

# SUSTAINABLE INDUSTRIAL WATER USE IN SOUTHERN GERMANY

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## Summary

The chapter describes the development of the infrastructure of the Neckar River valley, in southern Germany, as an example of the utilization of one of the smaller rivers for a variety of purposes in providing the needs of the resident population. In earlier times these needs were water transport, potable water supply, hydro-electric energy, agricultural water supply, dilution and disposal of waste water, cooling of thermal power plants, as well as providing zones of retreat for relaxation and leisure activities along the river banks.

With the rapid industrial development in the area over the past century, the Neckar River became a workhorse for side-by-side activities, often uncoordinated and conflicting, and began to lose its pristine appeal as a valued nature resort area. Thermal pollution due to the discharge of cooling water from thermal power plants, physical and chemical pollution due to waste water discharges from cities, towns and industrial complexes overloaded the river's natural capacity for cleaning itself. Leisure areas were rapidly absorbed in conurbation and industrialization.

The situation became critical and the authorities and public held deliberations towards rectifying the state of affairs. Through integrated management and purposeful planning of future developments and clearing up of old mistakes, the river system and its immediate surroundings now are once more restored to its former appeal as a home for its inhabitants.

## 1. Introduction

The famous American novelist, Mark Twain, wrote in his book *Tramp Abroad*:

*Germany in the summer, is the perfection of the beautiful, but nobody has understood and realized and enjoyed the utmost possibilities of the soft and peaceful beauty unless he has voyaged down the Neckar on a raft.....*

During his journey to Europe in the second half of the nineteenth century, Mark Twain visited a part of the valley of the river Neckar in southern Germany and, obviously liked it, but the region seemed to him to be rather remote:

*Along the ... shores of the beautiful Neckar ... were ruined castles on the overhanging cliffs and crags all the way; they were said to have their legends, like those on the Rhine. There was nothing in the books about that lovely region; it has been neglected by the tourist.*

Things have much changed since the time of Mark Twain. From a touristic point of view, the region of the lower Neckar valley, and in particular, the beautiful old town of Heidelberg, has become quite famous. The region of the middle Neckar valley, which Mark Twain did not visit, but which used to have natural assets comparable to those described in his book, has been developing into one of the most important regions for trade and industry in the world.

This has become a constellation of towns and urban complexes, where a densely populated, highly industrialized region (the second largest conurbation and economic center in Germany) puts heavy demands on its regional, comparatively small river, the Neckar.

Here many activities dealing with the interconnection of region and river have been going on. It is deemed to be a good demonstration subject for *Steps to Sustainable River Water Uses in Industrialized Regions*, which this contribution is concerned with.

## 2. The Region and the River - Characteristics, Properties, Features

Two regional divisions will be distinguished in the following section, namely first concentrating on the more heavily developed Middle Neckar region, and then followed by the Neckar River basin as a whole.

## 2.1. The Middle-Neckar Region (Region Stuttgart)

- General situation

The Middle-Neckar region, a part of the *Land Baden-Württemberg*, a federal state in the south-west of Germany, is favorably situated in the center of Europe as shown in Figure 1. It is well integrated into the European air-, rail-, motor- and waterway network and has a well-developed public transportation system. Telecommunication systems (data and speech) are also available on an advanced level.

The town of Stuttgart is the capital of the Land Baden-Württemberg. With its approximately 582 thousand inhabitants, it is the heart of the Middle-Neckar region. Therefore, the regional association which is formed by the town of Stuttgart and its neighboring 179 towns and communities, was given the name *Association Region Stuttgart*. The area of the *Region Stuttgart* is mainly identical with the entity which is less formally known as the *Middle-Neckar region*.

However, the notion *Middle-Neckar region* is mostly used in this contribution since it refers directly to the links between the region and the river. Since a river passes boundaries, and the river Neckar is the focus of the present chapter, other parts of the Neckar basin will be given due attention where appropriate.



Figure 1: The Middle-Neckar region in relation to Europe

- Population

The German federal state of Baden-Württemberg has 10.426 million (1998 census) inhabitants on an area of 35 751 km<sup>2</sup>. The population density amounts to 292 inhabitants per square kilometer. Ten percent of the area of Baden-Württemberg, equivalent to around 3700 km<sup>2</sup>, is occupied by the Middle-Neckar region (Region Stuttgart), but twenty-five percent of Baden-Württemberg’s population (equivalent to approximately 2.58 million) live here. The resulting population density in the Middle-Neckar region is 705 inhabitants per square kilometer.

