full potential.

02

USE OF RESOURCES IN AGRICULTURE

LAND USE

LAND USE (AS PER 31/12/2009)

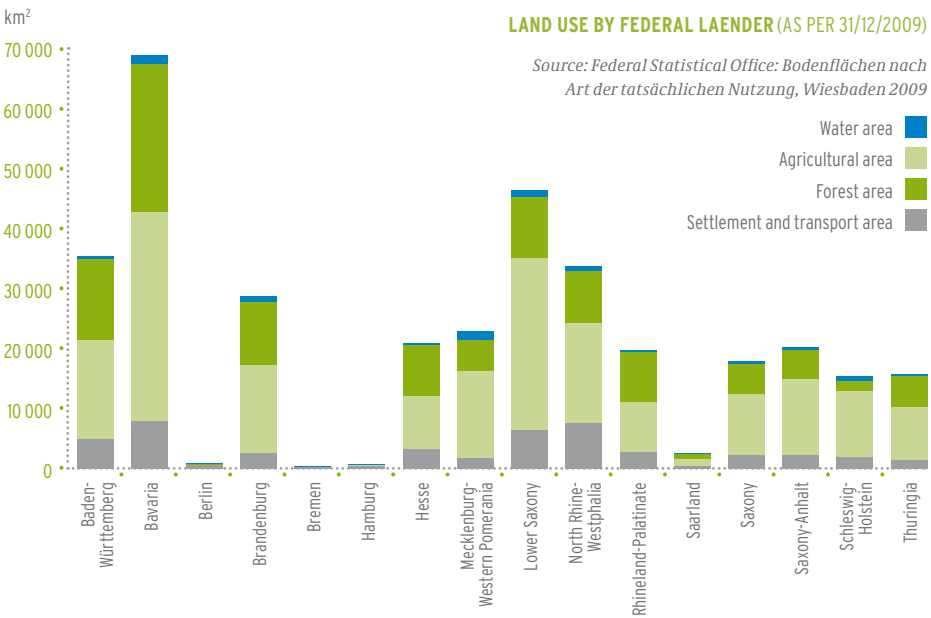


Source: Federal Statistical Office: Bodenflächen nach Art der tatsächlichen Nutzung, Wiesbaden 2009

Germany has a total land area of 357 125 km². 52.4 % of this is agricultural land. Since the mid-1990s the agricultural land area declined by 1.6 %. Agricultural land is to be found mainly in Bavaria and Lower Saxony, but also in large part in North Rhine-Westphalia, Baden-Württemberg, Mecklenburg-Western Pomerania and Brandenburg.

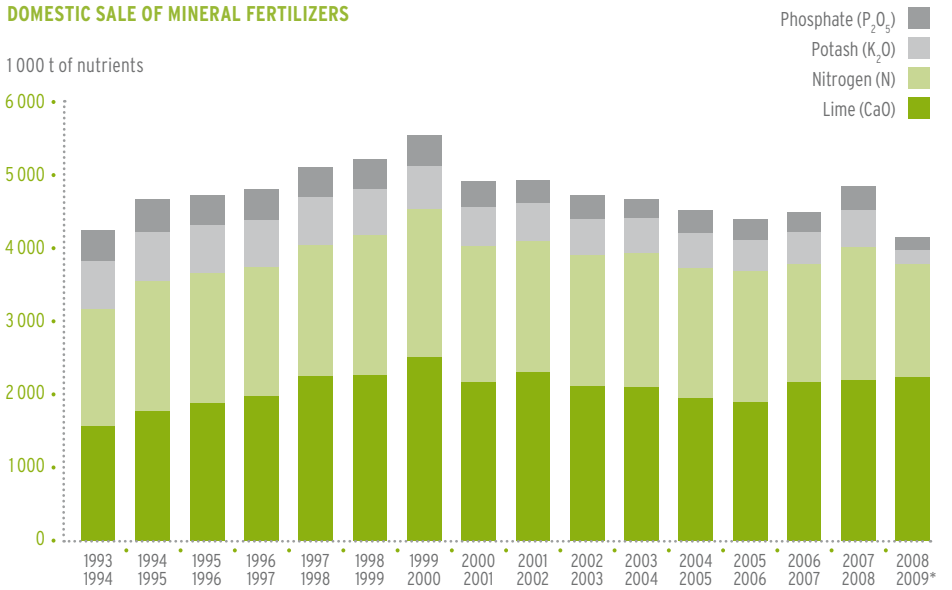
LAND USE BY FEDERAL LAENDER (AS PER 31/12/2009)

Source: Federal Statistical Office: Bodenflächen nach Art der tatsächlichen Nutzung, Wiesbaden 2009



SALES OF FERTILIZER

DOMESTIC SALE OF MINERAL FERTILIZERS



Source: Federal Ministry for Food, Agriculture and Consumer Protection (BMELV): Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten der Bundesrepublik Deutschland, Münster-Hiltrup, verschiedene Jahrgänge

Sales of nitrogen from commercial fertilizer vary because the price is strongly coupled to the oil price due to the high energy demand for fertilizer production and because farmers buy material when prices are favourable and then stockpile them. In the first half of the 1990s fertilizer sales increased again up to the late 1990s before declining again after 2000. In 2007/08 sales increased again. In 2008/09 they reached an all-time low. When interpreting the figures it should be considered that the sales must not be identical with the use in the agricultural field as material is stockpiled when prices are favourable. The aim of the Fertilization Ordinance, which came into force in 1996 and was amended in 2006, is to reduce nutrient inputs into waters and other ecosystems in the long term by applying fertilizers carefully (good farming practice) and avoiding nutrient losses. To assess their effects on the environment not the sales or use of fertilizers are decisive but the balance surplus, which is determined either as farm gate balance comprising all sources or alternatively as combined

field-stable balance. The medium-term development of the sales of commercial fertilizers is also affected by the economic framework as well as by agricultural and environmental policy, e.g. promotion of biogas and renewable resources, design of agrienvironmental programmes and organic farming subsidies.

SEWAGE SLUDGE

Sewage sludge from municipal waste water treatment plants contains valuable plant nutrients (nitrogen, phosphorus) and organic matter. That is why it can be used as so-called secondary raw material fertilizer in agriculture. Yet, sewage sludge may contain pollutants which are removed from waste water during treatment and which accumulate in the sludge. That is why utilizing sewage sludge in agriculture means not only to recycle nutrients but also pollutants. Therefore, although heavy metal concentrations in sludge are declining significantly and legal requirements are in place through the Sewage Sludge Ordinance, sewage sludge utilization in agriculture is controversial and is handled differently in the Federal Laender. The contamination by organic substances, which the current statutory requirements and limit values cover only partially or not at all, is problematic. In addition, after removal from waste water by means of iron salts phosphorus (P) is present as iron phosphate, which is poorly soluble and not bio available in the short term. That is why the amended Sewage Sludge Ordinance is to contain additional limits for organic pollutants and the duty to indicate the iron content in sewage sludge.

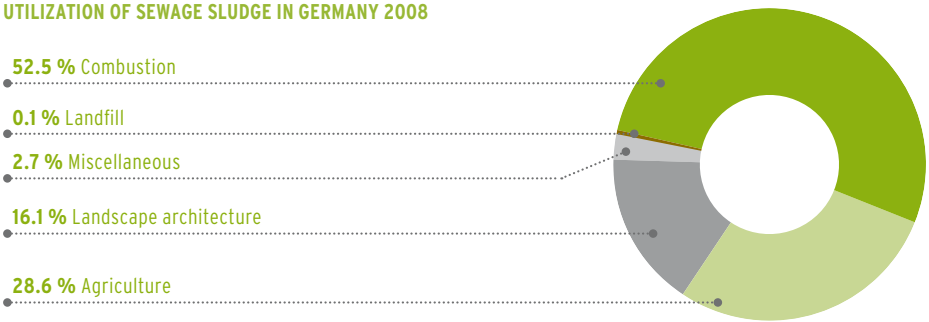
Whereas in Schleswig-Holstein 70 % of the total sewage sludge is applied in agriculture Bavaria and Baden-Württemberg are aiming to abandon the agricultural use of sewage sludge completely. In Switzerland after an extended transition period the utilization of sewage sludge in agriculture has not been allowed since 2008. A number of techniques have now been developed by means of which at least some of the phosphate may be returned to agriculture without being affected by contaminants. They are based either on a selective precipitation of magnesium-ammonium phosphate (MAP) from waste water or on mono-incineration of sewage sludge and subsequent extraction from ash. Currently, almost 53 % of the sewage sludge generated is incinerated. About 22 % of this is burned in mono-incineration plants and the remainder goes to co-incineration plants.

The disadvantage of co-incineration is that due to the high dilution recycling of raw materials from ash is no longer possible.

Due to the global financial crisis, resulting also in a massive fall in prices for mineral raw phosphates, such alternatives of phosphate recovery are, at present, not economically competitive. The drawback of this technique is that water-soluble potassium and also nitrogen and organic substance are lost during combustion. As Germany depends completely on the import of phosphates recycling procedures for extracting phosphate will, however, gain in importance. A Federal Government-Laender working group has prepared a strategy on Germany's phosphate supply. The measures proposed are to be implemented until 2020. The Federal Environment Agency advocates replacing at least 50 % of mineral P imports by recycling products by 2020.

DISTRIBUTION OF THE THERMAL UTILIZATION OF SEWAGE SLUDGE 2008

UTILIZATION OF SEWAGE SLUDGE IN GERMANY 2008

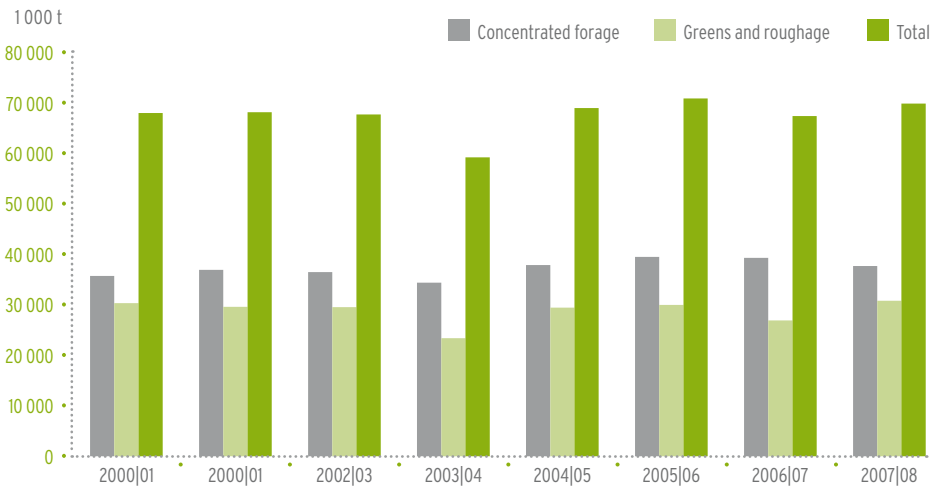


Source: Federal Ministry for Food, Agriculture and Consumer Protection (BMELV): Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten der Bundesrepublik Deutschland 2009

USE OF FODDER

60 % of the agricultural acreage serve the production of fodder. About two thirds of the whole quantity of fodder (69 586 000 t of grain units in 2008/09) are produced directly in farms. The biggest part of the fodder bought additionally is mixed fodder. The selection of the fodder depends on a number of factors. In addition to the animal species factors such as the direction of production (milk, meat, eggs), age/efficiency stage, nutrition value, prices and availability are also considered.

FODDER QUANTITIY (IN 1 000 TONS OF GRAIN UNITS)

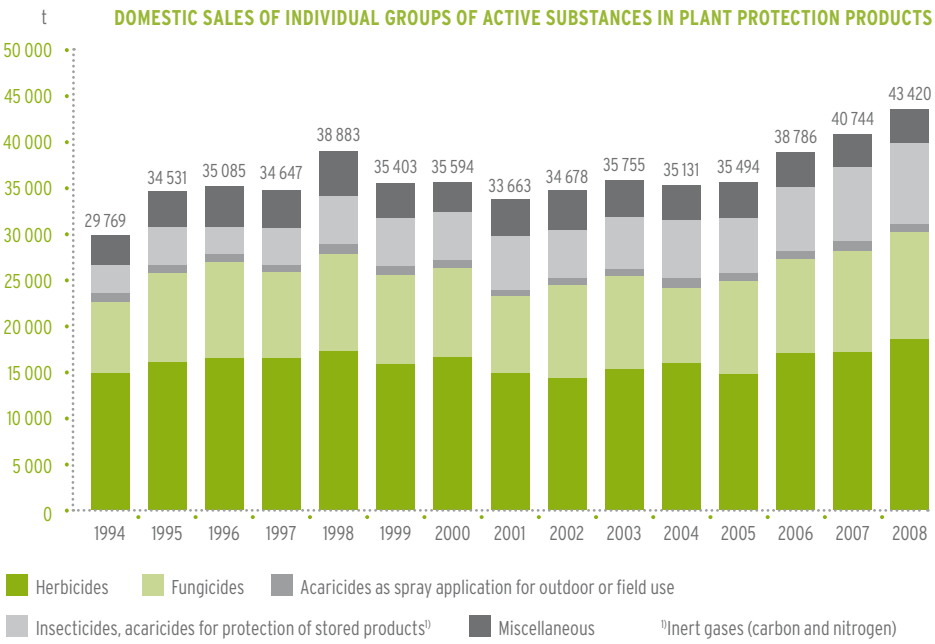


Source: Federal Ministry for Food, Agriculture and Consumer Protection (BMELV): Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten der Bundesrepublik Deutschland 2009

Fodder is subdivided into forage and roughage. Concentrated forage (mostly grains) results in high performances as it is rich in energy and protein whereas roughage (grass, hay, silage, clover) has a high share of raw fibres and owing to its structure is fed for filling. Roughage is essential for ruminants. They need structurally rich fodder to regulate the acid balance in their stomachs. In addition, feeding has effects on the formation of milk fat. Pigs are mainly given fodder rich in grain. By-products of food industry such as brewer's grains, molasses and oilseed cake are also frequently used as fodder. Also from

the viewpoint of environmental protection it is important that the share of greens and roughage will not further decline. In addition, grassland represents a CO_2-sink. In intensive cultivation of forage grassland is often ploughed up and substantial quantities of mineral fertilizer are used. Monocultures as can frequently be found e.g. in maize cultivation may in addition result in the decomposition of humus in soil.

SALES OF PLANT PROTECTION PRODUCTS



Source: Federal Ministry for Food, Agriculture and Consumer Protection (BMELV): Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten der Bundesrepublik Deutschland 2009, Münster-Hiltrup, verschiedene Jahrgänge

After a stagnation phase lasting until 2005 domestic sales of plant protection products in Germany, notably of herbicides, increased again. Possible reasons for this are the abolishment of an obligatory arable set-aside rate, the progressive introduction of plough less

soil cultivation methods and the expansion of the cultivation of maize and rape caused by the bioenergy boom. Plant protection products are environmentally relevant because they are applied to farmland on a large scale and may be harmful not only to the target organisms, but also to other animals and plants. Undesired side-effects from the use of plant protection products are not restricted solely to the treated crop area as the products may also get into border biotopes and water bodies during application, e.g. by drift of spraying solution or dusts abraded from treated seeds during sowing or afterwards by run-off or drainage from treated fields.

The environmental risk assessment carried out at the Federal Environment Agency in the framework of the authorization of plant protection products, and the environmentally related conditions of use imposed on this basis are expected to largely prevent direct harmful effects - as long as the conditions are complied with during application. However, certain indirect effects of the use of plant protection products cannot be sufficiently addressed by the authorization procedure, e.g. the increasing food shortage for farmland birds due to the intensive use of broad-spectrum herbicides and insecticides. Additional measures are needed to tackle these problems, designed to further reduce the intensity of pesticide use to an ecologically acceptable level and to sufficiently compensate unavoidable negative effects linked to the use of plant protection products in the agricultural landscape.

Besides the extension of organic farming the Federal Environment Agency also considers it necessary in this context to ensure through appropriate measures that ecological set-aside areas (fallow land, flower strips and other ecologically advantageous land uses) are created and maintained on farmland to compensate the negative effects of the use of plant protection products on biological diversity.

