

The Elbe - Contribution of the IKSE and of several research programmes to the protection of an unique riverscape

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Summary

Numerous research activities - often following initiatives and cooperation with the IKSE - contribute to the targeted ecological rehabilitation of the catchment of the River Elbe to ensure the uses of the river while preserving its quality as habitat. Nevertheless, the Elbe is still counted among the most polluted rivers. As research can only provide the basis for political decision-making, the implementation of the concepts is in the hands of decision-makers in the Federal government, in the Länder, and in the municipalities. That is why an essential concern of research is to prepare and present its results in such a way that users can understand and apply them easily.

Sommaire

Avec une longueur d'environ 1.100 km et un bassin versant total de presque 150.000 km², l'Elbe est un des plus grand fleuves de l'Europe centrale. Bien que plus de 80% des surfaces originellement inondées aient disparu pour des raisons d'endiguement, le paysage de l'Elbe présente toujours de nombreux secteurs constituant partiellement des zones de protection à l'échelon international. La Commission Internationale pour la Protection de l'Elbe (Internationale Kommission zum Schutz der Elbe (IKSE)) ainsi que de nombreuses activités de recherche créées agissent dans le but de la protection du paysage et de la mise en évidence des possibilités d'amélioration et de conservation de la qualité des eaux ainsi que du fonctionnement écologique de l'Elbe, de ses affluents et de ses plaines alluviales, tout en gardant des utilisations importantes, comme par exemple la navigation. Le présent article montre les tâches de l'IKSE ainsi que divers programmes de recherche, comme notamment le programme „Ökologische Forschung in der Stromlandschaft Elbe (Elbe-Ökologie)“ (Recherche écologique dans le paysage de l'Elbe (écologie par rapport à l'Elbe)) promu par le Ministère fédéral de l'éducation et de la recherche (Bundesministerium für Bildung und Forschung (BMBF)).

1 Introduction

With a length of about 1.100 km and a catchment area of approximately 150.000 km², the Elbe is one of the largest rivers in Central Europe. About 100.000 km² (65 %) of the catchment are German territory, 50.000 km² (34 %) are Czech, and minor parts belong to Austria and Poland (together 1 %) (Figure 1). The Elbe basin is inhabited by nearly 25 million people, of these about 19 million in the Federal Republic of Germany. Although today more than 80 % of the original inundation areas are cut off from the river by dykes, the Elbe riverscape still has many reaches in near-natural state, some of which are protection areas of international significance. Last but not least, the recognition of the Biosphere Reserve "Elbe riverscape" by UNESCO in December 1997 highlights the significance of the Elbe basin as natural as well as cultivated landscape. To protect this landscape and to identify possibilities to preserve or improve water quality and ecological functionality of the Elbe, its floodplains, branches, and tributaries - taking into account important uses like for instance inland navigation - is the objective of the International Commission for the Protection of the River Elbe (*Internationale Kommission zum Schutz der Elbe* (IKSE)) and numerous research activities. This paper describes the tasks of the IKSE and presents several research activities, with special emphasis on the programme "Ecological Research in the Elbe Catchment Area (Elbe Ecology)" that is supported by the German Federal Ministry of Education and Research (BMBF).



Figure 1: The Elbe Catchment Area [IKSE 1995]

2 International river commissions

2.1 International Commission for the Protection of the River Elbe (IKSE)

In 1990, the Czech Republic, the Federal Republic of Germany and the European Communities concluded a contract about the establishment of the International Commission for the Protection of the River Elbe (*Internationale Kommission zum Schutz der Elbe* (IKSE)) that came into force in 1992. The objective of this commission is the improvement of the conditions for a sound aquatic ecosystem of the River Elbe, including rich diversity of species in flora and fauna. This should be achieved by additional activities in the treatment of municipal and industrial wastewaters and by reducing non-point pollution sources. Thus the preconditions for multiple uses such as drinking water abstraction from bank-filtered river water and agricultural uses of water and sediments are provided.

However, first it is necessary to improve the state of the River Elbe and its main tributaries in physical, chemical, and biological terms in the compartments "water column", "suspended solids", "sediments", and "organisms", while increasing the ecological value of the waters and the floodplains in the Elbe basin. The implementation of these steps means simultaneously a lasting reduction of the pollution load into the North Sea. Diverse working groups have devised programmes towards these objectives. These include measuring and monitoring programmes, action programmes for pollution reduction as well as recommendations for short-, medium-, and long-term activities for improving the qualitative and ecological status of waters in the Elbe basin (Figure 2).