- Economy

The Middle-Neckar region is invested with strong economic power. Big global players (such as automobile-, powertool- and computer manufacturers) have been present for many years with production plants, offices and services or even locating their headquarters here. But the economic “landscape” of the Middle-Neckar region is highly diversified.

Its approximately 140 000 small, medium-sized and big companies in 1996 achieved an “added economic value” of more than 140 billion German Marks (DM). This is equivalent to the magnitude of the gross domestic product of Ireland or Finland. The shares of the various economic sectors (agriculture, forestry and fishery production, services, trade and others) to the added economic value are displayed in Figure 2.

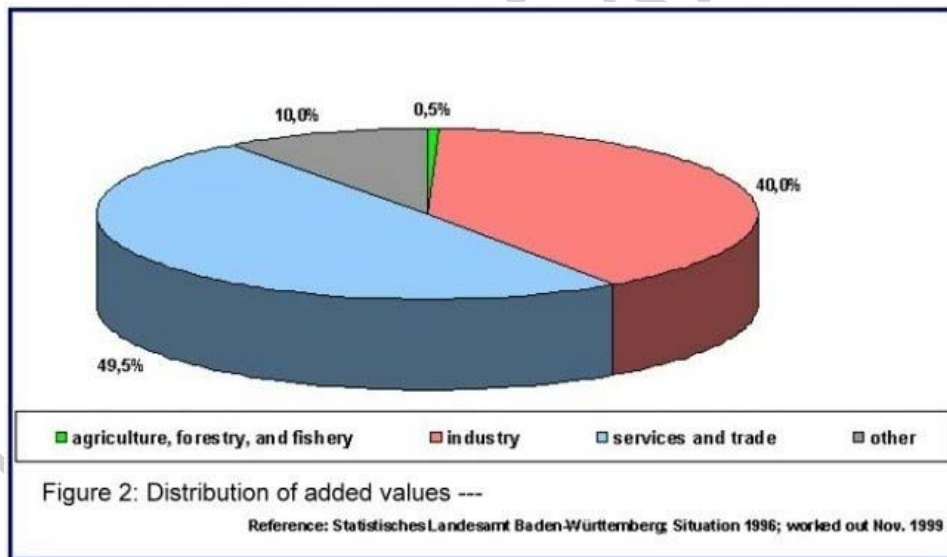


Figure 2: Distribution of added values according to sectors of economy in the Middle-Neckar region for 1996 (as evaluated in 1999)

On a European level, the region is in the top range with respect to its economic power, expressed as an added economic value of 114 000 DM per working person per year.

The local industry is export oriented. Forty-seven percent of the total turnover in the production sector stems from exports (1999). This is the highest value for the industrialized regions in Germany, which is an export country as a whole.

The sectors of the production industry are highly diversified. They range from the classical fields of industrial production such as car-manufacturing, machinery, electrical equipment, metallurgical products to the new dynamic technologies of computing, telecommunication and environmental protection techniques. The total number of working persons in the region is 1.225 million.

- Landscape

The topography of the Middle-Neckar region has many varying aspects. It is surrounded by the two low mountain ranges (a few hundred meters in height) of the Black Forest in the west and the Swabian Alb in the south-east. The valley of the river Neckar is at some places in the region, carved into the gently rolling hilly land, at others it opens into vast plains. The traditional attractiveness for living purposes of this area places it, next to the Rhine valley, near the top of the scale in Germany. This is partly due to the relatively high mean annual temperatures, the good quality of the soil and the resulting favorable conditions for growing plants.

Neighboring centers of urbanization in the Neckar basin are Heilbronn, downstream of the Stuttgart region and Mannheim-Heidelberg, at the confluence of the Rhine and Neckar Rivers, as seen in Figure 3.

## 2.2. The River Neckar

- Characteristics of the river Neckar catchment area and its hydrography

The specially marked catchment area of the river Neckar - as shown in Figure 3 - forms along its south-eastern boundary the European Watershed between the Rhine and the Danube Rivers.