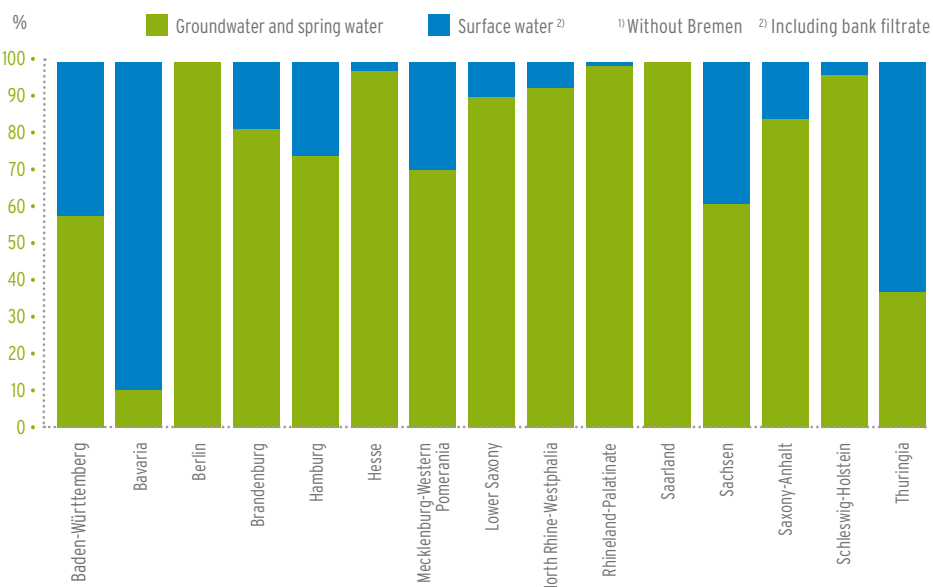
WATER USE

Water consumption by agriculture depends on the crops grown and their demand for irrigation, but also on the given climatic conditions of a region. Germany is situated in the moderate climatic zone which is characterised by year-round precipitation. A simple comparison shows that farmers in Germany enjoy a relative advantage: In Europe the agricultural sector accounts for 35 % of all water abstractions, and

worldwide its share is even approx. 70 %. In contrast, in Germany water abstraction by agriculture is very low, with a share of less than 0.25 % of total water consumption. Irrigation farming plays only a minor role in Germany, only 560 000 ha are equipped with irrigation systems which is only 3.3 % of the whole agricultural land. The water is extracted via own wells or abstraction plants of irrigation associations supplying farms connected to them with water. Farms included in the survey of the Federal Statistical Office extracted a total of slightly more than 81 million m^3 of water in 2007. However, extractions by agriculture differ widely between the Federal Laender. More than half of the water is used solely in Lower Saxony. This corresponds to the distribution of irrigated areas in Germany. Of the total of 560 000 ha, 300 000 ha - more than 50 % - are located in Lower Saxony [4]. Countrywide 85 % of the irrigation water is obtained from groundwater and spring water, less than 15 % come from surface waters.

Here too, the proportions are differently distributed among the Federal Laender. Whereas in Bavaria and Thuringia the use of surface waters predominates farms and horticultural companies in Berlin and the Saarland cover their demand completely from groundwater and spring water.

WATER WITHDRAWAL FOR IRRIGATION 2007 SHARES OF GROUNDWATER AND SURFACE WATER [1]



Source: Federal Statistical Office: Personal Information of 04/11/2009, Wiesbaden

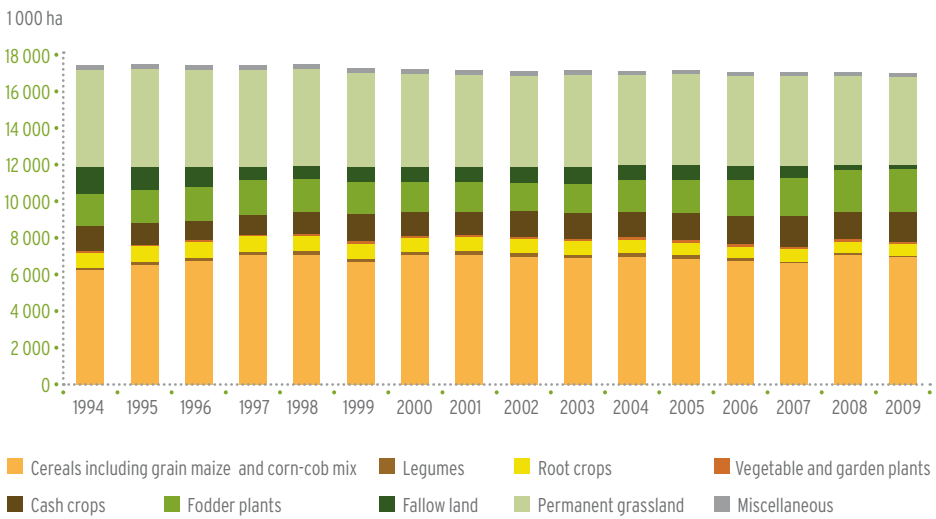
03

CHANGING LAND USE

STRUCTURE OF THE AREA USED BY AGRICULTURE

In 2009 16 889 600 ha were in agricultural use in Germany, of which 11 945 100 ha (70.7 %) was farmland, 4 741 400 ha (28.7 %) meadows and pastures (grassland) and 203 100 ha (1.2 %) permanent crops.

AREA IN AGRICULTURAL USE



Miscellaneous: garden land, orchards, tree nurseries, vineyards
Cash crops: oil seeds, hops and other commercial plants, e.g. beets and grass to obtain seeds, medical plants and herbs

Source: Federal Ministry for Food, Agriculture and Consumer Protection (BMELV): Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten 2008; Statistischer Monatsbericht, A. Landwirtchaft, Bodennutzung 2009, Endgültiges Ergebnis

Due to the cultivation of specific crops special impacts such as e.g. soil erosion or nitrate leaching are relevant to environmental protection. Such environmental impacts are possible notably by the cultivation of root crops such as beets, maize and potatoes, by wine and hops cultures or intensive vegetable gardening. To reduce soil erosion e.g. crop rotation or intercropping would be appropriate. Good

farming practice should be maintained on the whole area and constantly improved.

In 2009 cereals were cultivated on 57.9 % of acreage, fodder plants were cultivated on 19.7 % , cash crops (e.g. oil seeds, hops) on 13.2 % and root crops on 5.5 % of acreage; 2.1 % of the remaining area were fallow land[1] (s.: Loss of ecologically high-value set-aside areas p. 91), 1.1 % vegetable and garden plants and 0.7 % legumes.

The cereals cultivation area (including grain maize and corn-cob mix) increased again in 2008 to the level of 2000 after having declined for years and declined insignificantly in 2009. The cultivation of legumes and the share of fallow land are declining. However, the cultivation of fodder plants shows a rising trend.

[1]Fallow land, also other acreage not cultivated and main field crops which have to be ploughed up. From 1993 onwards also areas set aside due to the economic situation without cultivation of renewable resources. Renewable resources on areas set aside due to the economic situation are recorded according to their respective main groups [5].

THE CURRENT GRASSLAND PROBLEMS

Meadows and pastures are elements of a high aesthetic value giving the landscape its character. They are an essential component of a multifunctional agriculture producing not only food and feedstuff and renewable resources but also contributing to landscape conservation for leisure time, sports and recreation. In addition, extensive grassland provides habitats for a high diversity of species in the agricultural landscape. However, permanent grassland areas have been declining for years. This corresponds partly to the declining animal stocks. On the other hand, dairy farming has the trend to move from south to north where livestock breeding is carried out frequently in stables all year round and with a high share of concentrated fodder (maize, crushed rape) and imported substitutes (soya). This trend is supported by state subsidies from the "second pillar" of the Common Agricultural Policy ("improvement of competitiveness"). At the same time, the state tries to keep alive grassland farming in hilly and mountain regions by programmes for mountain farmers and support for less favoured areas. Here, it will be required to harmonize the agricultural policy aims to reach more coherence. Ploughing up of

permanent grassland is limited to 5 % of the reference areas on land level due to cross compliance. In the case of exceeding this limit further ploughing up of grassland will require official permits. In the case of more than 8 % it will be prohibited. As the first Federal land Schleswig-Holstein reacted to the dramatic grassland loss by adopting an Ordinance to maintain permanent grassland. Due also to the high incentives for biogas provided by the Renewable Energy Sources Act recently numerous grassland areas have been ploughed up in favour of cultivating energy maize. The Federal Environment Agency considers it necessary to correct this unfavourable development by amending the Renewable Energy Sources Act. The current development in the use of energy maize in biogas production should be documented and analyzed in the framework of the progress report relating to the Renewable Energy Sources Act. Based on this progress report it will then be possible to include in the amendment of the Renewable Energy Sources Act necessary changes in the incentive structures for the use of renewable resources such as e.g. energy maize, which would become effective on 1 January 2012.

DATA RELATING TO PLOUGHING UP GRASSLAND BETWEEN 2003 AND 2008

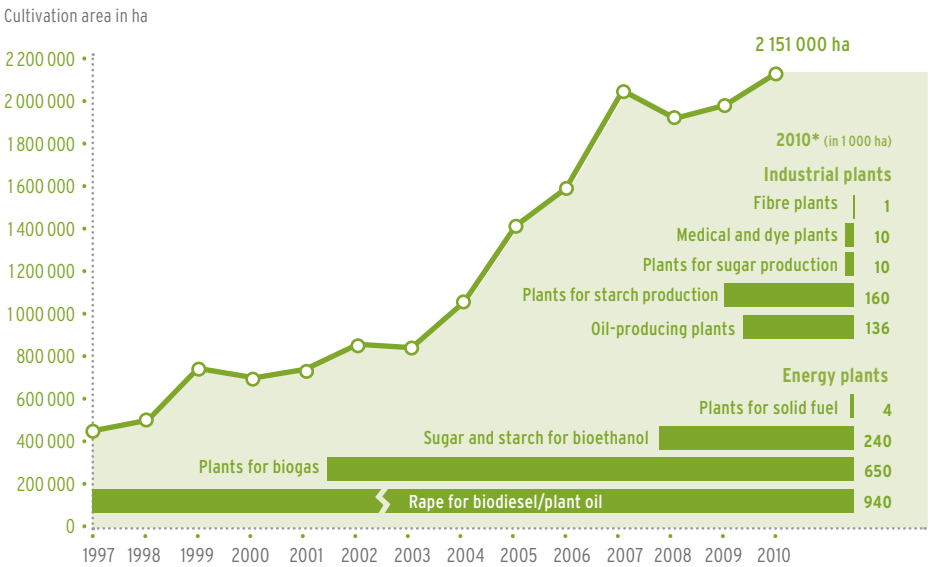
Federal land	Change in grassland share	Absolute change in grassland
Baden-Württemberg	-2.50 %	-3.20 %
Bavaria	-1.90 %	-2.50 %
Brandenburg and Berlin	-3.50 %	-4.20 %
Hesse	1.30 %	-1.50 %
Mecklenburg-Western Pomerania	-5.60 %	-6.30 %
Lower Saxony/Bremen	-5.00 %	-5.40 %
North Rhine-Westphalia	-4.40 %	-5.00 %
Rhineland-Palatinate	-5.20 %	-6.40 %
Saarland	0.00 %	-4.10 %
Saxony	-1.20 %	-2.00 %
Saxony-Anhalt	-3.30 %	-3.60 %
Schleswig-Holstein/Hamburg	-7.50 %	-7.70 %
Thuringia	-0.70 %	-0.90 %
Germany	**-3.40 %**	**-4.10 %**

Source: Federal Ministry for Food, Agriculture and Consumer Protection (BMELV)(2008): Daten nach dem Integrierten Verwaltungs- und Kontrollsystem (InVeKoS)

Meadows and pastures are elements of a high aesthetic value lending the landscape its character. They are an indispensable component of a multifunctional agriculture.

AREA FOR CULIVATING RENEWABLE RESOURCES

CULTIVATION AREA IN GERMANY BETWEEN 1997 AND 2010



Source: Agency for Renewable Resources 2010

*preliminary estimation

For the harvest 2010 renewable resources were cultivated on about 2.15 million ha [6]. Thus, about 18 % of the domestic acreage serves to produce renewable vegetable raw materials for energy production and industry. The highest increase as compared with the preceding year showed the production of energy plants for biogas plants going up from 530 000 to 650 000 ha. Now as before the most important energy plants by far are rape for biodiesel and maize for biogas. Thus, the expectation that renewable resources could contribute to the extension of crop rotation and to increase agricultural biodiversity has not been fulfilled so far. The Soil Protection Commission of the Federal Environment Agency classifies rape as being problematic due to its high demand for

plant protection agents and maize due to its erosion and eutrophication promoting effect. In addition, when using renewable resources the whole biomass is, as a rule, taken from the field, thus requiring intensified efforts to equalize the humus balance. It is especially problematic if grassland, in particular on fens, is ploughed up to cultivate renewable resources. Due to subsequent humus losses the greenhouse gas balance of such land use changes will be negative for a long time.

According to a decision adopted by the Conference of the Federal and Länder Ministers of Agriculture in spring 2010 the promotion of biogas is to be modified and reduced overall because it may locally distort the leasehold market. The Federal Ministry for Food, Agriculture and Consumer Protection (BMELV) wants to improve the utilization of renewable resources in future and is preparing a corresponding strategy. According to estimations made by the Agency for Renewable Resources renewable resources could be cultivated on up to 4 million ha until 2020. Research projects relating to so-called silvo-arable forest ecosystems find great interest. There the cultivation of food, fodder and renewable resources is combined, which is hoped to reduce pollution, protect against erosion, bring more diversity and a revival of the landscape. New crops such as silphium perfoliatum and specific species of millet also seem to be promising and would increase agricultural biodiversity.

Rape for biodiesel and maize for biogas remain the most important energy crops by far.

04

AGRICULTURE AND ENVIRONMENTAL MEDIA

SOIL

NITROGEN SURPLUS

The aim is to reduce the nitrogen surplus in agriculture's gross balance to 80 kg/ha agricultural land and year by 2010.

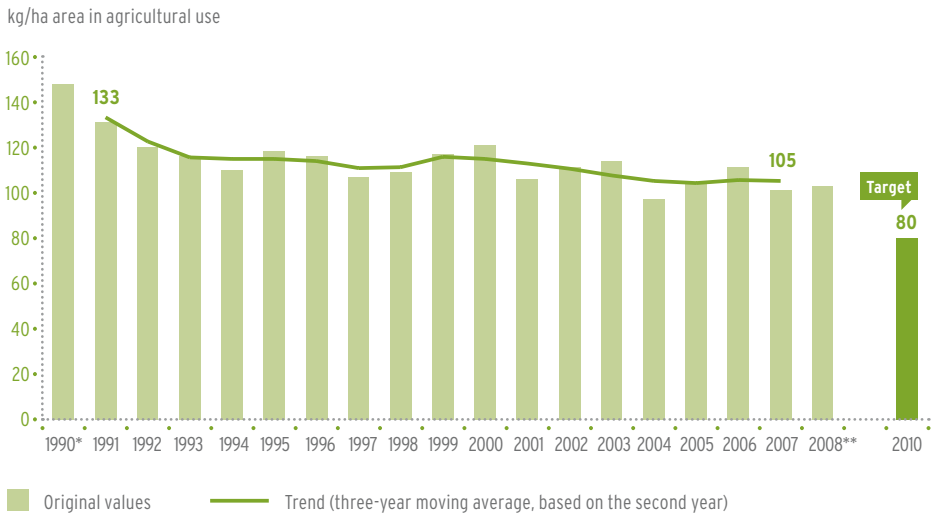
Between 1991 and 2007 agriculture's nitrogen surplus decreased from 133 kg/ha and year to 105 kg/ha and year (three-year moving average). This corresponds to a reduction of more than 20 %. The current figure is still significantly higher than the target value.

The target for the year 2010 was to reduce the nitrogen surplus in the gross balance to 80 kg/ha agricultural land and year. In addition the Federal Government is aiming to achieve a further reduction by 2015.

The clear decline of the nitrogen surplus at the beginning of the time series resulted from the decreasing number of livestock in eastern Germany. The slight decline since 1993 is due to an increase in efficiency in using nitrogen (increase in yields in plant

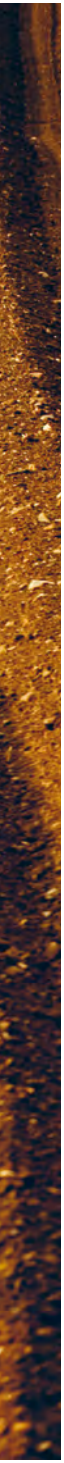
production and better utilization of fodder for livestock). Analyses show that high surpluses occur mainly in farms with a high livestock density. They also show that even in livestock breeding farms with a comparable production structure nitrogen surpluses vary within a broad range. This suggests that a further reduction will be possible by improving the efficiency of nitrogen use, e.g. by optimizing nutrient management in the farm, site-adjusted cultivation, appropriate species of plants and acceptable livestock numbers. In spite of their decline nitrogen surpluses from intensive fertilization and excessive livestock densities will continue to have adverse effects on the environment. Diffuse nutrient sources reach their maximum where excessive animal densities are kept at sites with high nutrient discharge potential. This is the case in the whole northwestern part of Germany (sandy soils) and in some areas of the foothills of the Alps (high runoff). Effective measures to reach the aim set by the Federal Government should primarily result in a more efficient use of nitrogen. A more uniform distribution of liquid manure from livestock farming is the prerequisite.