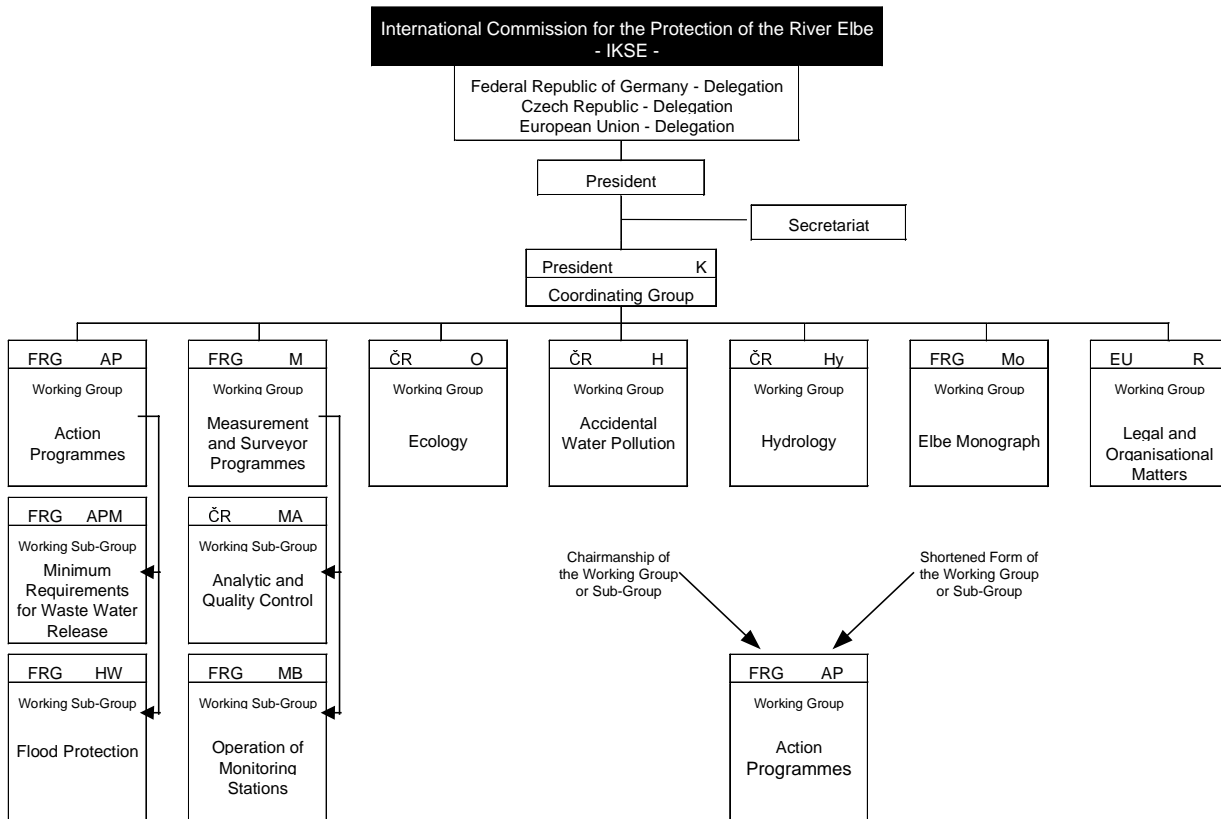


Figure 2: International Commission for the Protection of the River Elbe (IKSE)

Numerous activities of the IKSE have contributed to a noticeable improvement of water quality in the Elbe which used to be extraordinarily poor only some years ago. The success in the ecology is also reflected in the definition of numerous reserve areas in the river valleys. Along the course of the Elbe from the Riesengebirge to the North Sea, there are currently more than 200 areas under different protection statuses.

2.2 Other international river commissions

The foundation of the IKSE was oriented at the examples of existing international river commissions, some of which have a long standing. First the International Commission for the Protection of the River Rhine against Pollution (*Internationale Kommission zum Schutz des Rheins gegen Verunreinigung* (IKSR)) was founded in 1950, first without an international contract. In 1963 the corresponding contracts were signed, in 1965 they came into force. Additional agreements concerning chemical pollution were concluded in 1976 and came into force in 1979. The main tasks of the IKSR are determining and documenting the quality of the river water, organising an international warning service, and implementing the conventions on the protection of the Rhine against chemical pollution with chlorides.

