Danube Facts and Figures

Germany

(July 2007)

General Overview

Of Germany's territory, over 56,184 km² in Bavaria and Baden-Wuerttemberg are drained by the Danube River – almost 17 % of the country and 7 % of the Danube River Basin. In Germany, 9.4 million inhabitants live in the area, making up 11.6% of the population in the entire Danube Basin.

Germany has been a Signatory State to the Danube River Protection Convention since 1994 and a Contracting Party since 1998.

Topography

The source of the Danube is in the Black Forest in Baden-Württemberg at the confluence of the Brigach and Breg Rivers in Donaueschingen. The river flows 584 km from the Black Forest Mountains to the Austrian border. Interestingly, the Danube loses about half its discharge to the Rhine Basin through underground passages in its upper course near Immendingen.

The larger tributaries, comprising approximately 4000 km² in the German Danube region, are the Naab, Isar, Lech, Inn and Salzach Rivers. In addition, the Donauried and Donaumoos moor landscapes are located along the Danube.

The German Danube region covers the Swabian and Frankonian Alb, parts of the Oberpfälzer and the Bavarian and Bohemian Forests in the north. To the south lie the Swabian-Bavarian-Austrian foothills. The southern borderline is formed by the Alpine Rhine and Lake Constance as well as the southern tributaries of the Lech, Inn and Salzach Rivers.

In the Alpine foothills there are many lakes formed by glacial processes. The largest are Chiemsee (80 km²), Starnberger See (56 km²), Ammersee (47 km²), Walchensee (16 km²), Waginger See (9 km²), Tegernsee (9 km²), Alpsee (9 km²), Staffelsee (8 km²), Simssee (7 km²), Kochelsee (6 km²) and Königssee (5 km²). In addition there are several large reservoirs as Forggensee (16 km²), Sylvensteinspeicher (6 km²) and Altmühlsee (5 km²) in the Bavarian part of the Danube region.

Precipitation, climate and water flow

The German Danube region is influenced by the Atlantic Climate with an average precipitation of about 1030 mm per year, increasing from north to south. The average monthly temperature is at its minimum in January (Danube Valley –1°C,

Bavarian Forest –2°C, Alps –10°C) and reaches its maximum temperature in July (Danube Valley 20°C, Bavarian Forest 18°C, Alps 4-10°C).

Hydrographic key figures of the German Danube region

Waters	Gauge Site	Series	Mean Low Discharge [m3/ s]	Mean Discharge [m3/ s]	Mean High Discharge [m3/ s]
Donau	Ehingen-Berg	1930-1998	12.9	37.9	204
Donau	Neu-Ulm	1954-2003	44.9	125.0	581.0
Donau	Achleiten	1954-2003	645.0	1,438.0	4,317.0
Iller	Wiblingen	1971-2003	7.7	56.0	428.0
Lech	Kraftwerk Rain	1982-2001	47.8	116.0	485.0
Isar	Plattling	1954-2003	95.3	176.0	562.0
Naab	Heitzenhofen	1954-2003	18.5	50.2	298.0
Regen	Regenstauf	1954-2003	13.1	37.9	297.0
Altmühl	Beilngries	1985-2002	6.56	17.2	91.0
Inn	Passau-Ingling	1954-2003	296.0	747.0	3,058.0

Land use and settlements

Of the 9.2 million inhabitants living in the German Danube Basin, 41 % live in urban agglomerations with more than 100,000 inhabitants: Ulm, Ingolstadt, Augsburg, Ratisbon and Munich. The most important settlements and industry centres are located around these cities, such as the automobile, machine and electric industries as well as the petrochemical and chemical industries. In addition, the processing of agricultural products is also very important and 57.5 % of the German Danube region is used for agricultural activities, mainly in the Danube valley (Donaumoos), in the northern part of the Danube (Ries, Keuper-Lias-Land) and portions of the south-eastern part of the Danube (Hallertau, Gaeuboden).