NITROGEN SURPLUS IN THE GROSS BALANCE IN GERMANY



* Data basis partly unreliable ** Data basis partly preliminary

Source: Institute for Crop and Soil Science - Julius Kuehn-Institute (JKI), and Institute of Landscape Ecology and Resources Management, University of Gießen, March 2010



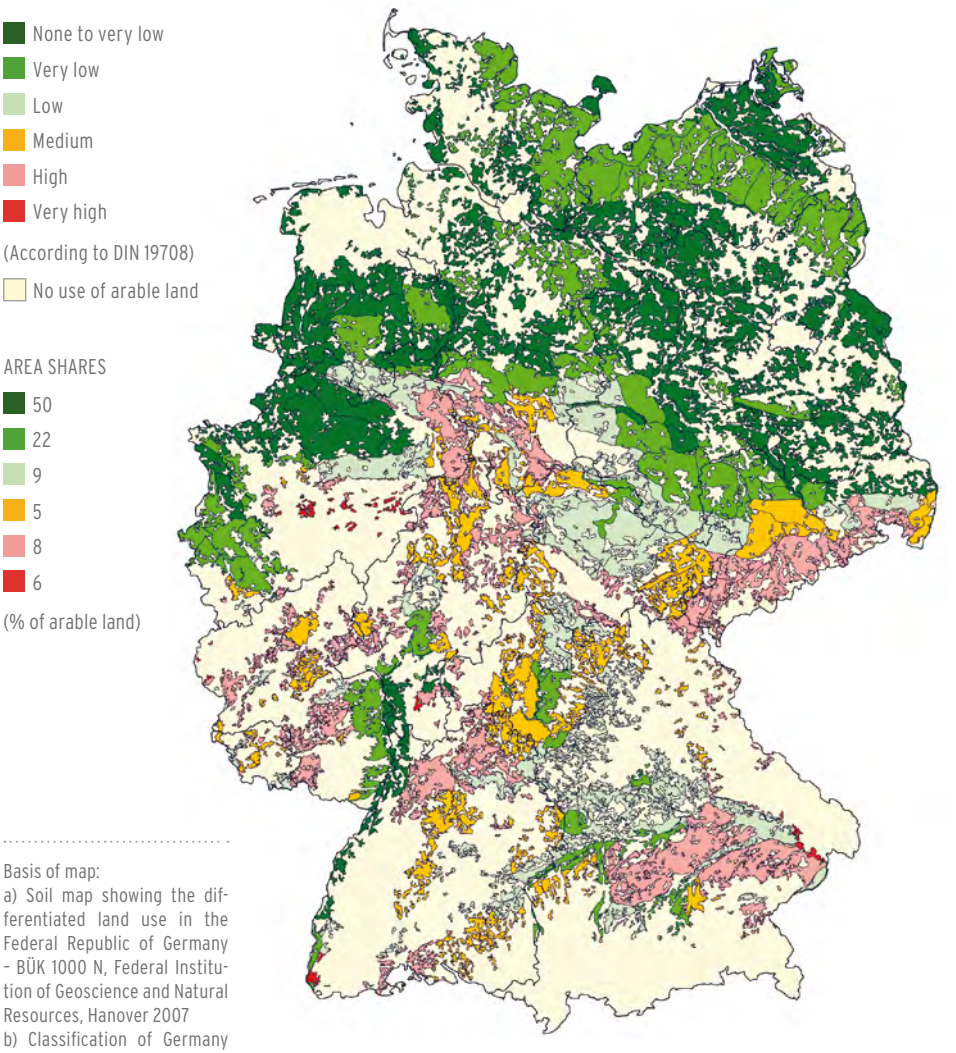
SOIL EROSION CAUSED BY WATER

Bare soil is exposed to the energy of water so that in case of strong precipitation events soil erosion and thus loss of soil can occur. The direct consequence is a reduction of the soil thickness and a loss of the nutrient-rich, humus-containing upper soil which is essential for agricultural yields. In addition, nutrients bound to soil particles are moved with the soil, reaching adjacent waters or other ecosystems. The soil types, the content of soil organic matter, and aeration determine the susceptibility to the eroding effect of water. The factor decisive for the extent of soil erosion, however, is the agricultural management as erosion would not be detectable under the natural climate and vegetation conditions in Central Europe. Crop rotation, the intensity and direction of cultivation, and the size of plots decide on the extent of soil erosion. Cultures such as maize and sugar beets - but also winter crops - increase the erosion risk as owing to the late development of the plants the soil is predominantly not covered, notably in winter, early spring and early summer.

Actually measuring erosion is possible only on a random basis because it is very costly. That is why models such as the "General soil erosion equation - ABAG" are used to assess the erosion risk. According to a present risk calculation approximately 14 % of the arable land in Germany show an average long-term soil erosion of more than three tons per hectare and year, i.e. they are strongly endangered by erosion. On 36 % of the arable land soil fertility is endangered in a longer perspective. Specific plant cultivation measures may be applied to take precautions against soil erosion by water which aims at improving the soil cover to thus break the destructive power of water or stop surface runoff.

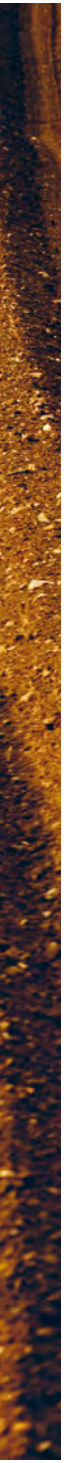
Conservation soil management (no-till or minimum-till) represents the state of the art today. Soil erosion could be reduced by 40 % because half of the acreage is already cultivated in conservation agriculture (and no longer conventionally). Climate change scenarios show a change in the intensity of precipitation and a shifting of vegetation periods owing to a change in annual development of temperature. The resulting increased erosion risk has to be compensated.

AVERAGE LONG-TERM SOIL EROSION DEPENDING ON THE CULTIVATION ON ARABLE LAND AREAS IN GERMANY FOR THE REFERENCE PERIOD 1971-2000 IN THE CASE OF 50 % OF CONSERVING SOIL MANAGEMENT



Basis of map:
a) Soil map showing the differentiated land use in the Federal Republic of Germany – BÜK 1000 N, Federal Institution of Geoscience and Natural Resources, Hanover 2007
b) Classification of Germany according to the natural regions, Federal Agency of Nature Conservation (BfN)

Source: Wurbs, D., Steininger, M.: Untersuchungen zu den Auswirkungen des Klimawandels auf die Bodenerosion durch Wasser. (Federal Environment Agency (ed.): F+E-Vorhaben, FKZ 370 871 205



SOIL COMPACTION BY AGRICULTURAL MANAGEMENT

The increasing mechanization in agriculture and forestry has led to more efficient machines. With growing tractive power and harvesting capacity the vehicle weights increased, exerting corresponding pressure on soil. This development has consequences for the efficiency and productivity of soils. If no technical measures are taken as a precaution, progressing soil compaction up to a harmful compaction is to be expected in the long term.

At present, harmful compaction of topsoil concerns locally the areas of headland, lanes and deeper parts of the topsoil. The non-slacked soil below, which the most attention should be paid to has not shown an area-wide harmful compaction yet. Harmful compactions can only be detected by soil identification at the sites concerned so that country-wide surveys of actual damage are possible only to a limited extent.

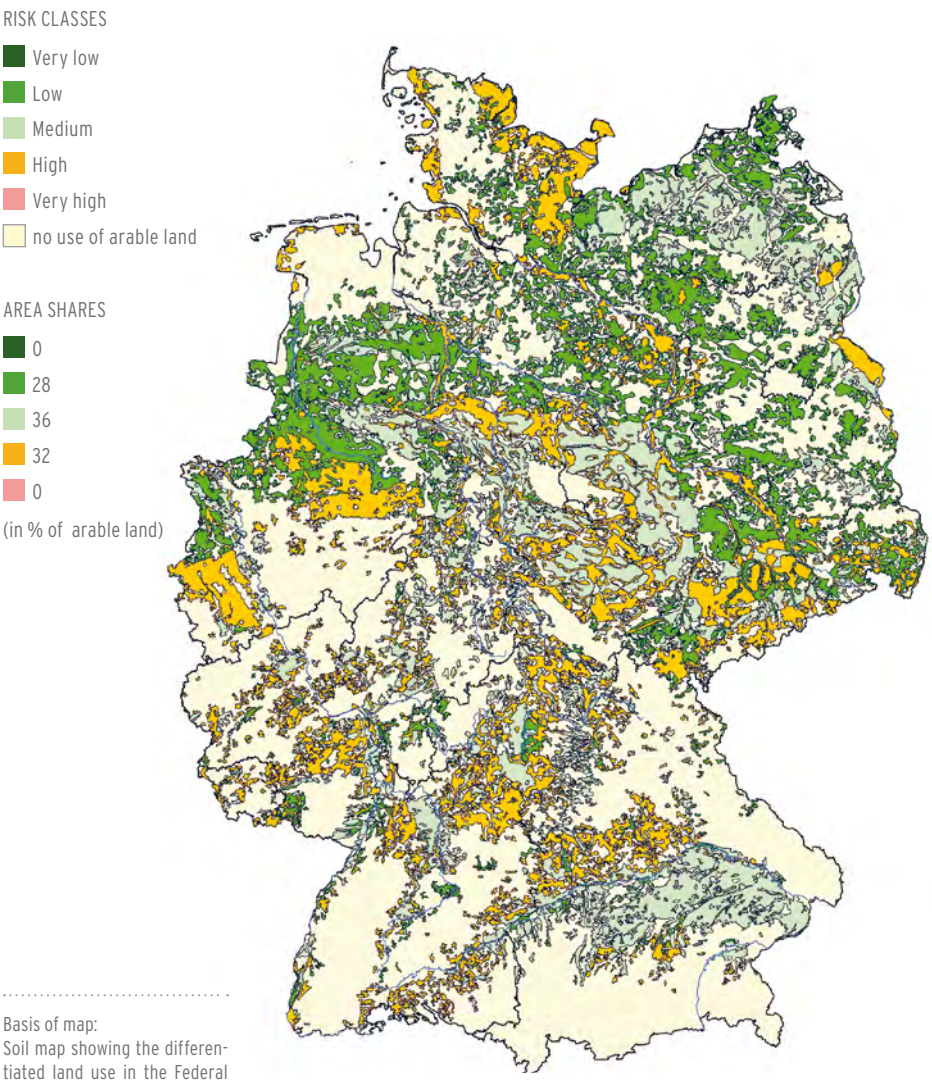
The assessment of soil structure to evaluate the degree of subsoil compaction follows specific criteria. Assessments showed an impaired efficiency for 50 % of the German acreage. This does not constitute a harmful compaction but a reduced quality of the soil structure.

Identifying areas with a special risk is important for developing regional soil protection concepts. The representation of risks takes into account the level of compaction and the risk of a progressing compaction for specific soils. Current calculations show that nearly 70 % of the German acreage is endangered by compaction during wet to humid conditions in the subsoil. Supposing average water content it may be assumed that one third of the German acreage is endangered by an additional compaction.

The numbers show a need for action and the necessity of a further qualification of advisory practice. To choose measures at farm level a consultation concept is needed to give daily advice on how to avoidadditional soil compaction. It is especially important to perfect the assessment of the cultivation-specific soil pressure to determine the practical demands for protecting the subsoil. On farm level many

technical and organizational measures are available to adapt the soil pressure to the actual carrying capacity of the soil. Apart from technical measures such as use of low-profile and terra tires and tire pressure controllers and the general reduction of the wheel loads also operating sequences and cultivation methods may be optimized. In particular no-till soil cultivation, an enlargement of the working width and a general avoidance of driving on wet soil are recommended [7].

ENDANGERING OF THE PRODUCTIVITY OF THE SUBSOIL OF ARABLE LAND AT AN AVERAGE SOIL HUMIDITY OF 80 % OF THE FIELD CAPACITY



Basis of map:
Soil map showing the differentiated land use in the Federal Republic of Germany – Federal Institute for Geosciences and Natural Resources, BÜK 1.000

Source: Lebert, M. (2010): Entwicklung eines Prüfkonzeptes zur Erfassung der tatsächlichen Verdichtungsgefährdung landwirtschaftlich genutzter Böden. Umweltbundesamt (Hrsg.), FKZ 370 771 202

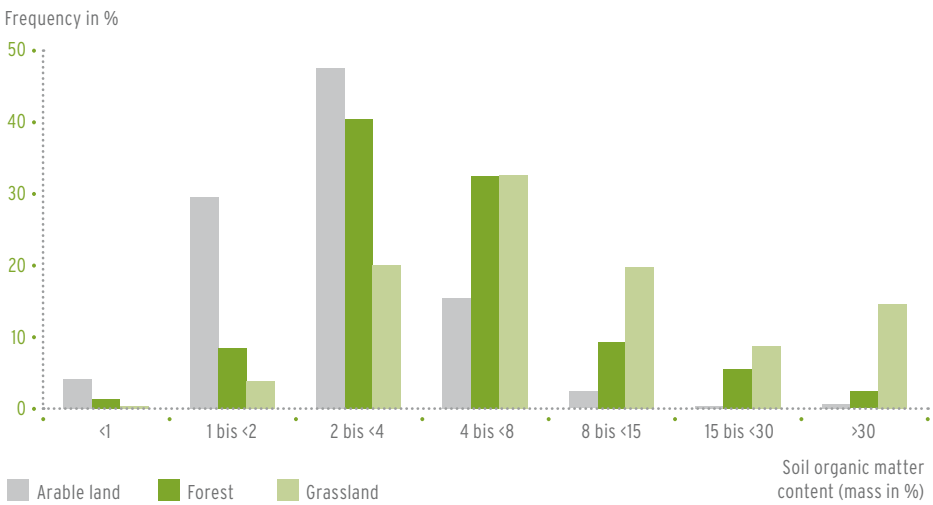
ORGANIC MATTER STATUS OF THE SOILS

Soil organic matter is a decisive factor for ensuring a multitude of soil functions. It is the storage and buffering medium for water, nutrients and pollutants. It controls essentially the nutrient and pollutant retention capacity of soils and has soil structure forming effects. In addition it creates habitats for soil organisms and has a central function in the carbon cycle as a storage medium for carbon. Soils provide the biggest terrestrial carbon storage taking over an important function in emitting or fixing climate-relevant gases such as carbon dioxide (CO_2) and methane (CH_4).

A soil function or climate related assessment of the soil's state is, as a rule, first of all, made for topsoils as they have the highest organic matter content and are, in particular, sensitive to changes caused by land management

and/or climate changes. The Federal Institute for Geosciences and Natural Resources (BGR) evaluated approximately 9 000 profile data with analytical information relating to organic matter contents in topsoil from the period from 1985 until 2005. The figure "Frequency distribution of soil organic matter content" shows the relative frequency of the classified content of organic matter for the three main types of land use arable land, grassland, and forest. Basically a higher organic matter content in topsoil can be observed in the following order: farmland, forest, grassland. If the median values of the soil organic matter content of the area are classified according to soil parent material, land use and climate region, the spatial distribution pattern represented in the map "Content of organic matter in the topsoil of Germany" is obtained. According to the map higher soil organic matter contents are to be found at the rainy North Sea coast, in the central German uplands and in the Alpine region; in addition a gradient with declining soil organic matter contents in the direction of the continental East of Germany can be observed. With this area-related information it was possible for the first time to provide quantitative data relating to the content of soil organic matter regionally differentiated according to soil parent material, land use and climate regions on a country-wide scale.

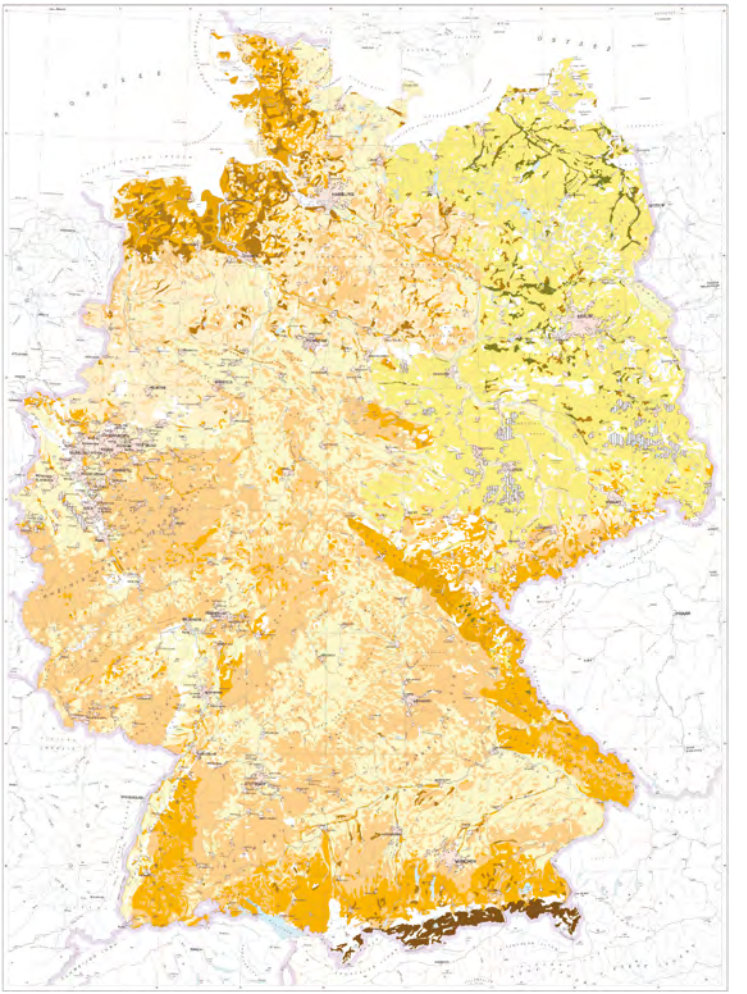
FREQUENCY DISTRIBUTIONS OF SOIL ORGANIC MATTER CONTENT



(Soil organic matter classes according to the German soil survey manual, 5th edition (KA5)

Source: Düwel, O., Utermann, J., (2008): Humusversorgung der (Ober-)Böden in Deutschland – Status Quo. In: Hüttl, R., Bens, O., Prechtel (Hrsg.): Zum Stand der Humusversorgung der Böden in Deutschland. Cottbuser Schriften zur Ökosystemgenese und Landschaftsentwicklung Bd. 7, 115-120.