In 1961 the contracts for the foundation of the International Commissions for the Protection of the Rivers Moselle and Saar against Pollution (*Internationale Kommissionen zum Schutz der Mosel und der Saar gegen Verunreinigung* (IKSMS)) were signed that came into force in 1962. Issues of flood protection and water conservation are in the foreground here. In 1994, an International Commission for the Protection of the River Danube (*Internationale Kommission zum Schutz der Donau* (IKSD)) was established (in force in 1998) with the main task of coordinating transboundary problems of streamflow and water quality. As well in 1994 the International Commission for the Protection of the River Maas against Pollution (*Internationale Kommission zum Schutz der Maas gegen Verunreinigung* (IKSM)) was founded; the contracts did not come into force yet. In 1996 the International Commission for the Protection of the River Odra (*Internationale Kommission zum Schutz der Oder* (IKSO)) followed with a similar scope of tasks (in force in April 1999).

3 Research Programmes

To create a basis for the desired improvement of the quality of waters and of the ecological situation, many national and international research efforts were initiated on the River Elbe and its tributaries. Three major research projects are presented here, representing the activities on the River Elbe, with special reference to the research programme "Ecological Research in the Elbe Catchment Area (Elbe Ecology)".

3.1 The Czech Elbe Project

After its foundation in September 1990, the Czech Ministry of the Environment launched a national Elbe Project with the aim to establish a qualitative inventory of the present state of water, sediments, and biota and to derive therefrom a water protection concept for the Elbe basin. The project covered above all priority substances (heavy metals and specific organics) and nutrients (phosphorus and nitrogen). Additional parameters such as COD and BOD, as well as radioactivity monitoring completed the measuring programme. The project was scheduled for the years from 1991 to 1994 and comprised three main topics: Pollution sources (point and non-point), the pollution status of surface waters, sediments, and biocoenosis as well as measures for the improvement or rehabilitation of the ecosystem. The Elbe Project, in which some 50 specialised institutions participated under the guidance of the Research Institute of Water Resources Management (VÚV) TGM Prague, produced thus the most detailed study in the context of water conservation in the past 20 years in the area of the Czech Republic.

3.2 Lead project "Elbe 2000"

On the German side, the Federal Ministry of Research and Technology (today Federal Ministry of Research and Education/*Bundesministerium für Bildung und Forschung* (BMBF)) initiated in 1990 the Lead Project "Elbe 2000" which constituted the contribution of research and development to the rehabilitation of the River Elbe. The objective of this Lead Project is the complex analysis of the river system to provide by the year 2000 the groundwork for an ecologically balanced river system which allows reasonable and nature-compatible uses. The whole river system has been examined and characterised for water quality, the basis for a reasonable and balanced monitoring system has been created, priority areas for rehabilitation have been identified, and activities for restoration have been initiated. Additional foci of research were the development of new technologies for the treatment of water for drinking, for industrial processes and agricultural irrigation as well as the development of analytical methods to identify quickly and reliably threats to the waters. In this project too research institutions of different professional orientation have been working together.

3.3 Research Association "Elbe Ecology"

3.3.1 Objectives

Against the background of already strongly reduced water pollution, this research project is mainly devoted to devising future-oriented use and development concepts, which help to preserve or improve the ecological functionality of the river. This requires comprehensive knowledge about the multiple interrelations between the Elbe River, its floodplains, and its catchment. The Federal Ministry of Education and Research (*Bundesministerium für Bildung und Forschung* (BMBF)) has consequently supported since 1996 numerous research activities on the basis of its research conception "Ecological Research in the Elbe Catchment Area (Elbe Ecology)" to contribute to the ecologically based and economically sustainable development of the Elbe riverscape (picture 1).

The research programme was devised jointly by scientists and decision-makers at the levels of the Federal Government and of the German *Länder* in close coordination with the IKSE, and it comprises a frame concept and sub-concepts on the three topics "Ecology of Flowing Waters", "Ecology of the Floodplains", and "Land Use in the Catchment Area". The supported projects should elucidate ecological and socio-economic connections, close gaps in knowledge by applying innovative methods, and devise application-oriented concepts for solving conflicts between various use interests. A basic concern of these research projects lies in the further development of tools for forecasting ecological impacts, for instance of hydroengineering interventions or changes in land use, and in defining development goals for different natural regions.