Human uses of water and water bodies

- Flood and torrent management, landslides

Bavaria and Baden-Wuerttemberg have a long history of dealing with floods. The first guidelines for the organisation of flood forecasts were set in 1883.

The Bavarian Ministry of the Environment, Public Health and Consumer Protection developed the programme 'Sustainable Flood Control in Bavaria — Flood Protection Action Programme 2020 for the Danube and Main River Basins', which stipulates specific targets, groups together individual activities at bodies of water and indicates the expected costs for a time horizon of 20 years. However, in high-quality use areas, technological flood control measures are required: dykes and walls, measures to improve flow, retention reservoirs, or dams. In principle, only settlements or transport systems of more than regional importance are protected against floods by these means. Such cases are usually assessed based on a flood arising on a long-term average of once in one hundred years. Thus, 300 km of protective dykes were renovated in improve flood control along the Danube and its tributaries.

To limit damage, impending floods are identified and announced by the Bavarian and the Baden-Wuerttemberg Environment Agencies. Flood forecasts are constantly improved thanks to state-of-the-art technology and support from the German Meteorological Service. The Danube water level can be predicted for a period of twelve hours to within 20 centimetres.

- Use of hydroelectric power

Water power currently amounts to a 15 % share of the total energy consumption in Bavaria. About 13 billion kilowatt hours are generated annually in 4,250 water power stations – 90 % of this in 218 large plants of over 1,000 kilowatt ultimate capacity. The majority of these power stations are situated on the alpine tributaries of the Danube: the Iller, Lech and Isar Rivers. Measures have been taken to protect the environment, such as the additions of fish-ladders or by-passing streams created near power stations to make the river passable for fish and other aquatic organisms. Further extension of water power requires balanced solutions taking into account the interests of environmental protection and of energy management.

- Navigation

From Kelheim on, the Danube serves as an international waterway. The river is also linked with the Rhine River Basin by way of the Main-Danube Canal, connecting the Main River at Bamberg with the Danube at Kelheim in Bavaria. Construction of the canal started in 1960 and was completed in 1992. The canal is 55 m wide and 4 m deep.

- Rivers as receiving waters for effluents

Rivers have been used as receiving waters for both urban and industrial waste water effluents for hundreds of years. They also transport diffuse pollution loads. Over the past decades, general water quality has improved considerably through

large investments into wastewater treatment plants. There have been substantial reductions in the oxygen-sapping organic substances and nutrients, such as phosphate and nitrogen. Since 1950 the number of wastewater treatment plants has increased from 20 to about 3,000. In the year 2000, around 93 % of the Bavarian population was connected to these wastewater disposal facilities. The wastewater of the remaining 7 % is treated in around 190,000 small wastewater plants.

Since 1975 water body protection includes measures specifically relating to the treatment of mixed water and rainwater. So far, storm-water tanks with a total capacity of 1.95 million m^3 have been built.

- Use of groundwater bodies: drinking water supply

Bavaria's drinking water comes mainly from the subsoil: 93 % from ground or spring water. More than 10,000 wells and springs currently supply about 0.9 billion m^3 of ground water with drinking water quality per year. Almost two-thirds of the abstracted water requires no purifying treatment. The rest is processed largely for technical reasons: substances such as iron, manganese or carbonic acid, which might cause corrosion or deposits in the pipes, are removed. Only a small amount of the water has to be disinfected for health care purposes.

- Use of surface water bodies: drinking water supply

Ground or spring water is not available everywhere in Bavaria in the quantity water suppliers need. In parts of the Upper Franconia and the Bavarian Forest the water supply has been secured by the construction of drinking water reservoirs. Some regions also rely on bank filtrate.