CONTENT OF ORGANIC MATTER IN TOPSOIL OF GERMANY



Classified contents (medians) of soil organic matter in mass-%

- 1 - <2%
- 2 - <3%
- 3 - <4%
- 4 - <6%
- 6 - <8%
- 8 - <11,5%
- 11 - <15%
- 15 - <30%
- >30%

Town centre regions (> 70% of land surface sealed)

Not determined

Anthropogenically superimposed areas (30-70% of land surface sealed)

Technogenically formed areas including mining areas

Sources: Utermann, J., Düwel, O., Fuchs, M., Gäbler, H-E., Gehrt, E., Hindel, R., Schneider, J. (1999): Methodische Anforderungen an die Flächenrepräsentanz von Hintergrundgehalten in Oberböden. Forschungsbericht 29771010, UBA-FB 99-066, 141 pp. UBA Texte 95/99

Federal Government/Laender Working Group on Soil Protection (2003): Hintergrundwerte für organische und anorganische Stoffe in Böden. 3. Auflage

Federal Institute for Geosciences and Natural Resources (BGR) (2007): Bodenübersichtskarte Deutschland

05

AGRICULTURE AND ENVIRONMENTAL MEDIA

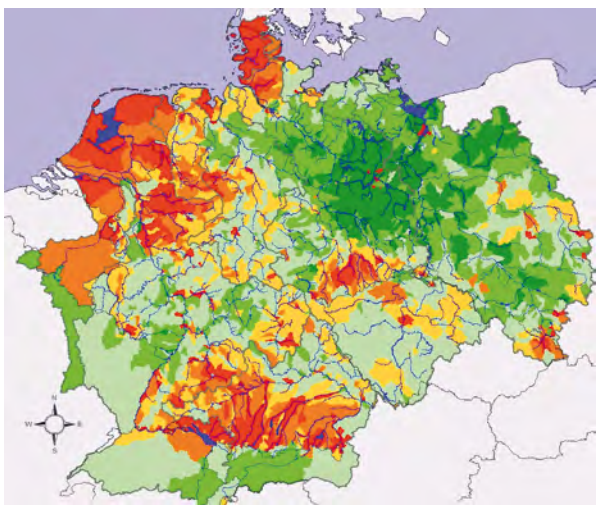
WATER

NITROGEN INPUT INTO SURFACE WATERS

Catchment areas of the North Sea and Baltic Sea

In Germany nitrogen inputs into surface waters (565 kt (2005)) are still much too high althoughthey have declined by 465 kt (45 %) compared t to the year 1985. The main source of nitrogen emissions into surface waters is agriculture. About 77 % (2005) of the overall nitrogen emissions come from agriculture. The main pathways are groundwater, erosion, surface runoff and drainage. During the last few years diffuse nitrogen inputs from agriculture could be reduced, but not to the same extent as nitrogen emissions from municipal and industrial discharges. The spatial distribution of area related nitrogen emissions shows a higher input in western Germany compared to the eastern part of the country.

TOTAL NITROGEN INPUT INTO SURFACE WATERS



- Spatial distribution of average area-related total nitrogen inputs into surface waters in the period 2003 - 2005
- Data basis: IGB, MONERIS model results

Specific TN input in kg/(ha•a)

- <5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- >25
- Surface waters
- National frontiers
- River systems

Source: Leibniz-Institute of Freshwater Ecology and Inland Fisheries

NORTH SEA

In the German North Sea catchment area nitrogen inputs decreased by 48 % from 804 kt to 418 kt between 1985 and 2005. This was due mainly to the reduction of emissions from point sources (by 77 %). 75 % of total nitrogen inputs come from agriculture (2005), mainly via groundwater (46 %) and drainage (21 %). Nitrogen inputs via deposition to surface waters and erosion contribute only insignificantly to the total input into surface waters, with approx. 2 % each, and surface runoff with approx. 6 %.

BALTIC SEA

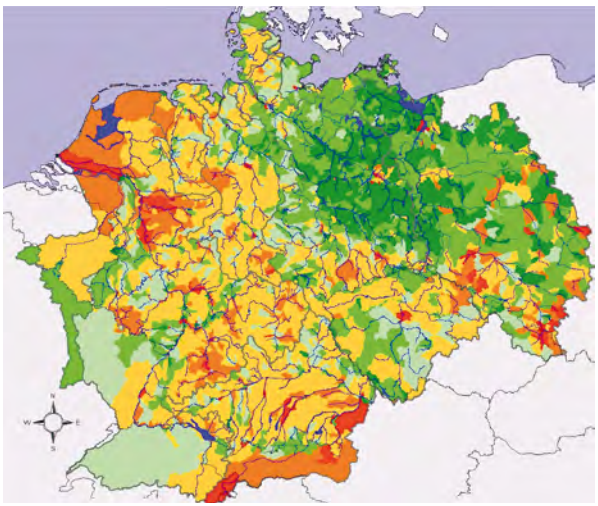
Nitrogen inputs into surface waters in the German Baltic Sea catchment area decreased by about 50 % from 63 kt to 31 kt between 1985 and 2005. In the Baltic Sea catchment area agriculture is the main source of nitrogen input (82 % of total nitrogen input).

PHOSPHORUS INPUT INTO SURFACE WATERS

Catchment areas of the North Sea and the Baltic Sea

In Germany phosphorus inputs into surface waters decreased by 71 % from 58 kt to 23 kt between 1985 and 2005. The main source is agriculture followed by municipal and industrial dischargers. Water pollution caused by municipal and industry sewage dischargers has declined significantly (86 %) during the last few years Although phosphorus inputs from point sources have decreased, they are still relatively high, at 35 % of total inputs. Inputs from agriculture declined only by 1 % between 1985 and 2005. In 2005 54 % of total phosphorus inputs came from agriculture.

TOTAL PHOSPHORUS INPUT INTO THE SURFACE WATERS



- Spatial distribution of average area-related phosphorus inputs into surface waters in the period 2003 - 2005
- Data basis: IGB, MONERIS model results

Specific TP input in kg/(km²·a)

- <20
- 20 - 40
- 40 - 50
- 50 - 100
- 100 - 200
- >200
- Surface waters
- National frontiers
- River systems

Source: Leibnitz Institute of Freshwater Ecology and Inland Fisheries

NORTH SEA

In the German North Sea catchment area phosphorus inputs decreased to 18 kt in 2005. Diffuse sources represent the dominant pathways with about 63 % of total inputs, of which approx. 50 % is attributable to agriculture.

BALTIC SEA

In 2005 phosphorus inputs into the Baltic Sea catchment area totalled 0.86 kt. Agriculture contributes to this value by, 0.54 kt (63 % of total input).

EUTROPHICATION OF COASTAL WATERS

Eutrophication is the excess enrichment of nutrients (phosphate, nitrate) in marine water caused by human activities. One of the main sources of such nutrients isagriculture. Eutrophication has a number of negative effects on the marine ecosystems. Nutrients fuel the massive reproduction of smallest algae and cause a shift in the species composition of this phytoplankton. Frequently, toxic "algal blooms" occur, or e. g. "blooms" of foam algae which leaves behind slimy foam blankets on the beach. The turbidity of the water affects the development of the macrophyte vegetation. In the Wadden Sea the eel grass stands declined drastically whereas in the Baltic Sea a decline of the bladder wrack stands was observed. The dead algal biomass accumulates on the bottom and its decomposition leads to oxygen deficiency affecting bottom-dwelling animals. They suffocate or die due to toxic hydrogen sulphide being released. Besides fishing eutrophication can be considered as causing the largest ecological problems in the German coastal waters of the North and the Baltic Seas. Due to eutrophication effects nearly all coastal water bodies currently fail to achieve the "good status" required by the EC Water Framework Directive.

The efforts made during the last 25 years to reduce nutrient inputs primarily through the rivers have resulted in a decline of some eutrophication effects. Yet, as to the ecological effects the all-clear signal cannot yet be given. Whereas a remarkable success in reducing phosphorus has been achieved by introducing phosphate-free detergents and improving sewage treatment the reduction of nitrogen has been stagnating in the last few years. The causes are primarily the insufficient success in reducing nitrogen emissions and discharges from agriculture.

ASSESSMENT OF THE ECOLOGICAL STATUS OF THE COASTAL AND TRANSITIONAL WATERS OF THE GERMAN NORTH SEA AND BALTIC SEA

Asessment of coastal and transitional waters (as per 19/11/2009)

Ecological status: High Good Moderate Poor Bad

Ecological potential: Maximum Good Moderate Poor Bad

Schleswig-Holstein Lower Saxony Mecklenburg-Western Pomerania

Boundary of river basin district Territorial waters Deep water roads

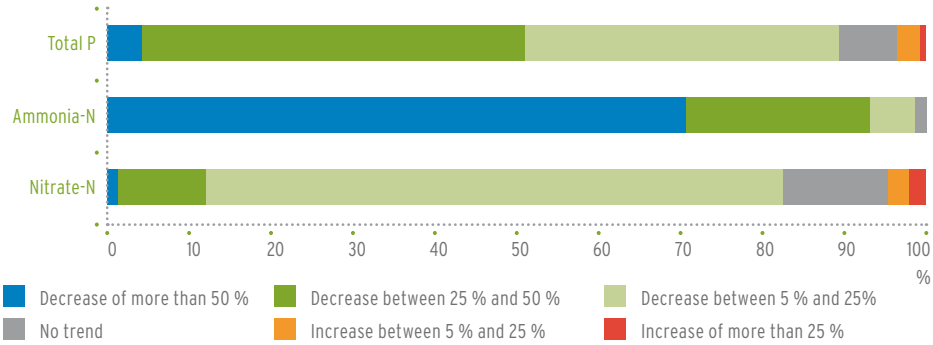
Source: Voß, J., Knaack, J., von Weber, M. (2010): Ökologische Zustandsbewertung der deutschen Übergangs- und Küstengewässer. Indikatorbericht. Bund-Länder Messprogramm.

CHEMICAL QUALITY OF THE SURFACE WATERS

The reduction of phosphorus and nitrogen inputs from waste water treatment plants has positive effects on the condition of the waters. The figure below compares the averaged 90-percentiles for the N- and P-concentrations at the monitoring sites of the Working Group of the Federal States on Water (LAWA) for the periods between 1991 and 1999 and between 2000 and 2008. It shows:

- a decline in total phosphorus concentrations at 89 % of the monitoring sites, no trend at 7 % and an increase at 4 % of sites,
- for ammonia-nitrogen reductions at 99 % of the monitoring sites and no trend at 1 % of sites,
- for nitrate-nitrogen reductions at 82 % of the measuring sites, no trend at 13 % and an increase at 5 % of sites.

CHANGE IN TOTAL PHOSPHORUS, AMMONIA-NITROGEN AND NITRATE-NITROGEN CONCENTRATIONS 2000 – 2008 VERSUS 1991 – 1999



Basis: LAWA network of monitoring sites; mean of 90-percentiles over the years

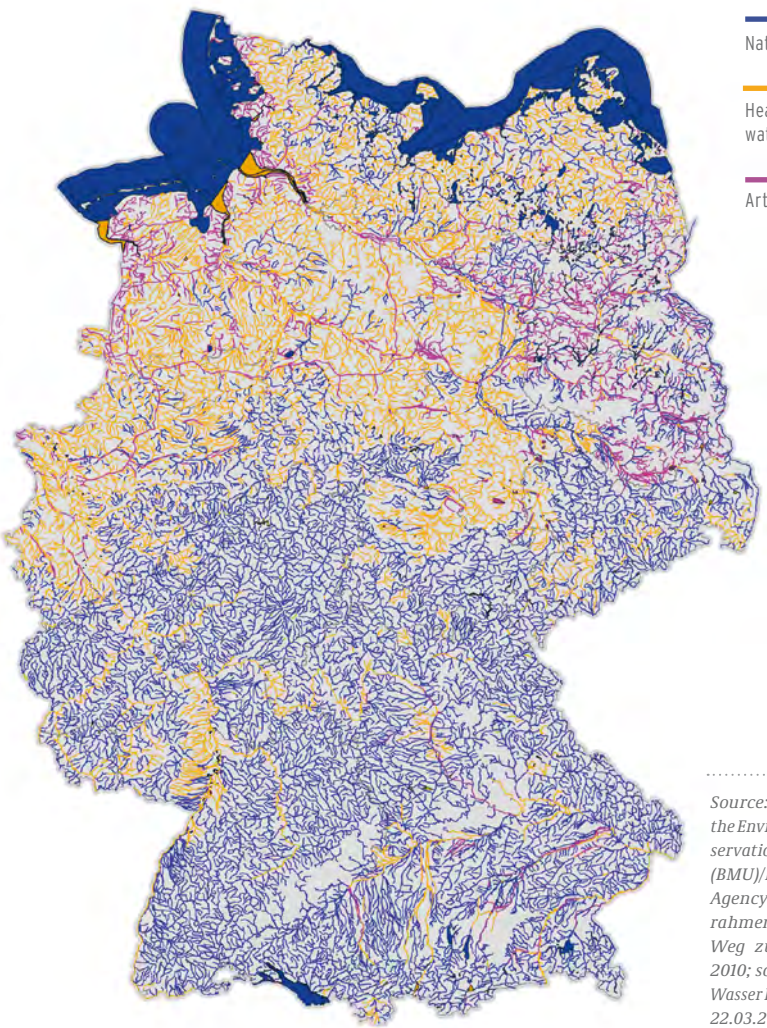
Source: Federal Environment Agency: Own compilation of data based on data of the Working Group of the Federal Government and the Federal States on Water (LAWA)

While concentration levels of total phosphorus and ammonia nitrogen began to decrease in the early 1990s, for nitrate nitrogen a decrease did not become apparent until the mid-1990s and was not as pronounced as for total phosphorus and ammonia nitrogen. However, nitrate nitrogen concentrations are still too high. In 2009, the type-specific guideline value for total phosphorus of 0.10 and 0.15 mg/l respectively was met at only 34 % of LAWA monitoring sites (233 sites). By contrast, the guideline value for ammonia nitrogen of 0.1 and 0.3 mg/l respectively was adhered to at 96 % of LAWA monitoring sites (233 monitoring sites).

In 2009, only 16 % of LAWA monitoring sites (232 measuring sites) had nitrate levels below the target value of 2.5 mg N/l serving to protect the sea against excessive nutrient loads. Apart from that there is an environmental quality standard which is set at the level of the drinking water limit value of 50 mg NO_3/l (corresponding to 11.3 mg/l nitrate-nitrogen), which was met at all LAWA monitoring sites in 2009. A comparison of the environmental quality standards for pesticides and biocides with the annual mean values of 2009 at LAWA monitoring sites reveals isolated incidences of the levels being exceeded for 2.4-D, bentazone, isoproturon, MCPA, mecoprop, monolinurone and terbutryn. However, at many monitoring sites, compliance with EQSs could not be verified for a number of substances (e.g. dichlorvos) because the limit of quantification is above the EQS. Analyses using automatic sampling that responds to surface run-off from fields found peak levels of pesticides in small agricultural streams. This led to the absence of sensitive aquatic insects, for instance ones that only reproduce once a year or less frequently. Such events are thought to occur frequently.