Foto: Prange

Picture 1: The Elbe riverscape

3.3.2 Tasks of the Project Group Elbe Ecology

The Federal Institute of Hydrology (*Bundesanstalt für Gewässerkunde* (BfG)) was entrusted by the BMBF with the task of developing the organisational and scientific structure of ecological research on the River Elbe. In May 1994, the interdisciplinary Project Group Elbe Ecology was established in the BfG Branch Office Berlin. Priority task of the Project Group is the comprehensive expert coordination of the interdisciplinary research projects. This includes also the organisation of meetings on various topics covering the whole project scope to ensure the mutual information of project partners about objectives, approaches and methods and to coordinate the resulting possibilities of mutual support and cooperation. Moreover, the Project Group supports on the basis of the information system ELISE (accessible via internet <http://elise.bafg.de>) the flow of information and exchange of experience among the research partners and with partners in practice.

In the future, the comprehensive evaluation and presentation of research results will be one focus of activities, since some of the projects have reached their final phase already. Beyond this, the Project Group is also active in the field of public relations. (Figure 3)

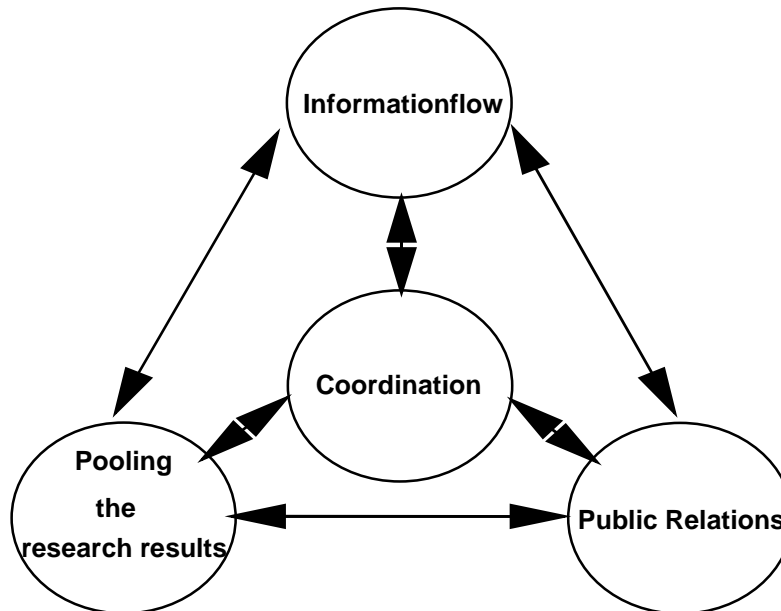


Figure 3: Tasks of the Project Group Elbe Ecology

3.3.3 Projects under the Research Association Elbe Ecology

The table below gives an overview of the projects which are currently supported in the framework of the Research Association Elbe Ecology. The projects are classified under the topics "Ecology of Flowing Waters", "Ecology of the Floodplains", and "Land Use in the Catchment Area". The research priorities of these topics are shown in Figure 4.

Research Priorities of the Elbe Ecology programme:
<p>Ecology of Flowing Waters</p> <ul style="list-style-type: none"> • Ecomorphology (bed erosion, flow dynamics, habitat structures) • Species and biocoenosis, bioindication (fish, zoobenthos) • Structure-bound turnover processes (river bed, interstitial, groynes)
<p>Ecology of the Floodplains</p> <ul style="list-style-type: none"> • Ecological flood protection (repositioning of dykes, reclamation of retention areas) • Use and renaturation concepts (development of floodplain forests, environmentally compatible agriculture) • Bioindication (assessment, forecast, monitoring and assessing the success of measures)
<p>Land Use in the Catchment Area</p> <ul style="list-style-type: none"> • Water budget and mass balance of the landscape in the entire catchment area and in representative subregions (lowland, Loess region, mountain area) • Reduction of diffuse immission by socioeconomically acceptable sustainable land use concepts

Figure 4: Research Priorities of the Elbe Ecology programme

Table: Overview of ongoing projects in the framework of the Research Association Elbe Ecology (Status of October 2000)