Figure 3: The catchment area of the river Neckar  
(by courtesy of Gewässerdirektion Besigheim)

It has a size of 14 000 km<sup>2</sup>, thus covering 39 percent of the total area of Baden-Württemberg - an area where about half the population of the state of Baden-Württemberg live. The Middle-Neckar region in particular, which lies primarily on the lee-side of the Vosges Mountains (in France: the western boundary of the Rhine valley) and the Black Forest, represents an area of distinctly low precipitation, if compared to average conditions in Germany.

Water scarcity, high demographic and industrial density, already referred to, point to the problems in connection with water demand and supply, aggravated by questionable water quality, which is considerably impaired by waste water. Also, there is a definite ground-water shortage in the entire catchment area, which is largely due to the extensive karstified shell limestone areas found there and the various Jurassic formations of the Swabian Alb.

- Discharge behavior of the river Neckar

The long term average discharges, MQ, of the river Neckar are not very spectacular. They increase from 50 m<sup>3</sup>/s at Plochingen, a gauging station a couple of kilometers upstream of Stuttgart, over 88 m<sup>3</sup>/s at Lauffen (close to the town of Heilbronn) to 134 m<sup>3</sup>/s at Rockenau, not far from the town of Heidelberg. But the discharge behavior of the river Neckar is quite extreme, which is essentially due to the uneven distribution or precipitation and the lack of ground-water reservoirs on any larger scale. In Table 1 are represented the low-water flow (NQ), and the flood discharge (HQ) for several gauging stations.

The unfavorable discharge conditions of the river Neckar become obvious when compared with the data of the Danube and Rhine Rivers. The comparison of the maximum flood to the minimum discharge for the river Neckar reveals a ratio of 311:1 (Plochingen gauge) as against 39:1 for the Danube (Neu-Ulm gauge) and 13:1 for the Rhine (Maxau near Karlsruhe). The corresponding catchment areas amount to 3995 km<sup>2</sup>, 7578 km<sup>2</sup> and 50 196 km<sup>2</sup> respectively.

River basin	Gauge	HQ (m <sup>3</sup> /s)	NQ (m <sup>3</sup> /s)	NQ/HQ	Related time period	Catchment area (km <sup>2</sup> )
Neckar	Rottweil	234	0.45	1/520	1939-91	
	Horb	524	1.03	1/509	1932-91	
	Kirchentellinsfurt	630	2.74	1/230	1951-89	
	Plochingen	1150	3.7	1/311	1921-91	3995
	Lauffen	1650	14.1	1/117	1951-91	
	Rockenau	2230	18.4	1/121	1951-91	
Rhine	Maxau	4400	340	1/13	1931-91	50 196
Danube	Berg	445	4.58	1/97	1930-91	
	Neu-Ulm	861	22	1/39	1954-91	7578

Table 1: Catchment areas, characteristic discharge figures (flood flow HQ, low water flow NQ) and the ratio NQ/HQ (low flow/flood flow) of the river Neckar at several gauging stations and, for comparison the same at gauging stations of the Upper Rhine and Danube Rivers.

### 3. Water Usage in the Middle-Neckar Region - Problems and Solutions

In the following sections a number of different uses of the river Neckar, as has developed over the past centuries, will be discussed. This has all occurred in parallel with the remarkable development of the entire Middle-Neckar region.

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### **Biographical Sketch**

**Prof. Jürgen Giesecke** (Dr.-Ing. habil. Dr.-Ing. E.h.) graduated in Civil Engineering from the Technical University of Stuttgart, Germany, in 1955. From 1956 to 1968 he worked as research assistant at the Technical University of Stuttgart, where he presented his dissertation in 1960 and his post-doctoral thesis in 1965. From 1968 to 1971 he was Managing Director at Dorsch Consulting in Munich. Since 1971 he has been Full Professor and holder of the Chair of Water Resources and Hydraulic Engineering, Director of the Institute of Hydraulic Engineering, University of Stuttgart. He has published several papers on hydrology, river engineering, dam construction and hydropower plants. At present he is Vice President of the German ICOLD Committee and of the German Association for Water Resources and Land Improvement (ATV-DVWK).