STRUCURE OF SURFACE WATERS

NATURAL, HEAVILY MODIFIED AND ARTIFICIAL WATER BODIES IN GERMANY



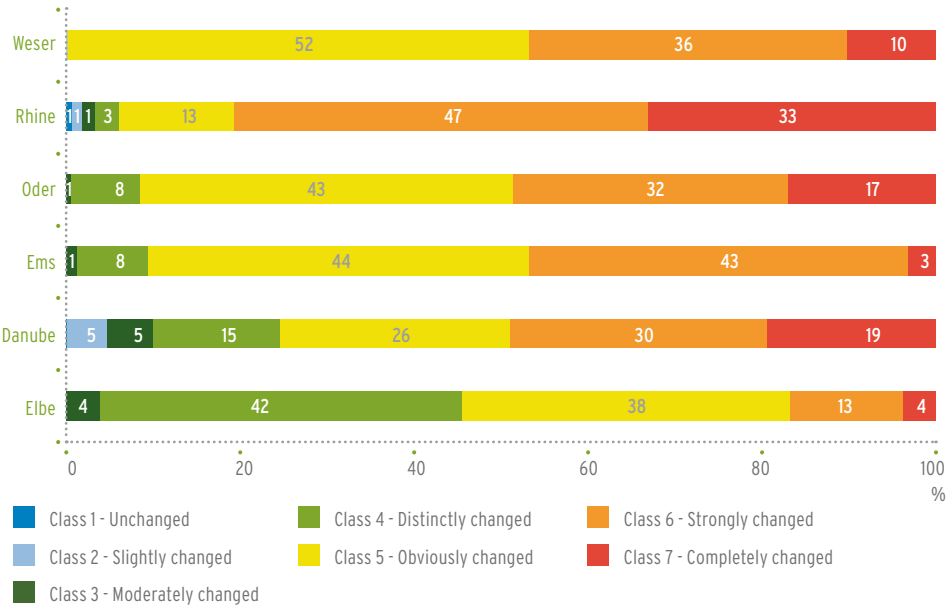
Source: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)/Federal Environment Agency (UBA): Die Wasserrahmenrichtlinie – Auf dem Weg zu guten Gewässern. 2010; source: Berichtsportal WasserBLIcK/BfG, last updated 22.03.2010

Agricultural use changes running waters and their floodplains significantly. Water courses of small streams are straightened for drainage, the profile is changed and aquatic plants are regularly removed. Floodplains are among the most intensively used landscapes, but they also belong to those of most ecological importance. They are fertile farmland, yet also lifelines for man and nature. Today, most watercourses have only an insignificant share of virtually undisturbed sections due to hydraulic engineering measures. They were e.g. regulated, thus the flow length was shortened, the banks were obstructed, dams were erected, water was diverted into channels and flood protection structures such as dykes were erected. Apart from that, additional drainage measures were carried out. In many rivers the bed was deepened to improve water flow and to thus reduce the frequency of flooding. Today stream and river beds are frequently trapezoidal in shape, uniform and embanked. Natural structures are removed and their development inhibited.

Most of the smaller rivers and streams were regulated in favour of agricultural use (e.g. by melioration), to protect settlements, transport routes, or modified for water power use in mountain areas. They are regularly "maintained". Thus, morphodynamic (self-development) processes are stopped. In these water bodies distinctly changed (class 4) up to completely changed (class 7) structural conditions predominate. The map shows that most of the artificial and heavily modified water bodies are to be found in floodplain areas where watercourses were rebuilt for agriculture, land drainage, water regulation and the protection of settlements and infrastructure.

The figure "Percentage distribution of structure classes on the major rivers in Germany" shows the effects on large rivers. In favour of shipping and use of water power the rivers were, as a rule, equipped with weirs and locks. Furthermore, the floodplains were, for the most part, separated from the river by means of dams and narrowed. This explains their remarkable structural deficits and their predominant allocation to the classes "obviously changed" up to "completely changed". Only the Elbe-river, after departing from the Central German Uplands to the Geesthacht weir, still has a number of sections that have retained significantly more of their natural structure (quality classes 3 and 4) .

PERCENTAGE DISTRIBUTION OF STRUCTURE CLASSES ON THE MAJOR RIVERS IN GERMANY



Source: Working Group of the Federal Government and the Federal States on Water (LAWA) - Gewässerstrukturgüteatlas der Bundesrepublik Deutschland

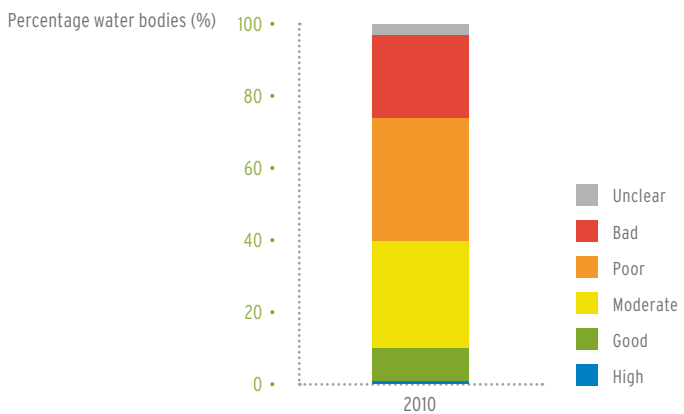
ECOLOGICAL STATUS OF SURFACE WATERS

The ecological status of surface waters is assessed based on biotic communities living in water which in their composition reflect all influencing factors and stressors. According to the EC Water Framework Directive (WFD) all surface waters have to have good ecological status by 2015, yet at the latest in 2027. The ecological status of a water body results from the degree of deviation from the natural condition of the water type as regards the occurrence and frequency of habitat-typical species. Five classes are distinguished: high, good, moderate, poor and bad. The biological quality element with the worst assessment determines to which class the water body

belongs. The invertebrate fauna (macrozoobenthos), fish fauna and plants (macrophytes, phytobenthos, phytoplankton) are assessed. If the environmental quality standard of a river basin specific pollutant is exceeded the ecological status of the water body will at best be moderate. In addition, the values of physico-chemical parameters such as nutrient content, temperature or salinity must fall within a range that allows for good ecosystem functionality.

At present, only just under 10 % of the water bodies in Germany reach a "good" or "high" ecological status [8]. The most frequent causes for moderate or worse ecological status are, in the case of rivers, hydromorphological changes which deprive them of their natural habitats and excessive nutrient inputs, mainly from agriculture. These impacts result in massive changes in the natural biota. High nutrient inputs are the main reason why lakes, transitional and coastal waters fall short of "good ecological status". Macrozoobenthos and diatoms are the biological quality elements indicating the nutrient loads coming from land use within the catchment area. Macrozoobenthos species are especially sensitive to the input of fine sediments and pesticides from agricultural areas and to the high temperature variations of open waters without riparian woodlands. Diatoms indicate pollution from nitrogen and phosphorus inputs by shifts in species composition. Both lack habitats if streams and rivers are "maintained" with no regard to ecological concerns.

PERCENTAGE DISTRIBUTION OF ECOLOGICAL STATUS CLASSES OF SURFACE WATER BODIES IN GERMANY



Source: Federal Environment Agency (UBA),
Daten der LAWA; Datenquelle: Berichtsportal WasserBLIcK/BfG, Stand 22.03.2010

GROUNDWATER

DISTRIBUTION OF NITRATE CONCENTRATIONS IN THE EEA GROUNDWATER NETWORK (2008)

Source: Federal Environment Agency (UBA) (2010): Own compilation

Nitrogen compounds - mostly nitrate - are the most frequent cause of poor groundwater status in Germany. For 2008, measurement results showing nitrate levels in groundwater are available for 701 of the approx. 800 sampling sites of the German groundwater monitoring network for the European Environment Agency (EEA monitoring network). 49.2 % of all sites show nitrate concentrations <1 and 10 mg/l and are therefore not polluted at all, or only insignificantly. At 36.1 % of the sites nitrate concentrations are between 10 and 50 mg/l. These measuring points are significantly to heavily polluted by nitrate. The remaining 14.7 % of sampling sites are so heavily polluted by nitrate that the water cannot be used for drinking water without further treatment because it exceeds the limit set by the Drinking Water Ordinance of 50 mg/l, in some cases significantly. Information on the main reasons for nitrate input into groundwater by comparing the preferred land uses in the vicinity of sampling sites and the nitrate concentrations in groundwater. In the group of sites predominantly surrounded by forest the lowest pollution is detected. Nitrate concentrations of more than 50 mg/l are detected at less than 4 % of sampling sites of this group. If grassland (meadows and pastures) dominates the catchment of the sites

the number of sites highly polluted by nitrate increases to approx 7 %. If agricultural land or settlements dominate the catchment the proportion of sites with nitrate concentrations of more than 50 mg/l increases to 24 % and 16 %, respectively. Thus, the input of nitrogen from agriculture is the most frequent cause of the pollution of groundwater by nitrate.

WATER PROTECTION BY AGRICULTURE

In agriculture there are primarily four ways to decrease water pollution through adapted farm and land management practices [9]:

- nutrient balances and fertilizer management
- crop rotation and site-adapted land use and buffer strips
- plant protection
- ecologically oriented water maintenance [10].

The programmes of measures developed in Germany for implementation of the EC Water Framework Directive [11] contain numerous measures to reduce pressures from agriculture. They were prepared in many cases jointly by water management authorities and agricultural-sector actors and go beyond the statutory minimum requirements for good agricultural practice:

- imposing restrictions on the application conditions for mineral fertilizer
- extension of winter greening (catch cropping and undersowing)
- increased use of ground coverings and of soil protecting tillage methods
- applying liquid manure in a water-protective manner, e.g. via modified application techniques, protected zones, temporal limitation of application, increase of storage capacities
- prohibition of applying pesticides
- extension of organic farming
- creation of water buffer strips, self-dynamic development of waters
- more or more targeted information and advisory services for farmers

Organic farming is an especially environmentally friendly form of agriculture which is also promising from the economic viewpoint. Expanding organic farming will reduce the nitrogen input and the use of synthetic pesticides. Consumer demand for organic products is rising steadily and the organic-food market has been growing for years.

06

AGRICULTURE AND ENVIRONMENTAL MEDIA

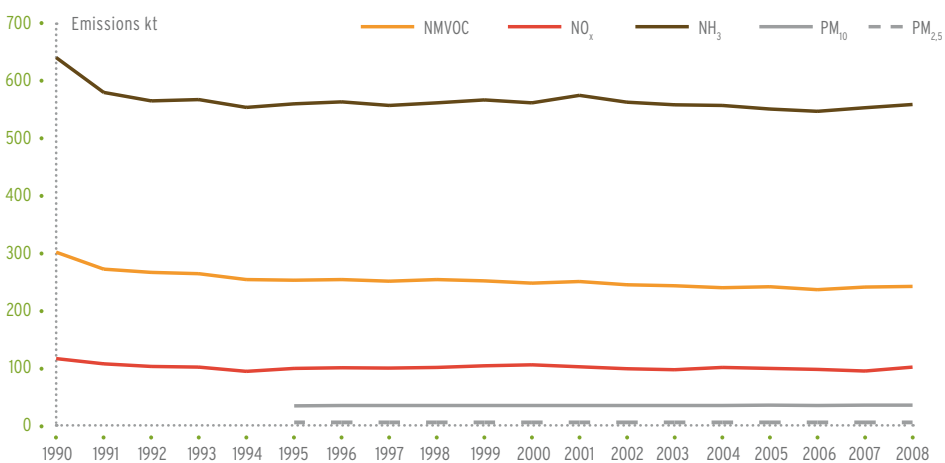
AIR

EMISSIONS OF POLLUTANTS INTO THE ATMOSPHERE

Relevant atmospheric pollutants emitted by agriculture are ammonia (NH_3), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) and particulate matter (PM_{10} und $PM_{2,5}$)[1]; they originate from animal husbandry and from agriculturally used soils. The mentioned pollutants are important as they contribute to acidification ($S0_2$, NO_x), to eutrophication (NO_x) and to the formation of ozone (NO_x, NMVOC). They affect human health (particulate matter - by direct emissions as well as by particles formed from primary substances (secondary PM)). In 2008 agriculture accounted for 95 % of total NH_3 emissions in Germany. The contribution of the agricultural sector to total NMVOC and NO_x emissions was 19 % and 7 %, respectively, and it contributed 10 % of PM_{10} emissions and 5 % of $PM_{2,5}$ emissions. The agricultural sector emitted approx. 599 kt of NH_3, 242 kt of NMVOC, 101 kt of NO_X, 35 kt of PM_{10} and 5 kt of $PM_{2,5}$ in 2008.

[1]Particles with an aerodynamic diameter of less than 10 or 2.5 µm.

EMISSIONS FROM AGRICULTURE (NFR 4[1])



[1]NFR 4: report category 4 – Agriculture of UNECE reporting (New format for reporting)

Source: Federal Environment Agency (UBA): Nationale Trendtabellen für die deutsche Berichterstattung atmosphärischer Emissionen seit 1990 (Stand: 15. April 2010) http://www.umweltbundesamt.de/emissionen/publikationen.htm

The figure shows that air pollutant emissions from the agricultural sector declined only slightly in the past years. According to forecasts by the Federal Environment Agency only minor reductions in agricultural emissions may be expected in future with the measures initiated so far (current legislation).

To comply with the international reduction targets (Directive 2001/81/EC of 23/10/2001 on national emission ceilings for certain atmospheric pollutants - NEC Directive) Germany will have to make further efforts to reduce atmospheric pollutant emissions - notably ammonia emissions.

REDUCTION OF AMMONIA EMISSIONS

The agricultural measures initiated so far have only partly contributed to reducing ammonia emissions since the early 1990s. The reasons for this is that some licensing obligations established under the Federal Immission Control Act have been revoked and planned measures (restricting application of liquid manure by band-spreading, instructions for using mineral urea fertilizer, immediate incorporation of slurry into the soil) have not yet been implemented. Possibilities for financially supporting agri-environmental measures and the agricultural investment promotion programme have so far not been systematically used towards reducing emissions. In view of the target set for Germany in the Directive on emission ceilings (2001/81/EC) of reducing ammonia emissions to 550 kt NH_3/a by 2010 measures which can be implemented quickly by means of organisational changes should be realized in the short term. These measures are known to be comparatively low in costs. The reduction potential of ammonia reduction measures varies. They can be taken in both animal husbandry and plant cultivation. A high reduction effect is achieved by measures connected with a generally low nitrogen input such as e.g. nitrogen-reduced feeding adapted to the protein demand of the animals and measures resulting in high nitrogen efficiency.

SELECTION OF MEASURES TO REDUCE AMMONIA EMISSIONS AND THEIR POTENTIALS

Agricultural sector	Measure	Predicted NH_3 reduction potentials for 2015 (kt/a NH_3)
Animal husbandry	Low-emission technique of applying farm manure, immediate incorporation of applied organic fertilizer into soil	12
Animal husbandry	Covering of systems for storage of farm manure	10
Animal husbandry	Use of waste air treatment plants in pig farming	10
Animal husbandry	Change to solid manure procedures	3
Plant cultivation	Adaptation of fertilizer quantities to the nutrient demand of the plant	12
Plant cultivation	Reduced use of urea fertilizers	15
Plant cultivation	Combined measure consisting of fertilization according to nutrient demand of the plant and reduced use of urea fertilizers	40

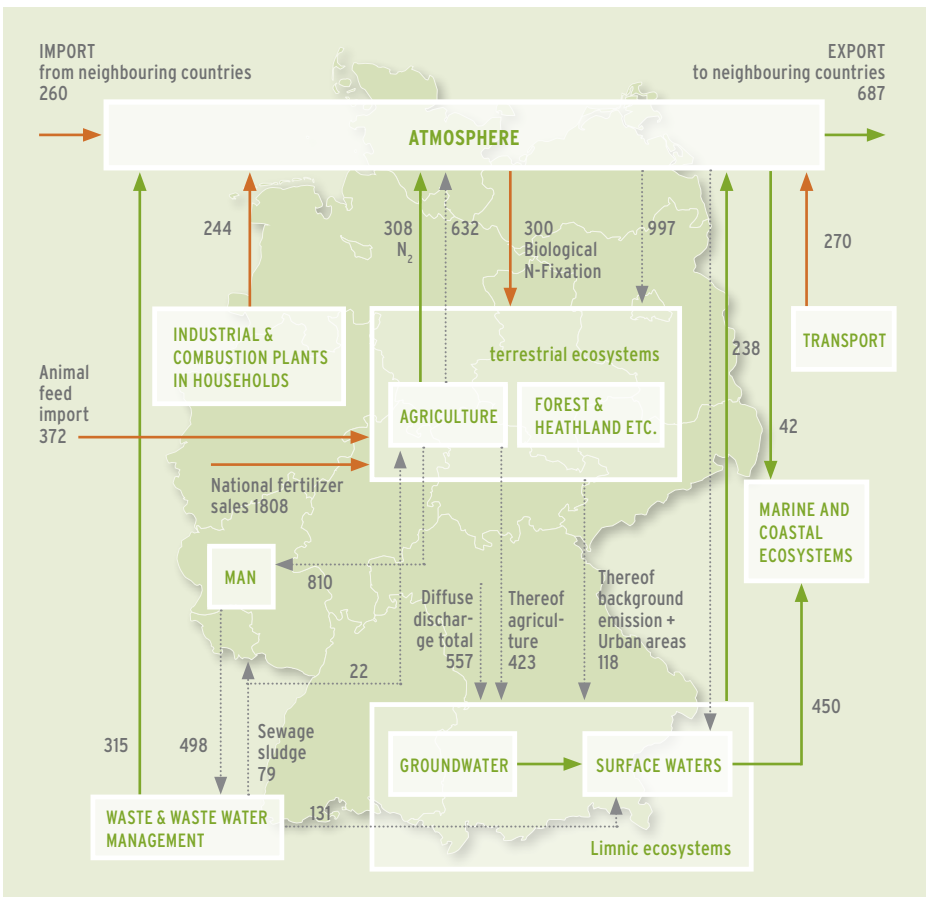
Source: Dämmgen, U., Haenel, H.-D., Rösmann, C. (vTI-AK), Eurich-Menden, B., Grimm, E., Döhler, H. (KTBL), Hahne, J., (vTI-AB) (2008): Teilbericht Landwirtschaftliche Emissionen, Forschungsteilbericht Umweltbundesamt, PAREST-Vorhaben: Fkz 20643200/01 Strategien zur Verminderung der Feinstaubbelastung

Adapted fertilization may reduce ammonia emissions

NITROGEN EMISSION REDUCTION STRATEGY

For less nitrogen in water, soil and air

NITROGEN FLOWS IN GERMANY



Source: Federal Environment Agency (UBA) (2009): Stickstoffemissionsminderungsstrategie

Elementary atmospheric nitrogen is converted to reactive environmentally relevant nitrogen through numerous anthropogenic processes. As well as the transport and energy sectors, intensive agriculture contributes to the accumulation of reactive nitrogen in ecosystems due to the use of mineral fertilizers and the cultivatation of nitrogen-fixing legumes. The excessive release of reactive nitrogen compounds seriously disturbs natural substance cycles and ecosystem relations. This may result in an extensive eutrophication and acidification of ecosystems, including a decline in the biodiversity in waters. Likewise, increased emissions of nitrous oxide contribute to exacerbating climate change. Apart from that, gaseous nitrogen compounds endanger human health, either directly or through the formation of ground-level ozone and secondary PM. In addition, ground-level ozone results in vast damage to sensitive plants and to loss of yield.