Project management	Project title
Overriding subjects	
Federal Institute of Hydrology (BfG)	Establishment of a www-based information system for the research project "Elbe Ecology" of the BMBF (ELISE)
Technical University Berlin	Economic evaluation of measures towards a sustainable development of the Elbe River basin
Ecology of Flowing Waters	
University Karlsruhe	Morphodynamics of the Elbe
Federal Waterways Engineering and Research Institute (BAW)	Study of impacts of activities in the Elbe foreland on the flow situation and river morphology at the example of the erosion reach and the reach of dyke relocation between Wittenberge and Lenzen
Technical University Darmstadt	Effects of groynes on semiterrestrial areas
Federal Institute of Hydrology (BfG)	Significance of tributaries for the solid-matter budget of the River Elbe
University Hamburg	Ecological relations between the structures of the fish community and the habitats in the River Elbe
State Agency for Ecology of Lower Saxony (NLÖ)	Studies on the migration behaviour of fish in impoundments in large rivers at the example of the Elbe impoundment weir Geesthacht
Technical University Dresden	Significance of biofilms in the interstices of the River Elbe for mass flow dynamics, riverbed permeability, and nutrient elimination
University Hamburg	Structure and dynamics of the pelagial, benthic, and aggregate-associated biocoenosis, their interactions and material fluxes
Federal Institute of Hydrology (BfG)	Significance of lentic zones and the interstices for the elimination of nutrients in the River Elbe
Institute of Freshwater Ecology and Inland Fisheries (IGB)	Importance of fluviomorphologic structures for the retention and decomposition of particulate organic matter and for the sediment fauna in the River Elbe
Environmental Research Centre Leipzig-Halle (UFZ)	Nutrient flow and –dynamics in groyne fields of the Elbe river
Ecology of the Floodplains	
State Agency for Large Reserve Areas (LAGS)	Possibilities and constraints of the regeneration of floodplains and the development of floodplain forests shown at the example of nature conservation projects on the Lower Elbe (Brandenburg)
State Agency for the Environment (LAU) Saxony-Anhalt	Reclaiming retention areas and restoring inundation areas on the Middle Elbe
Thuringian State Agency for the Environment (TLU)	Revitalisation of the Unstrut floodplain

Project management	Project title
Alfred Toepfer Academy for Nature Conservation (NNA)	Idealised concepts (<i>Leitbilder</i>) of nature conservancy and their implementation with agriculture - objectives, tools, and costs of environmentally compatible and sustainable land uses in the Elbe floodplains of Lower Saxony
Saxon State Agency for Agriculture (LfL)	Development of sustainable land use methods in the Saxon basin of the River Elbe
Technical University Dresden	Silviculturally and ecologically founded concepts for near-natural management, renaturation and reproduction of floodplain forests on the Elbe (ecology of floodplain forests)
Environmental Research Centre Leipzig-Halle (UFZ)	Gravel mining in floodplains examined at the example of the River Elbe: Assessment basis for large-scale ecological impacts
Environmental Research Centre Leipzig-Halle (UFZ)	Transfer and enhancement of a robust indicating system for ecological changes in floodplains
Technical University Braunschweig	Ecological indices for assessing dynamic habitats of selected carabid species in the Elbe floodplains
University Halle-Wittenberg	Integration of landscape conservation and land use in the Biosphere Reserve "Middle Elbe River" –western part- by coordinated development of nature conservation, tourism and agriculture
Land Use in the Catchment Area	
Research Centre Jülich (FZJ)	Areal analysis of water balance, retention times and groundwater quality for the classification of the Elbe catchment area according to natural regions
Potsdam Institute for Climate Impact Research (PIK)	Impacts of land use on water budget and mass balances of the River Elbe and its basin
Centre for Agricultural-landscape and Land use Research (ZALF)	Water and mass retention in the lowlands of the Elbe basin
Environmental Research Centre Leipzig-Halle (UFZ)	Areal water budget and mass balance in the Loess region of the Elbe basin as a basis for the implementation of sustainable land uses
Technical University Dresden	Potential impacts of environmental changes on flow-paths and flow-time behaviours of different runoff components and the related land use dependent nitrogen outwash from regions with exposed rock/low mountain range of the Elbe

3.3.3.1 Ecology of Flowing Waters

The morphological development of the flowing waters and riparian land strips in the Elbe riverscape, including their role as habitat structures constitute the focus of project activities in this chapter.