In Bavaria, the water resources are subject to highly varied conditions. Whereas Southern Bavaria is rich in water due to his high precipitation, water is short in supply in large parts of Northern Bavaria. At times of low discharge, there is three times more water available per inhabitant in the Danube region in comparison to the Main (part of river Rhine) region. For this reason an inter-regional compensation system has been created between Southern and Northern Bavaria, i.e. between the Danube and the Main region. Through the Main-Danube Canal water is abstracted from the Bavarian part of the Danube River at Kelheim and diverted to the Rhine River Basin. Depending on the needs and the discharge of the Danube, up to 20 m^3/s or 125 Mio m^3/year are transferred to the Main i.e. Rhine river Basin.

Pressures on surface and groundwater bodies

- Sewerage and organic pollution

Biological indicators, known as 'indicator organisms,' can be used to determine the extent to which running waters are contaminated with organic pollutants. Saprobes may also be enlisted as a measuring standard for the biological quality

of water bodies. Water body status is classified in four quality grades with intermediate stages.

- Nutrient discharge

In addition, there are non-point source pollutants from the air, mostly emitted by road traffic and heating systems in buildings. Eutrophication, was the result in many water bodies. The corresponding loss of oxygen led again and again to the death of fish populations. Stricter legislation and the construction of biological waste water treatment plants have made it possible to reduce the nutrient entry into water bodies. Phosphorus contamination has decreased over recent years, but the nitrogen concentration in most surface waters remains at a high level.

- Priority substances

A larger set of emissions ordinances specifies the requirements for industrial wastewater discharges to waters and public sewerage systems. The effective implementation of emission based requirements for industrial effluents is primarily characterised by internal or 'front of pipe' measures, such as the prevention of raw material losses or water reuse added by reasonable 'end of pipe' techniques of wastewater treatment.

Impacts on surface and groundwater bodies

- Impacts on rivers (based on the *Year 2004 National Analysis* for Water Framework Directive implementation).

The risk assessment for rivers is based on four categories of evaluation: the biological categories of the saprobic situation (pollution by organic, oxygen depleting substances) and the trophic situation (pollution due to plant nutrients), chemistry (pollution due to specific chemical pollutants) and structure or flow regulations (hydromorphological alterations).

The four categories were evaluated separately in order to point out the different problems and pressures. Additionally, the significance of the four categories greatly varies. Biological and chemical criteria are decisive for the status of waters, structure is an additional criterion.

For the 'saprobic situation' and 'trophic situation' categories the achievement of objectives is expected for more than 65 % of rivers. With respect to chemistry the percentage even amounts to 90 %. The percentage is lower for the structure of water bodies: The achievement of objectives is only expected for 29 %, due to the multiple uses of the rivers.

- Impacts on lakes (based on the *Year 2004 National Analysis* for Water Framework Directive implementation, including the initial classification of heavily modified water bodies).

Of the 49 lakes surveyed, 25 are expected to achieve the objectives, 8 of them are at risk. For the examination of lakes, nutrient pollution (trophic situation) proves to be the most important criterion. There are only two cases in which possible effects of bank protection works or of chemical pollutants have been estimated to pose a risk.

- Impacts on groundwater (based on the *Year 2004 National Analysis* for Water Framework Directive implementation, including the initial classification of heavily modified water bodies).

Nitrate pollution proves to be the decisive risk assessment criterion for groundwater: Therefore, if no further measures are taken, 11 groundwater bodies (13 % of the German Danube) will presumably not achieve the objectives set out in the WFD. Among the plant protective agents it is mostly atrazine and its derivatives which pollute groundwater. Due to the fact that, in Germany, application of this agent has been forbidden since 1991, it is expected that residues of this substance accumulated in the soil will, by 2015, have decreased to such an extent that they no longer pose any risk. As far as the quantitative status of groundwater is concerned, there is no known risk for not achieving objectives.

- Pressures and impacts from hydrological alterations (based on the *Year 2004 National Analysis* for Water Framework Directive implementation, including the initial classification of heavily modified water bodies).

Analysis has provisionally designated 21 % of the rivers and 16 lakes in the German Danube region as artificial or heavily modified.

Web-links

www.wrrl.bayern.de
www.wrrl.baden-wuerttemberg.de