In spite of efforts having been made over many years the environmental quality and action targets for nitrogen compounds have not yet been reached in Germany. The sectoral nitrogen management applied so far has proved to be little effective as statutory requirements and regulations relating to the reduction of nitrogen emissions are limited to individual environmental policy fields. In view of the nitrogen cycle and the changeability and transportability of reactive nitrogen this may result in an undesired shifting of the problems to other environmental compartments. That is why an integrated approach is needed to effectively reduce nitrogen emissions while using, at the same time, the advantages of reactive nitrogen in food production.

Against this background the Federal Environment Agency has prepared an integrated strategy to reduce nitrogen emissions for Germany. This strategy quantifies the nitrogen cycle and assesses measures and instruments in an cross-sectoral way considering the nitrogen flows between the media. The analysis of the measures shows, in particular for agriculture, a cost-efficient potential for reducing nitrogen emissions. A comprehensive background paper of the Federal Environment Agency **[12]**, provides further information on nitrogen-related environmental quality and action targets **[13]** the German nitrogen cycle and the analysis of the measures.

07

CLIMATE CHANGE AND ADAPTATION

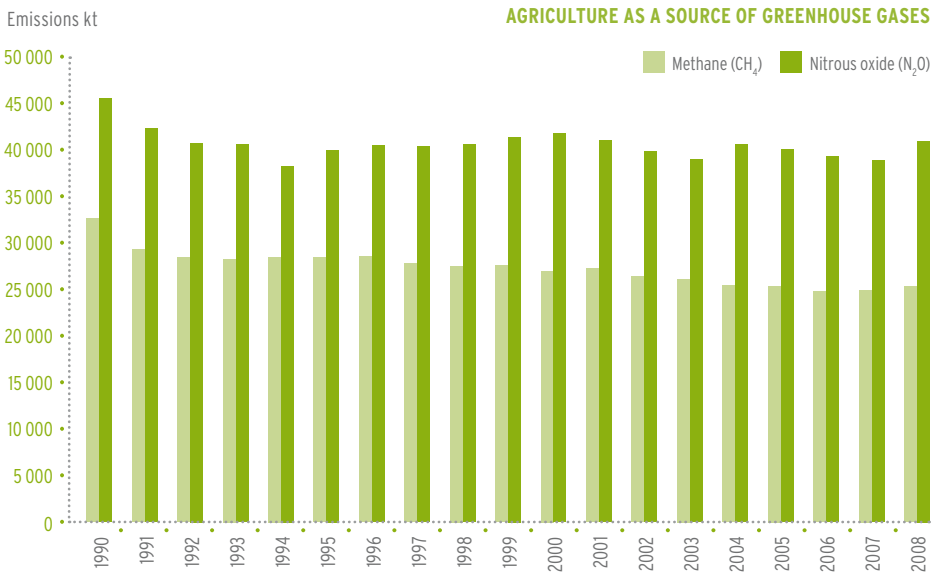
AGRICULTURE AS A SOURCE OF GREENHOUSE GASES

Agriculture in Germany makes a major contribution to emissions of greenhouse gases. Notably methane emissions (CH_4) from livestock breeding and nitrous oxide emissions (N_2O) from agricultural soils are responsible for this. From a global perspective paddy rice cultivation, slash and burn agriculture and burning of harvest residues in the field are important agricultural sources of gases harmful to the climate. However, they do not play a role in Germany.

In 2008 German agriculture was responsible for the emission of about 66 million tons of carbon dioxide equivalents. This is 6.9 % of the total greenhouse gas emissions of that year. This makes agriculture the third-largest producer of greenhouse gases in Germany, after energy production (80.6 %) and industry (10.9 %). 50 % of total CH_4 emissions and approx. 65 % of N_2O emissions come from this sector. Emissions from agricultural transport, electricity consumption, furnaces and the production of fertilizers and pesticides used are not covered by these figures. Emission sources in agriculture are as varied as agriculture itself. Livestock, manure management, and agricultural soils cause emissions of greenhouse gases (CH_4, N_2O, CO_2) and other pollutants (ammonia (NH_3), particulate matter). Since the sources are biological processes many factors influence the generation of emissions.

A slight decline in greenhouse gas emissions from agriculture is expected for the future. Considering the policy measures adopted so far, a 9.6 % (23.6 %) reduction of emissions will result from the structural changes in this sector in the period between 2005 and 2030 (or 1990-2030).

To further reduce the emissions additional measures will be required. By reducing emissions from nitrogenous fertilizers, protecting natural carbon stores such as forests or fens and further expanding organic farming, agriculture can contribute to reducing greenhouse gas emissions and to fixing CO_2.



Source: Federal Environment Agency (UBA): Nationale Trendtabellen für die deutsche Berichterstattung atmosphärischer Emissionen seit 1990 (Stand: 15. April 2010) http://www.umweltbundesamt.de/emissionen/publikationen.htm

CONTRIBUTION OF AGRICULTURE TO CLIMATE CHANGE MITIGATION

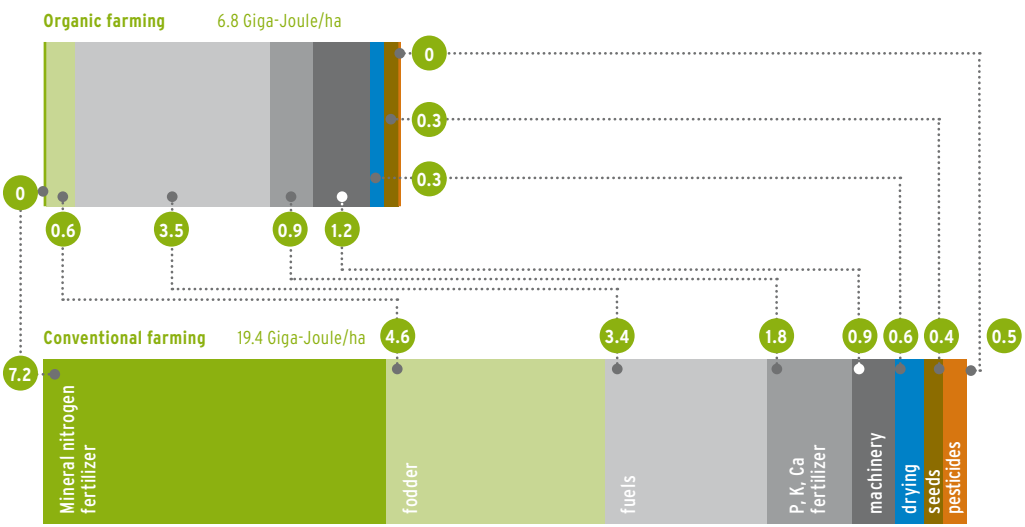
Reduction of greenhouse gas emissions

Agriculture has to adapt to the inevitable extent of climate change. Yet, it must also make a contribution to reducing greenhouse gas emissions to limit climate change to an extent where its effects may still be controlled. A starting point for reducing greenhouse gas emissions per produced unit is to increase the efficiency in the use of nitrogen and in feeding. Investigations carried out by Küstermann and Hülsbergen **[14]** in conventional and organic farms in Bavaria have shown that greenhouse gas emissions per product unit vary widely in both groups of farms: Farms can tap further potential for reducing greenhouse gas emissions by first

using liquid manure for the production of biogas and then applying the fermentation residues as fertilizer (cascade use). However, for this measure to be successful, the fermentation residues must be stored under gastight conditions.

Changing over to organic farming has climate advantages and should be sufficiently promoted. At present, only half of the demand for organic products in Germany can be met by domestic production. In spite of higher product prices there is still major growth potential for domestic organic farming on the demand side, which should be used for added value in rural areas as well as for climate protection and other ecosystem services. In its sustainability strategy the Federal Government set the target for organic farming to reach a share of 20 % of the agriculturally used area. Climate protection also requires an effective ban on ploughing up grassland, because this leads to the decomposition of humus stocks in the soils and the subsequent release of carbon dioxide and nitrate. In contrast, humus-enriched soil represents a sink for greenhouse gases. Efficient strategies to achieve this are wetland restoration and subsequently their appropriate use as so-called paludiculture. Reforesting marginal sites or their use for short rotation forestry represent a CO_2 sink, thus counteracting global warming.

ENERGY USE PER HECTARE IN CONVENTIONAL AND ORGANIC FARMING



Source: Bavarian State Ministry for the Environment, Health and Consumer Protection (ed.): Lebensmittel: Regional = Gute Wahl. 2007

CLIMATE CHANGE & AGRICULTURE

Expected effects of climate change

In eastern Germany low water availability and the risk of droughts in summer may be responsible for the decline of agricultural yields.

The expected effects of climate change will influence German agriculture with high probability by the end of this century. The mean temperature in Germany is expected to rise by 2 to 3.5 °C by that time.

In eastern Germany low water availability and the risk of droughts in summer can cause yield declines if irrigation is not provided sufficiently. A decrease in summer rainfall, which can already be observed today and is expected to continue, and increased evaporation as result of rising temperatures will further deteriorate the already unfavourable climatic water balance. Southern Germany, where at present the highest temperatures in Germany are measured, is predicted to experience the

highest temperature rise in Germany. This is accompanied by an increased risk of flood events in spring, caused by a shift in precipitation patterns from summer to winter and an increase in extreme precipitation events.

The central German uplands and northwestern Germany tend to be too cool or wet for agricultural use under present climatic conditions. These regions may profit from a gradual warming and a longer vegetation period. In particular, the cultivation of temperature-limited cultures such as maize, fruits, wine and oil seeds or winter forms of grain, requiring a warmer regional climate, might be possible in future. Viticulture will spread northwards while changing its spectrum of regional varieties.

HOW AGRICULTURE HAS TO ADAPT

Agriculture has a comparatively high ability to implement adaptation measures as it has numerous adaptation options at its disposal which are fairly simple and yet effective. Adaptation to the potential effects of climate change can easily be reached e.g. by modifying sowing times, choice of suitable varieties, crop rotation and introduction of new fruit species or by adapted cultivation methods to protect the soil. Other examples include a more efficient irrigation system, e.g. drip irrigation, site specific fertilization and plant protection schemes, insurance against loss of yield caused by climate change, and improvement of weather forecasting and extreme-weather warning systems.

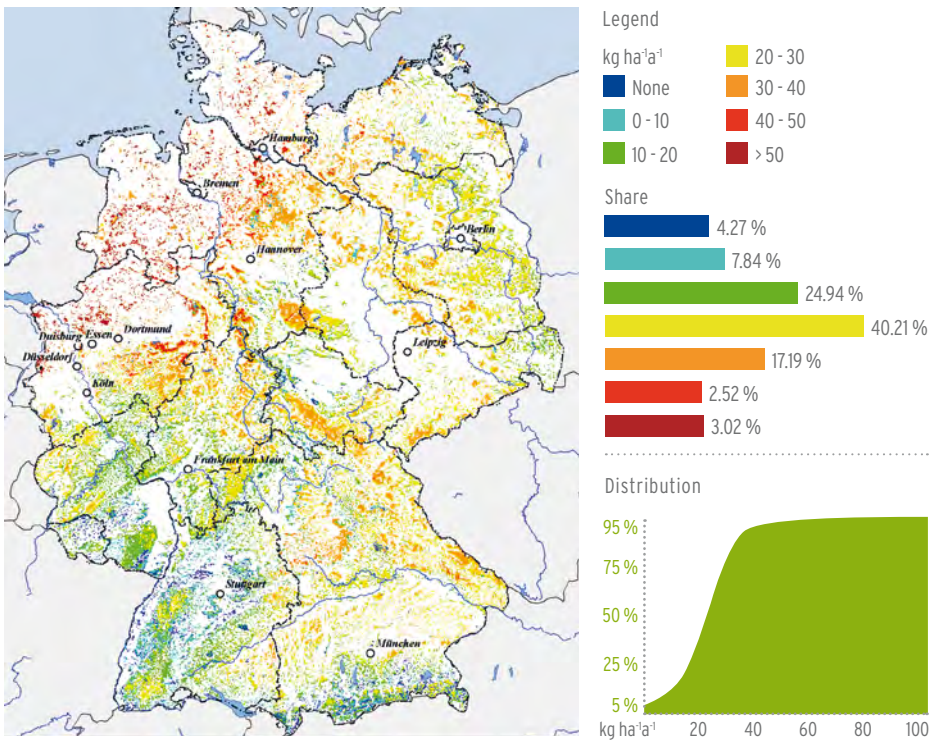
Agriculture is primarily affected by drought in summer. Indirectly, this implies an increased risk of pest infestation and diseases due to climate change. However, agriculture is able to adapt to changed climate and weather conditions comparatively quickly due to the wide selection of crop species and varieties and annual crop rotation.

08

PROTECTION OF THE ENVIRONMENT AND BIODIVERSITY

CRITICAL LOADS FOR EUTROPHYING NITROGEN

EXCEEDANCE OF CRITICAL LOADS FOR EUTROPHYING NITROGEN 2004

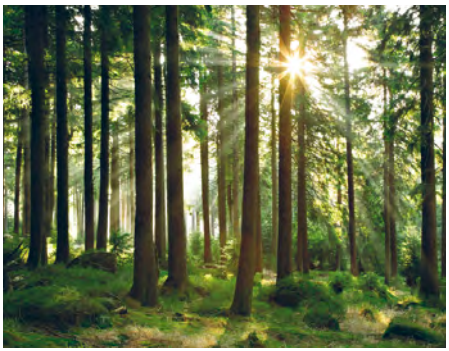


Source: Federal Environment Agency: Nationale Umsetzung UNECE Luftreinhaltekonvention. Research Project 204 63 252, Final report 2008; Federal Institute for Geosciences and Natural Resources (BGR), Hannover 2008

The oversupply of nitrogen in sensitive terrestrial ecosystems (eutrophication) is one of the main causes for the loss of biodiversity in Germany and Europe. Nitrogen accumulates in ecosystems primarily through atmospheric deposition of reactive nitrogen compounds. These nitrogen compounds are mainly of anthropogenic origin. Sensitive plant species, e.g. some mosses and lichens, are directly damaged by this

input. In the long term the oversupply of nitrogen results in altered living conditions and plant species adapted to low-nutrient conditions are displaced by nitrophilic species. As most animal species are bound to special plant species the decline in plant diversity also affects the diversity of animal species. That is why numerous biotope types are considered to be endangered today. Indirect effects of the continuous accumulation of nitrogen in ecosystems are e. g. the impairment of groundwater quality by increased nitrate input or increased emissions of greenhouse gases, notably nitrous oxide. To assess ecosystem exposure from eutrophying nitrogen inputs, so-called critical loads for eutrophication are derived. These are critical rates of exposure to atmospheric nitrogen depositions below which no harmful effects on sensitive ecosystems occur either in the short term or the long term, according to present

Increased nitrogen input by the animal fattening unit Dobberzin near Angermünde: Dense undergrowth of elder and other nitrogen indicators result in a shortage of water for the forest.