In order to be able to estimate the consequences of interventions through hydroengineering works on the structures of the river Elbe and its forelands, it is first necessary to analyse the interactions between hydrological and morphological processes. A project under the guidance of Karlsruhe University examines the Elbe from the German-Czech border to the weir of Geesthacht. On the basis of an inventory and assessment of the present state of the River Elbe and its forelands regarding their morphological development, forecasting instruments are developed for the large-scale estimation of the consequences of hydroengineering activities. Moreover, a basis is created for an analysis of future conditions and possible developments by detailed studies in the laboratory or on selected reaches of the Elbe.

For diverse reasons there will be interventions in the forelands of the river Elbe in the future, the impacts of which on the flow situation, the morphology of the river and of the banks and on bed erosion can be estimated today only vaguely. That is why a research project of the Federal Waterways Engineering and Research Institute (*Bundesanstalt für Wasserbau* (BAW)) examines the effects of different measures in the Elbe forelands on conditions of flow and solids transport by using different numerical and physical models, so that optimised use variants can be derived. Such activities are among others repositioning of dykes, changes in the foreland vegetation (e.g. development of floodplain forests) or the increase of the runoff component discharged over the forelands. Interest focuses here on the Elbe reaches in the region of Torgau (erosion reach) and Wittenberge/Lenzen.

A project under the guidance of the Technical University Darmstadt elucidates the relations between biotic and abiotic parameters in the amphibious zone of groyne fields and simulates them by numerical modelling. This lays the groundwork for a simulation tool for the prediction of the effects of different designs of groynes on hydrodynamics, morphodynamics and the biocoenosis.

The Federal Institute of Hydrology (*Bundesanstalt für Gewässerkunde* (BfG)) examines the role of tributaries in the solid matter budget of the Elbe. Because of the hydrological significance of these rivers, the study focuses on the Moldau, Ohre, Mulde, Saale and Havel. Sampling of suspended solids and bedload material allows to study the dependence on season and streamflow of the amount of material and its composition, the origin and fate of introduced or retained material, and the significance of these different portions for the River Elbe. Conclusions for a possible bed-load management and optimisation of monitoring networks will be drawn.

Concerning species and biocoenosis, attention is drawn to the fish fauna in the scope of two projects:

Inundation zones and banks, as well as river bottom and groyne fields are important structures for the Elbe-typical fish species as grounds for spawning and growing-up and refuge areas. Changes of these structures have influences on the composition of the fish communities. That is why fish are good indicators for the assessment of the ecological state of a water body. A research project under the guidance of Hamburg University is dealing with the fundamental relations between the structures of the fish communities and the habitats in the River Elbe. This includes the analysis of spawning grounds, habitats for growing-up and refuge and the assessment of their significance for population



Foto: Wasser- und Schifffahrtsamt Lauenburg

Picture 2: View on the weir and the sluice at Geesthacht (Elbe km 585,9)

structures and dynamics of fish biocoenosis. Thus, it will be possible to develop a habitat model and to formulate a fish-ecological *Leitbild* (idealised overall concept). Then, recommendations and criteria - also as decision aids for environment and fishing authorities - for the ecologically compatible maintenance and construction of embankments, riverbeds, groynes and foreshores will be derived.

Many species of river fish depend on the river continuum for the upstream and downstream migration in the River Elbe for their reproduction, growth and food.

This continuum is interrupted on the German side only by the impoundment weir Geesthacht (picture 2).

Aiming to gain knowledge about the significance of ship locks for fish migration, the State Agency for Ecology of Lower Saxony (*Niedersächsisches Landesamt für Ökologie (NLÖ)*) initiated pertinent studies at the weir of Geesthacht and the locks there. It compares the preferences of fish for possible migration pathways - taking into consideration also the fish pass recently rebuilt - to derive recommendations for the improvement of the migration.