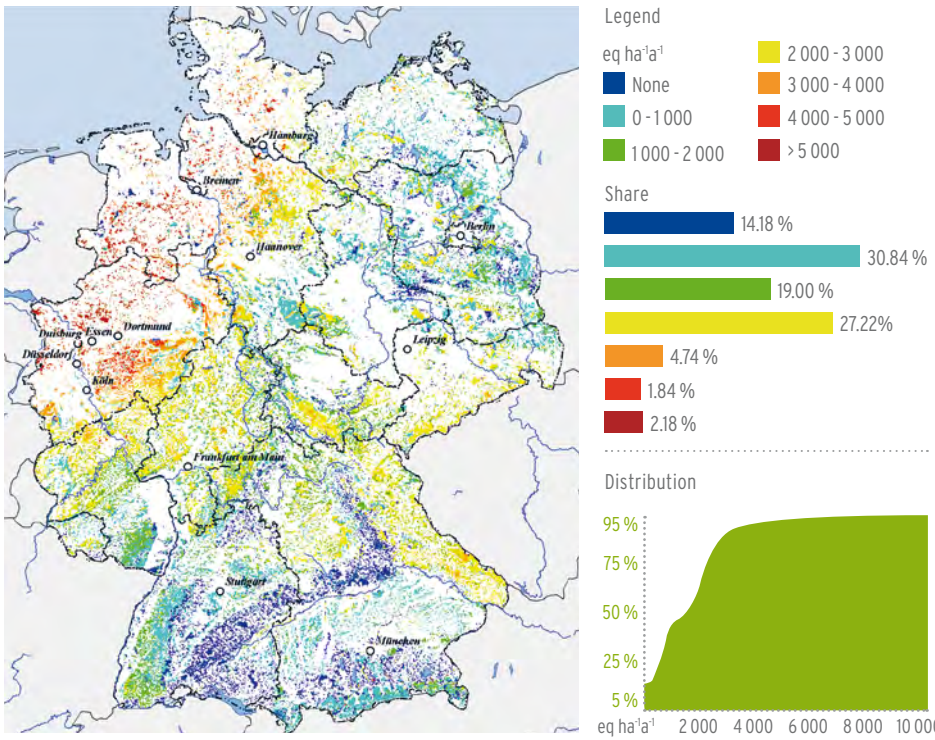


Pine stands in northeastern Germany: without a noticeable indication of effects by nitrogen

knowledge. The amount of the tolerable deposition depends on the properties of the considered ecosystem. A comparison of nitrogen deposition levels and the critical loads for eutrophication shows that critical loads are still exceeded today on nearly the whole area of sensitive ecosystems in Germany. They are especially drastically exceeded in parts of northwestern Germany where intensive livestock farming results in a high deposition of nitrogen. Whereas atmospheric nitrogen inputs from transport, energy conversion and industry into terrestrial ecosystems have declined in the last few years ammonia deposition from agriculture stagnates at a high level.

CRITICAL LOADS FOR ACIDIFICATION

EXCEEDANCE OF CRITICAL LOADS FOR ACIDITY 2004



Source: Federal Environment Agency: Nationale Umsetzung UNECE Luftreinhaltekonvention. Research Project 204 63 252, Final report 2008; Federal Institute for Geosciences and Natural Resources (BGR), Hannover 2008

The acidification of ecosystems is caused by the atmospheric input of sulphur and nitrogen-containing air pollution leading to negative effects in ecosystems. The input results in a decline of the pH value and the loss of nutrients. Long-term acid stress results in a reduced vitality of the plants and in an increased susceptibility to natural stress factors. Ecosystem functions such as water filtering may be carried out only on a limited scale. Due to altered soil and nutrient conditions plant species depending on neutral soil conditions are displaced by acidophilic species. This results in a decline

Site for measuring atmospheric deposition of pollutants in the beech stand in the Bavarian Forest National Park.

of plant species diversity and thus indirectly also in a decline of animal species diversity. Yet, the fauna is also directly affected by acidification: Ecologically irreplaceable earth-worms living in mineral soils may no longer exist in acidified soils because aluminium, which is toxic for them, is released at pH values below 4.

To assess the pollution of ecosystems due to the deposition of acidifying air pollutants so-called critical loads for acidification are derived. These critical loads indicate the input of acidifying air pollutants which the ecosystem may tolerate in the long term without any harmful effects. To this end acid producing soil processes are compared with acid consuming and buffering processes in a mass balance. The input of acidifying sulphur and nitrogen compounds from combustion processes has been distinctly reduced during the past twenty years. However, a comparison of air pollutant deposition and the critical loads for acidification shows that critical loads are still exceeded on a large part of the area of sensitive ecosystems in Germany. Currently, especially depositions of ammonium nitrogen from agricultural sources are responsible for acidification effects in sensitive ecosystems. The highest exceedances of critical loads are found in the northern German lowlands. As in these regions critical loads for eutrophication are also exceeded the most economically and ecologically efficient ammonia reduction measures should be implemented consistently, especially in livestock farming.

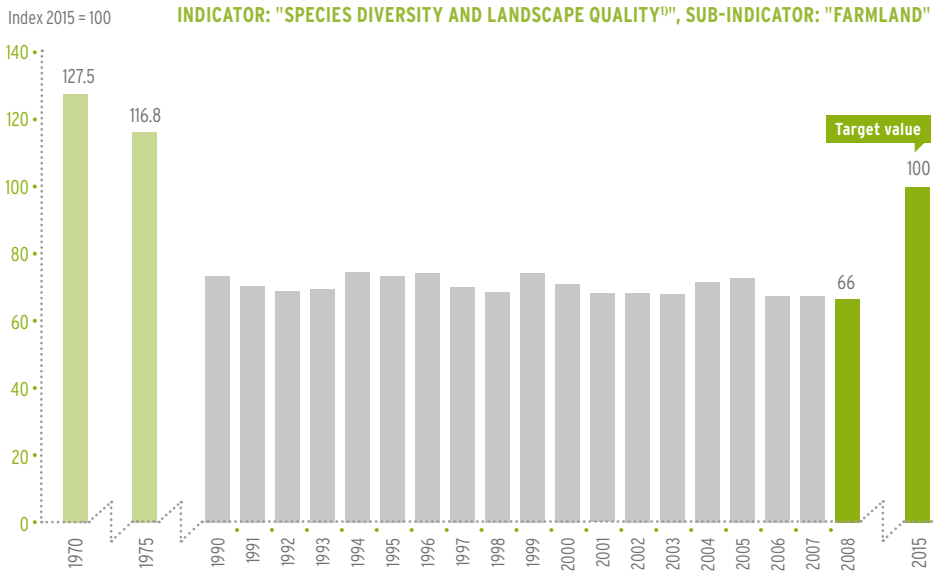
INDICATOR "SPECIES DIVERSITY AND LANDSCAPE QUALITY"

Sub-indicator "Farmland"

This sub-indicator describes species diversity and quality of the agricultural landscape under the varied influence of land use. For this purpose, the nationwide population sizes of 10 bird species representative of the agricultural landscape are monitored. If reduced environmental pressures, more sustainable land use or successful nature conservation measures cause habitat quality to improve, populations of the selected bird species will generally grow and the sub-indicator will show a positive trend.

An expert panel has determined, for each bird species, the population size attainable by 2015 if European and national law on

nature conservation and the guidelines for sustainable development are implemented speedily. The targets determined for each species for 2015 were normalized to 100 %.



[1)] The historical figures for 1970 and 1975 are reconstructed.

Source: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (ed.) (2010): Indikatorenbericht 2010 zur Nationalen Strategie zur biologischen Vielfalt. - Gödeke, I., Sukopp, U., Neukirchen, M., (editing), Ackermann, W., Fuchs, D., Sachteleben, J., Schweiger, M. (technical consultation) BMU. Berlin: 87 p.; Data: Federation of German Avifaunists (DDA) 2010

In 1990, the value of the sub-indicator was distinctly below the values reconstructed for the years 1970 and 1975. This is due to a severe drop of the population sizes of many indicator species of the agricultural landscape before 1990. The last 10 years of observation (1998 until 2008) saw a statistically significant trend away from the target. In 2008, the value of the sub-indicator stood at 66 % of the target value. The population situation of many farmland bird species is critical. Populations of birds that breed on arable land, meadows and pasture are declining in many places due to intensive agricultural use. Landscape quality and species diversity of farmland may be negatively affected as growing areas of grassland are ploughed up for arable use in some regions and as the cultivation of energy crops becomes increasingly widespread. It remains to be seen if the adopted agri-environmental and nature conservation measures will be sufficient in the medium and long term to reach the desired target value for the sub-indicator for farmland by the year 2015 **[15, 21]**.

HEDGES AND MEADOW ORCHARDS

Agricultural habitat for animals and plants

Since the Middle Ages orchards have formed a steady component of rural landscape in Germany.

The majority of animal and plant species in Germany occur in cultural landscapes shaped by agriculture and forestry. A major part of this biodiversity, such as bees and butterflies, is found in areas under agricultural use and is directly influenced by farming activities. However, the biological diversity has distinctly declined in the last 50 years due to the intensification and mechanisation of agricultural production. The structural diversity of agricultural landscapes has decreased as a result of the progressive removal of structural elements. Measures such as high application of agrochemicals (fertilizer, pesticides), decreasing crop rotation, increase in winter

grain and removal of set-aside areas have destroyed the habitats of many once-abundant animal and plant species. Extensive use of grasslands fosters the biodiversity on farmland. The structural diversity of the agricultural landscape also has positive effects on biodiversity. In this respect, hedges, field boundaries, field coppices and small water bodies as part of the cultural landscape as well as set-aside areas should be mentioned as examples.

Grassland provides space for more than 2 000 higher plant species, which represent 52 % of all plant species present in Germany. Currently, it is mainly the increasing intensification of agricultural production and land use changes which endanger grassland's role is for maintaining biodiversity [16].

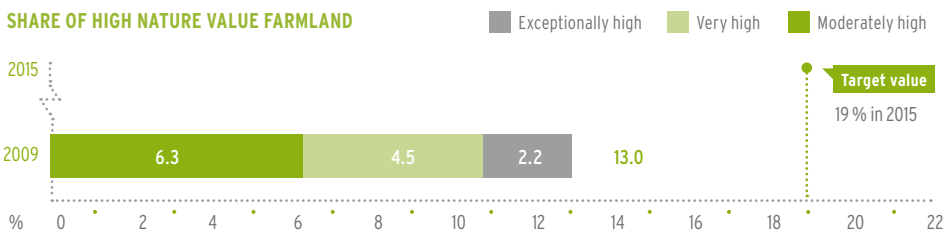
Meadow Orchards - meadows with tall fruit trees of all age classes - have formed a steady component of rural agriculture in Germany since the Middle Ages and been a prominent feature of the traditional cultural landscape. In 1855 1 263 varieties of apples and 1 040 varieties of pears were known. After World War II the economic importance of meadow orchards declined. In the last 40 years (1979 until 2009) alone meadow orchards declined by 74 % in North Rhine-Westphalia. Today meadow orchards cover only 18 000 ha (0.5 %) of the area of North Rhine-Westphalia [17]. In Baden-Württemberg the total area of meadow orchards was still 116 000 ha in 2008. Meadow orchards fulfil important ecological functions besides the production of fruits. With up to 5 000 animal and plant species they belong to the habitats with the highest biodiversity in Central Europe [18].

Many threatened and endangered plants depend on **hedges**. Among the more than 1 200 animal species (insects, spiders, birds, mammals) occurring in hedges there are many beneficial animals. With their great biodiversity hedges contribute to natural pest control on adjacent agricultural areas. They are also excellently suited for connecting habitats thus forming a basic element of biotope networks and provide protection from wind and erosion.

Grassland strips are long, narrow "bands" of land with meadow or pasture vegetation. They are situated along farmland strips, edge strips and embankments. Grassland strips are "special cases" of permanent grassland. In areas where permanent grassland has become rare they fulfil a highly important function: they serve as habitats for numerous animal and plant species that have been displaced from the modern production landscape. Grassland strips also serve as "migratory corridors" for animals and with them for seeds and plants. Besides hedges they form elements of a network of biotopes in open landscapes without structural elements.

HIGH NATURE VALUE FARMLAND

Owing to their ecological functions landscape elements and areas mentioned as examples in the preceding section may contribute to stopping a further loss of biodiversity [19]. To show the effects which agriculture has on biological diversity and successes achieved in promoting biodiversity in the agricultural landscape the so-called "high nature value farmland (HNV farmland)" baseline indicator was developed for use in required reporting under Council Regulation (EAFRD Regulation) [20]. The indicator shows the development of biological and structural diversity on farmland with a high nature value. The so-called HNV impact indicator, which is currently being developed by the Laender, is planned to be used in future to describe the extent to which agri-environment measures contribute to increasing the share of farmland with a high nature value. In the framework of examinations of random samples the share of areas with a high nature value (in ha) has been regularly determined since 2009 and they are classified as having an "exceptionally high", "very high" and "moderately high" nature value.

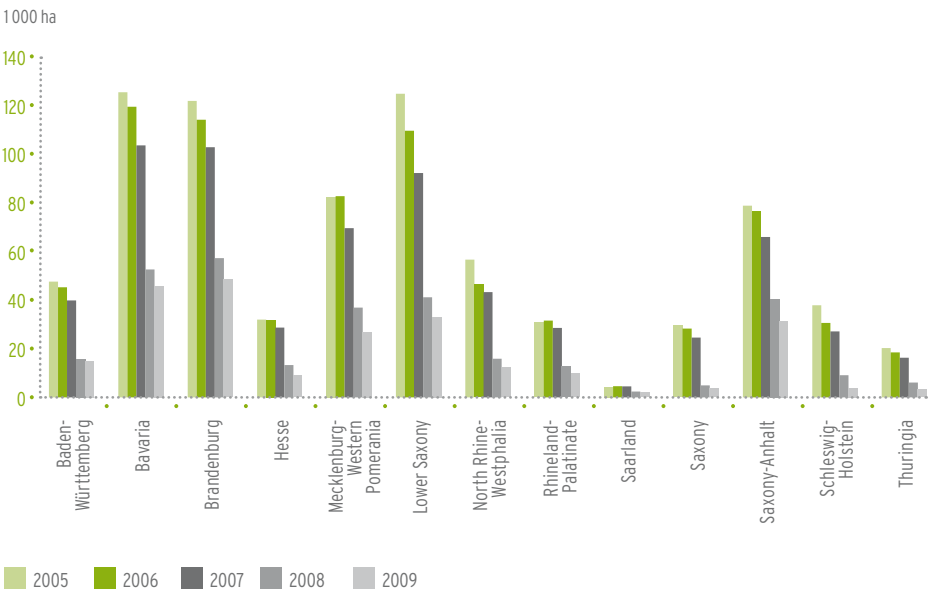


Source: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (ed.) (2010): Indikatorenbericht 2010 zur Nationalen Stragtegie zur biologischen Vielfalt.- Gödeke, I., Sukopp, U., Neukirchen, M., (editors), Ackermann, W., Fuchs, D., Sachteleben, J., Schweiger, M. (technical advisors) BMU. Berlin: 87 p.

In 2009 the share of farmland with an exceptionally high nature value was 2.2 %, with a very high nature value 4.5 % and with a moderately high nature value 6.3 %. The total share of farmland with a high nature value was 13.0 % [21]. The German National Strategy on Biological Diversity (BMU 2007) includes the aim of increasing the share of HNV farmland (including grassland with high biological and structural diversity, meadow orchards) by at least 10 % by 2015 as compared with 2005. In 2010 semi-natural landscape elements (e.g. hedges, borders, field shrubbery, small bodies of water) are to account for at least 5 % of agricultural areas [22].

LOSS OF ECOLOGICALLY HIGH-VALUE SET-ASIDE AREAS

AREA SET-ASIDE (WITHOUT NON-FOOD AREAS), FALLOW LAND IN THE FEDERAL LAENDER[1]) BETWEEN 2005 AND 2009



Source: Federal Statistical Office: Fachserie 3, Reihe 3.1.2, Stand 2009

[1]) Without Berlin, Bremen and Hamburg

Set-aside areas protect water bodies and soils against nutrient input caused by agricultural use and restore - to a certain extent - naturally occurring habitats. This results in repopulation with typical species and reduction of undesired effects such as eutrophication. The soils regenerate and can regain their full functional capacity. The maintenance of water bodies can be reduced to a minimum. As a consequence their original hydromorphological dynamics are restored.

Already since 1988 areas have been set-aside on a voluntary basis in return for financial compensation. In order to limit the excessive growth of agricultural production within the European Union the Commission prescribed an obligatory set-aside for the Member States in 1993. In Eastern Ger-

many (e. g. Brandenburg) up to 20 % - due to the economic change after reunification - and in western Germany up to 10 % of the otherwise intensively cultivated acreage were converted into - partly rotating - fallow land.

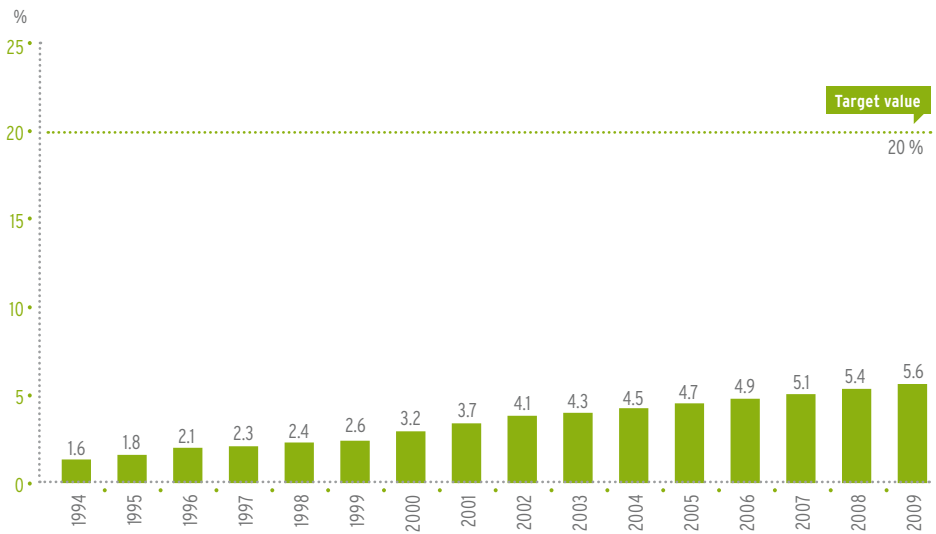
In 2007 the European Commission decided to abolish the obligatory set aside with the result that the share of fallow land and set-aide areas (here: all farmland without agricultural production including non-food [23]) decreased by 52 % in Germany between 2007 and 2008 alone. In 2008 fallow land and set-aside areas accounted for only 2.6 % of farmland, whereas in 2006 the share was still 6.2 %. As a result, habitats for animal and plant species were destroyed, depriving them of areas that provide food and space for sleeping, nesting and retreat in the intensively used agricultural landscape. Thus, seed-eating birds such as larks, finches and buntings lost their rich winter food reserve. In addition, connecting biotope structures got lost affecting migration possibilities for animal species. The additional farmland is cultivated predominantly with winter grain, rape and maize. Due to the continuous conversion of fallow land a further acceleration of the reduction of numbers of field bird species is to be expected [24]. This trend runs counter to the national biodiversity strategy [25] which aims to significantly increase biodiversity in agricultural ecosystems by 2020 and to secure the populations of most species (in particular wild species) typical of agricultural landscapes by 2015. However, the loss of this fallow land has negative consequences not only for wild animals and plants, but also for agriculture, e.g. through increasing soil erosion or loss of beneficial animals.