The focus of research in the field of mass balance dynamics is on the study of structure-bound turnover processes at different morphological structures such as groyne fields, river bottom, and interstices. A project of the Technical University Dresden looks into the significance of biofilms in the interstices of the Elbe for the mass dynamics, the permeability of the riverbed, and nutrient elimination. New knowledge is expected about the share of biofilms in nutrient retention or elimination on the riverbed and in the interstices, about the underlying processes, and the indicating value of the micro-organisms involved. The results will serve as a basis for predicting the future water quality with view to drinking water abstraction by bank filtration, which is practised along the Elbe on a large scale. A cooperation of different Institutes, the Institute for Freshwater Ecology and inland Fisheries (*Institut für Gewässerökologie und Binnenfischerei (IGB)*), the Federal Institute of Hydrology (*Bundesanstalt für Gewässerkunde (BfG)*), the Environmental Research Centre Leipzig-Halle (*Umweltforschungszentrum Leipzig-Halle (UFZ)*) and the University of Hamburg, gathers data which allow to analyse energy and mass fluxes and transport processes, as well as their effects on the quality of individual river reaches and thus provides a decision aid in the context of hydroengineering measures. Here, attention focuses on the role of groyne fields as sediment traps and nutrient sinks, material turnover in the Elbe, and the influence of navigation on resuspension and sedimentation of suspended solid particles.

3.3.3.2 Ecology of the Floodplains

The projects under this topic deal among others with questions of ecological flood protection in connection with the reclamation of retention areas. In the region of Lenzen, for instance, the State Agency for Large Reserve Areas Brandenburg (*Landesanstalt für Großschutzgebiete Brandenburg (LAGS)*) organises a study on the impacts of the repositioning of dykes on plants and animals, but also on the people living and working there. The possibility of revitalising floodplain forest in potential inundation areas is also a subject of this project. On another reach of the river, namely the Middle Elbe in Saxony-Anhalt, relocation of dykes is also planned. Under the guidance of the State Agency for the Environment Saxony-Anhalt (*Landesamt für Umweltschutz Sachsen-Anhalt (LAU)*), these plans are supported by scientific and engineering research with the aim to define criteria for (ecological) post-project monitoring and analysis of possibilities and constraints for the restoration of near-natural conditions in a riparian landscape.

The *Land* of Thuringia intends to convert the floodplain landscape on the River Unstrut to a more natural state. Scientific coverage of this project under the guidance of the Thuringian State Agency for the Environment (*Thüringer Landesanstalt für Umwelt (TLU)*) develops site-adapted development objectives and scenarios of land use and analyses and assesses them for their ecological and economical impacts.

The question for a joint strategy of agriculture and nature conservation is in the centre of a project guided by the Alfred Toepfer Academy for Nature Conservation (*Alfred Toepfer Akademie für Naturschutz (NNA)*) dealing with the Elbe floodplains in Lower Saxony. The point is here to identify perspectives for environmentally compatible land uses and to implement realistic development objectives for a region, which is of special interest for nature conservation because of its outstanding significance as habitat for threatened plants and animal species.

To this end, concrete objectives of environmental quality and regional overall concepts (*Leitbilder*) are developed on the basis of measurable criteria relating to soil, water, and organisms. Analyses of the economic consequences of different development objectives should help to consider also the economic interests of land users in the development of concrete proposals.

In a close relation to these aims a project coordinated by the University of Halle-Wittenberg deals with the integration of landscape conservation and land use in the Biosphere Reserve “Middle Elbe River” with a focus on nature conservation, tourism and agriculture.

A project led by the Environmental Research Centre Leipzig-Halle (*Umweltforschungszentrum Leipzig-Halle* (UFZ)) will develop a practicable system of bioindication for analysing, assessing, and predicting ecological changes in floodplains on the basis of available knowledge acquired on other European rivers. This system should allow, on the one hand, to indicate as sensitively as possible the ecological impacts of certain interventions and changes in land use on existing systems, and on the other hand, enable a very wide and universal application. As practice demands a possibly low expenditures for acquiring the needed measurements, the newly developed indicator system is tested for its robustness under conditions of minimised data acquisition efforts. The aim of a supplementary project of the Technical University Braunschweig is the creation of a tool which allows to analyse the impacts of measures in agriculture, forestry, and water-resources management regarding the population dynamics and habitat acceptance of typical floodplain-dwelling carabids.

On the middle course of the Elbe, between Dessau and Magdeburg, there still exist - unique among the large German river systems - wide continuous floodplain forests, which are still rather natural in their composition and dynamics and thus have high significance for nature conservation and biological diversity. The objective of a research project of the Technical University of Dresden is the development of concepts for near-natural conservatory management and controlled development of these threatened and sensitive forests with their high diversity and the definition of concepts for the establishment of floodplain forests in a near-natural state.

About 60 % of all ploughland in Saxony, which belongs nearly fully to the Elbe basin, are threatened by water erosion. This causes considerable loads of sediments, nutrients, pesticide residues etc. in the Elbe and its tributaries. A project of the Saxon State Agency for Agriculture (*Sächsische Landesanstalt für Landwirtschaft* (LfL)) assesses on representative fields in the Saxon Loess hill country novel, environment-saving tilling methods in a comparison with conventional cultivation in terms of soil, crops, and economy and offers solutions for the problems identified. A second part of this project deals with the testing of environmentally sound land-management systems with cattle, sheep and fallow deer on ecologically sensitive areas in the Elbe floodplain and their assessment for their impacts on the biotopes, soil, waters, erosion, and animals as well as the development of vegetation.

Another problem affecting the floodplain is gravel mining. It constitutes a direct intervention into the morphology and groundwater dynamics of floodplains. A project of the Environment Research Centre Leipzig-Halle (*Umweltforschungszentrum Leipzig-Halle* (UFZ)) pursues the aim to analyse and assess the ecological consequences of large-scale gravel mining. A six-month pre-study first examined the state-of-the-art and identified methodological deficits.

3.3.3.3 Land Use in the Catchment Area

Since point sources of pollution discharges into the Elbe have been reduced, non-point inputs gain in significance. Of the annual nitrogen load of about 150,000 tonnes about 88 % are washed from the landscape into the river. The reduction of these non-point inputs requires the application of site-adapted cultivation methods in the whole country.

The objective of the projects under this topic includes the prediction of long-term impacts of land use changes on the water budget and on the mass balance of the landscape. Tools should be developed to predict impacts of land use changes on all scales, thus providing the basis for the comprehensive river-basin management.

The study covers the whole catchment, while placing special emphasis on the three main natural regions in the Elbe catchment: the Pleistocene lowland, the Loess region, and the mountain areas.

Starting point for the studies is a classification of natural regions and a rough analysis of particularly wash-out prone regions in the Elbe basin by the Research Centre Jülich (*Forschungszentrum Jülich* (FZJ)) and the large-scale modelling of the landscape water budget and mass balance by the Potsdam Institute of Climate Impact Research (*Potsdam-Institut für Klimafolgenforschung* (PIK)). Projects studying the aspects of natural regions of the Centre for Agricultural-landscape and Land use Research (*Zentrum für Agrarlandschafts- und Landnutzungsforschung* (ZALF)) (lowland), the Environmental Research Centre Leipzig-Halle (*Umweltforschungszentrum Leipzig-Halle* (UFZ)) (Loess region), and the Technical University Dresden

(mountain areas) focus particularly on cause-effect relations between chemical washout into waters and their causes, in order to develop regionally adapted land use scenarios. To ensure that research findings will be transferred into practicable action concepts, the analyses cover not only the ecological impacts but also socio-economic consequences of land use changes.

3.3.4 Pooling the research results

Development concepts for large riverscapes, which consider the river with its floodplains and its catchment as a functional entity, are available only in first drafts both on national and international levels. Through the conceptual approach in Elbe-Ecology research, the individual projects produce results which may be pooled together to achieve a comprehensive river-basin management that is also demanded by the new European Water Framework Directive. In addition to these demands measures of a sustainable development of the Elbe River basin are evaluated by the Technical University Berlin under economic aspects using methods like the contingent valuation (CV).

Because of the numerous interactions between the compartments of the riverscape, complex systems are needed for the holistic assessment of the ecological situation of flowing waters, their floodplains, and catchments. These assessment systems are closely related with the development of ecologically based idealised concepts (*Leitbilder*) and practicable development objectives for the Elbe riverscape, based on the pooling of the (partial) results of the different projects. The results of the research will be brought together after completion of the projects in form of a handbook "Elbe Ecology" and edited for different users. Moreover, modern media like internet and CD-ROM will be used to open the findings to the public. Furthermore it is planned to bring together the results of the different research programmes (Project Elbe, Elbe 2000 and Elbe-Ecology) in a complex Decision Support System (DSS). In a DSS a structured approach towards river basin management is combined with eminent information technology, leading to an instrument that facilitates the processing, analysis and presentation of information to support the policy making process.

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