ORGANIC FARMING IS ON THE RISE

The percentage of area cultivated by organic farming systems in total farmland area as well as the share of organic farms compared to the total number of farms have increased countrywide. In contrast to conventional farming organic farming is characterized by mostly closed nutrient cycles and the fact that it does without mineral nitrogen fertilizers and synthetically produced plant protection products. Organic farms have to comply with stricter regulations than conventional farms, and this also applies to animal husbandry. That is why organic farming is considered to be an especially resource protecting and ecologically compatible form of agriculture. The basic re-

quirements for organic farming products are defined in EU legislation (Council Regulation (EC)) No 834/2007 on organic production and labelling of organic products). These requirements also form the basis for award of the German biolabel. In addition individual farming associations (Demeter, Bioland, Biopark etc., united in the German Association of Organic Farmer, Food Processor and Traders) have specific, further criteria.

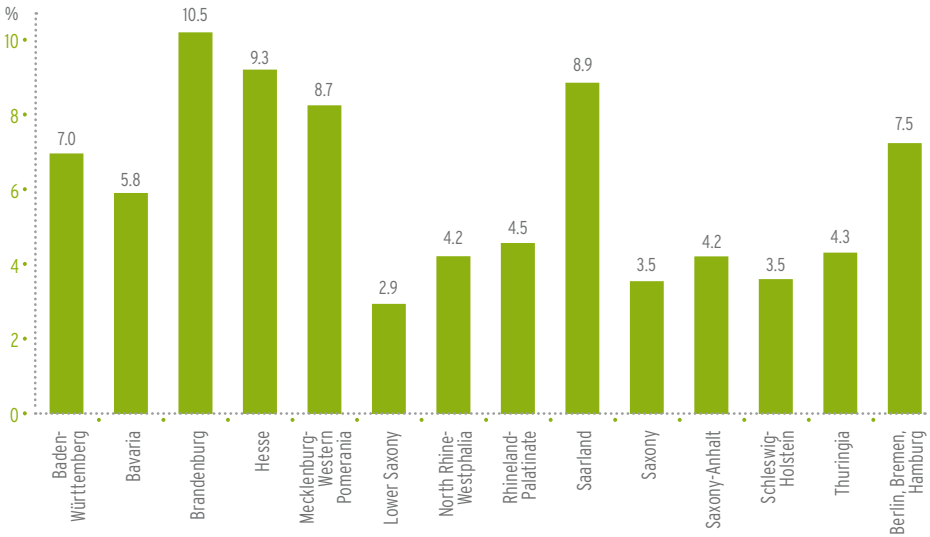
DEVELOPMENT OF THE SHARE OF ORGANICALLY CULTIVATED FARMLAND IN TOTAL FARMLAND IN GERMANY (1994-2009)



Source: Federal Ministry for Food, Agriculture and consumer Protection 2010 (http://www.bmelv.de/SharedDocs/Standardartikel/EN/Agriculture/OrganicFarming/OrganicFarmingInGermany.html)

However, we are still far away from the target set by the Federal Government, namely a share of 20% of total farmland area. Also compared with other European countries Germany is average at best, with 5.6 %. The leaders are Austria (2007: 12.7 %) and Sweden (2007: 9.2 %). Comparing the situation within Germany it becomes apparent that the importance of organic farming varies between the Laender. In terms of organic farmland as a proportion of total farmland Brandenburg, Hesse, the Saarland and Mecklenburg-Western Pomerania are dominant, with clearly more than 8 %, whereas in Lower Saxony, Saxony and Schleswig-Holstein organic farming is of minor importance, with less than 4 % .

COMPARISON BETWEEN LAENDER: ORGANICALLY CULTIVATED FARMLAND AS A PROPORTION OF TOTAL FARMLAND FOR 2009



Source: Federal Ministry for Food, Agriculture and Consumer Protection (BMELV) 2010 (http://www.bmelv.de/cln_154/SharedDocs/Standardartikel/Landwirtschaft/Oekolandbau/Tabelle2OekolandbauInD.html, 10.11.2010)

Organic farming pays off

Organic farming is promoted in the EU in the framework of agri-environmental measures. Organic products enjoy growing popularity and reach higher sales prices than products from conventional farming. Due to this organic farms often have a better standing than comparable conventional farms not only in terms of sustainability and resource protection but also economically.

COMPARISON OF PROFIT AND INCOME BETWEEN ORGANIC FARMS AND COMPARABLE CONVENTIONAL FARMS (DATA IN EUR)

	Organic farms	Comparable conventional farms
Profit per ha	468	366
Profit per farm	45 301	33 905
Income per worker	29 918	24 277

Source: Calculations of the Institute of Farm Economics of the von Thünen-Institute (vTI) based on data from test holdings for the financial year 2008/2009

The demand for organic products currently exceeds domestic production. That is why Germany is a net importer of organic products. Most of these imported organic products could be produced in Germany if attractive support was provided for the switch from conventional farming to organic farming. The support should be as attractive as to create a situation where as much of the demand as possible can be covered with domestic products. There is still room for improvement in that regard. The Federal Government has set up a "Federal organic farming programme" to support organic farming systems. It has already announced that in spite of all budget constraints this programme will be maintained in full. A strategy paper of the Federal Environment Agency on organic farming gives further guidance on how to reduce the flow of polluting substances from agriculture into the environment [26].

LITERATURE

[1] *Statistisches Bundesamt (Hrsg.): Entwicklung der Landwirtschaft in Deutschland und der EU 2009. Wiesbaden 2009, S. 9*

[2] *Statistisches Bundesamt (Hrsg.): Landwirtschaft in Deutschland und der Europäischen Union (EU), Wiesbaden 2009, S. 5 ff*

[3] *Europäischer Rechnungshof, Sonderbericht Nr. 8/2008 "Ist die Cross-Compliance-Regelung wirksam?" zusammen mit den Antworten der Kommission. http://eca.europa.eu.*

[4] *Bundesfachverband Feldberegnung 2008, Persönliche Mitteilung vom 4. November 2009*

[5] *http:// berichte.bmelv-statistik.de*

[6] *Angaben der Fachagentur Nachwachsende Rohstoffe e.V. (FNR)*

[7] *Lebert, Matthias: Entwicklung eines Prüfkonzeptes zur Erfassung der tatsächlichen Verdichtungsgefährdung landwirtschaftlich genutzter Böden. Umweltbundesamt (UBA), Texte Nr. 51/2010 (http://www.uba.de/uba-info-medien/4027.html)*

[8] *Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit/Umweltbundesamt (Hrsg.): Die Wasserrahmenrichtlinie - Auf dem Weg zu guten Gewässern 2010 (http://www.umweltdaten.de/publikationen/fpdf-l/4012.pdf), Wasserwirtschaft in Deutschland - Teil 2 Gewässergüte (http://www.umweltdaten.de/publikationen/fpdf-l/3470.pdf)*

[9] *Umweltbundesamt (UBA) (Hrsg.): Gewässerschutz mit der Landwirtschaft, 2010*

[10] *Umweltbundesamt (UBA) (Hrsg.): Gewässer pflegen und entwickeln - Neue Wege bei der Gewässerunterhaltung, 2009*

[11] *Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit/Umweltbundesamt (Hrsg.) (2010): Die Wasserrahmenrichtlinie - Auf dem Weg zu guten Gewässern ((http://www.umweltdaten.de/publikationen/fpdf-l/4012.pdf).*

[12] *Umweltbundesamt (UBA) (Hrsg.): Integrierte Strategie zur Minderung von Stickstoffemissionen (Stand April 2009) (http://www.umweltdaten.de/publikationen/fpdf-l/3813.pdf)*

[13] *Umweltbundesamt (UBA) (Hrsg.): Hintergrundpapier zur einer multimedialen Stickstoff-Emissionsminderungsstrategie (Stand April 2009) (http://www.uba.de/luft/downloads/emissionen/hg-stickstoffemissionsminderungsstrategie.pdf.)*

[14] *Hülsbergen, K-J., Küstermann, B. (2007): Ökologischer Landbau. Beitrag zum Klimaschutz. In: Angewandte Forschung und Beratung für den ökologischen Landbau in Bayern. (Hrsg.): Wiesinger, K. Lfl 3/2007*

[15] *Sukopp, U., Neukirchen, M., Ackermann, W., Fuchs, D., Sachteleben, J., Schweiger, M. (2010): Bilanzierung der Indikatoren der Nationalen Strategie zur biologischen Vielfalt: Wo steht Deutschland beim 2010-Ziel? – Natur und Landschaft 85 (7): 288-300*

[16] *Bundesamt für Naturschutz (BfN) (Hrsg.): Where have all the flowers gone? Grünland im Umbruch Hintergrundpapier und Empfehlungen des BfN, Bonn 2008, S. 3 – 4, 6 - 9*

[17] *Ministerium für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz des Landes Nordrhein-Westfalen (MUNLV-NRW) (Hrsg.): Streuobstwiesen in NRW. Düsseldorf Juni 2009, S. 7 – 10, S. 20*

[18] *Ministerium für Ländlichen Raum, Ernährung und Verbraucherschutz Baden Württemberg (Hrsg.): Streuobstanbau in Baden-Württemberg, Internet 18.8.2010*

[19] *Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) (Hrsg.): Nationale Strategie zur biologischen Vielfalt 2007 (NBS)*

[20] *Verordnung (EG) Nr. 1698/2005 über die Förderung der Entwicklung des ländlichen Raums durch den Europäischen Landwirtschaftsfonds für die Entwicklung des ländlichen Raums (ELER), Kapitel III, Artikel 11, Absatz 3, Buchstabe c.: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:277:0001:0040:DE:PDF (10.11.2010); Verordnung (EG) Nr. 1974/2006 der Kommission vom 15.12.2006 mit Durchführungsbestimmungen zur Verordnung (EG) Nr. 1698/2005 des Rates über die Förderung der Entwicklung des ländlichen Raums durch den Europäischen Landwirtschaftsfonds für die Entwicklung des ländlichen Raums (ELER), Anhang VIII.: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:368:0015:0073:DE:PDF (10.11.2010)*

[21] *Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) (Hrsg.) (2010): Indikatorenbericht 2010 zur Nationalen Strategie zur biologischen Vielfalt. - Gödeke, I., Sukopp, U., Neukirchen, M., (Red.), Ackermann, W., Fuchs, D.; Sachteleben, J., Schweiger, M. (fachliche Beratung) BMU. Berlin: 87 S.*

[22] *Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) (Hrsg.): Nationale Strategie zur biologischen Vielfalt 2007 (NBS), S. 47*

[23] *Statistisches Bundesamt: Pressemitteilung Nr. 279 vom 1.8.2008*

[24] *Christoph Braunberger (2009) Vögel der Agrarlandschaft. In: Sudfeldt, C., Dröschmeister, R., Flade, M., Grünberg, C., Mitschke, A.., Schwarz, J., Wahl, J. (2009): Vögel in Deutschland, DDA, BfN, LAG VSW, Münster 2009, S. 25-26.*

[25] *Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) (Hrsg.): Nationale Strategie zur biologischen Vielfalt 2007 (NBS), S. 47*

[26] *Umweltbundesamt (UBA) (2009): Strategiepapier: Förderung des Ökolandbaus als strategischer Beitrag zur Verringerung umweltbelastender Stoffströme aus der Landwirtschaft in die Umwelt. (http://www.umweltbundesamt.de/landwirtschaft/publikation/oekolandbaustrategie.pdf)*

SOURCES OF ILLUSTRATIONS

- *Titelseite, "Ähren", © iStockphoto/sankai*
- *Seite 9, "Mähdrescher", © Shotshop/Monkey Business*
- *Seite 19, "Ackerland", © Shotshop/Matthias Spitz*
- *Seite 21, "Bewässerung", © iStockphoto/YinYang*
- *Seite 31, "Ackerland, Luftaufnahme", © iStockphoto/Bim*
- *Seite 35, "Wiese mit Himmel", © Shotshop/S*W*Q*
- *Seite 37, "Rapsfeld", © Shotshop/Elena*
- *Seite 39, "Ackerland/Erde", © iStockphoto/melhi*
- *Seite 40, "Traktor auf Feld", © iStockphoto/ilfede*
- *Seite 45, "Bodeneinschnitt", © iStockphoto/gaspr13*
- *Seite 47, "Salatpflanze", © Shotshop/Gertrude Kaindl*
- *Seite 51, "Schafe," © iStockphoto/redmal*
- *Seite 54, "Strand", © Shotshop/Eva Gründemann*
- *Seite 65, "Ähren im Wind", © iStockphoto/Melbye*
- *Seite 67, "Rinder", © panthermedia/Design Pics*
- *Seite 69, "Düngung", © panthermedia/Herbert EsserDesign P.*
- *Seite 73, "Mais", © iStockphoto/LUGO*
- *Seite 77, "Trockenes Ackerland", © iStockphoto/mniebuhr*
- *Seite 79, "Feldsprenger", © iStockphoto/teveMcsweeny*
- *Seite 81, "Naturwiese", © Shotshop/Stefan Redel*
- *Seite 83, "Wald I", © Hofmann, Waldkunde Institut, Eberswalde*
- *Seite 83, "Wald II", © iStockphoto/ AVTG*
- *Seite 85, "Messfläche", © Umweltbundesamt*
- *Seite 86, "Feldlerche", © fotolia/ Wolfgang Kruck*
- *Seite 88, "Äpfel", © panthermedia/ Rainer Pfander*
- *Seite 95, "Obstkorb", © iStockphoto/ YinYang*

PARTICIPATING STAFF AND AUTHORS

Federal Environment Agency

Johanna Appelhans, Anna Biedermann, Katrin Blondzik, Dr. Jacqueline Burkhardt, Leonie Chonsch, Knut Ehlers, Markus Geupel, Dr. Frank Glante, Patrick Gniffke, Walburga Große Wichtrup, Dr. Andreas Hoffmann, Ulrich Irmer, Martin Ittershagen, Dr. Wera Leujak, Petra Mahrenholz, Stefan Marahrens, Steffen Matezki, Dr. Volker Mohaupt, Gertrude Penn-Bressel, Marian Pohl, Simone Richter, Dr. Dietrich Schulz, Antje Ullrich, Andreas Vetter, Rüdiger Wolter

Federal Environment Agency for Nature Conservation

Contributions to chapter 08:
Indicator „species diversity and landscape quality“, hedges and meadow orchards, high nature value farmland, loss of ecologically high-value set-aside areas

Armin Benzler, Dr. Annette Doerpinghaus, Dr. Manfred Klein, Melanie Neukirchen, Dr. Brigitte Schuster, Dr. Ulrich Sukopp

ABBREVIATIONS

D	*Germany*
%	*Percentage*
EUR	*Euro*
Gg	*Giga gram*
ha	*hectare*
kg	*kilogram*
km²	*square kilometer*
kt	*kilotonnes*
Mio.	*Million*
t	*ton*
t/a	*tonnes per annum*

Imprint

Publisher:
Federal Environment Agency
Wörlitzer Platz 1
06844 Dessau | Germany
Tel.: *+49(0)340 2103-0*
Email: *info@umweltbundesamt.de*
Internet: *www.umweltbundesamt.de*

Overall conceptual and editorial responsibility:
Federal Environment Agency | Dr. Jacqueline Burkhardt

Edited by:
Federal Environment Agency
Section I 1.5 "National and International Environmental Reporting"
Dr. Jacqueline Burkhardt, Walburga Große Wichtrup, Sibylle Wilke
Division II / Dr. Ulrich Irmer

Editorial Deadline:
November 2010

Translation:
Margit Tscherner

Layout:
www.publicgarden.de

Printed on 100% recycled paper

Umweltbundesamt

Wörlitzer Platz 1 | 06844 Dessau-Roßlau
Telefon: +49(0)340 2103-0
Email: info@umweltbundesamt.de
Internet: www.umweltbundesamt.de