measuring station has mostly practical reasons. The location of the selected site is situated in the near of the meteorological station of Tribsees. A first investigation at PROWATER start has indicated that the contents of available P (ammonium-acetate-lactate extractable = AL-P) varied according to land use and peat degradation. They ranged from 20 mg kg^{-1} soil at the natural site (Eichenthal I) to 68 mg kg^{-1} soil at the strongly degraded site (Langsdorf). Total P concentrations in the surface water of the ditches and the river Trebel were between 0.12 and 1.47 mg l^{-1}.

Equipment and measurement programme

The site at Langsdorf has been already equipped with an automated field research station and groundwater dip wells (see 2.3). According to soil stratification the soil sampling was be carried out at 5 different depths (0.00-0.10, 0.10-0.25, 0.25-0.50, 0.50-0.65 and 0.65-0.90 m). Water were taken from soil (suction cups), groundwater (pipe) and surface water.

2.2.4 The Droemling Nature Reserve (Germany)

Geographical and geological setting

The Droemling is the largest fen area in Saxony-Anhalt, Germany. The Saalian glaciation pre-formed the landscape of the Droemling. The sand cover of a glacial valley was eroded and extended trenches and hollows were formed. In the Weichselian glaciation the area was also an extended river valley systems. After ice melting 10,000 to 8,000 years ago the glacial forms were filled with water. Loamy, clayey and organic sediment was deposited in the shallow lake. Today, the Droemling is a Holocene lowland landscape with a size of ca. 320 km^2 situated in North-east Germany (Figure 2.5). Settlements are generally situated in outlying area of the fen on higher ground (relicts of ice-age sand horst's).

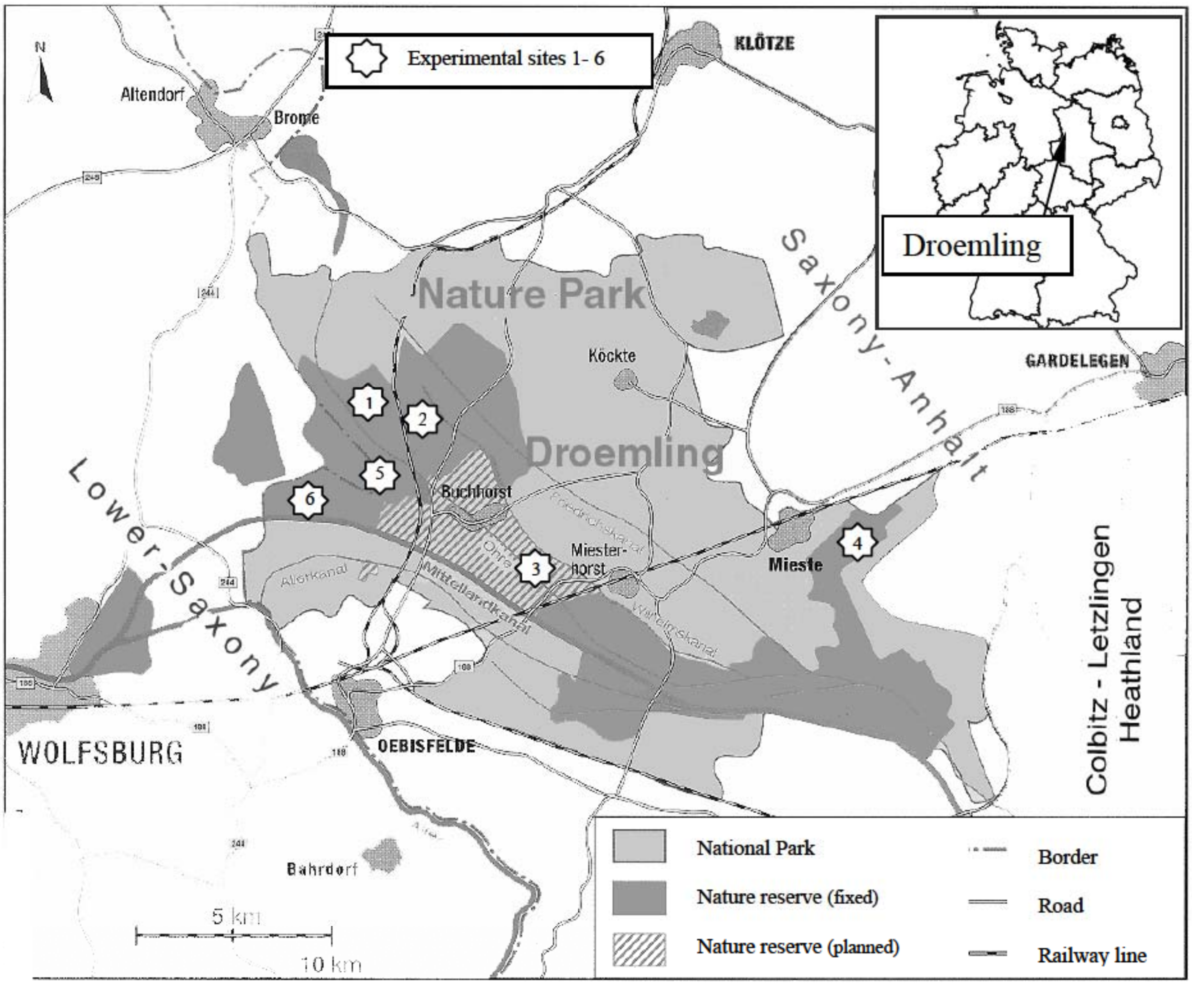

Figure 2.5 Map of Droemling Nature Reserve in Saxony-Anhalt, Germany

Hydrological and meteorological characteristics

The mean annual rainfall is about 600 mm. The estimated evapotranspiration ranges from 520 mm from the surrounding higher situated areas to at least 660 mm in the central parts. Thus, the fen sites of the central Droemling can have a negative water balance, because evaporation can exceed precipitation. The Droemling fens were first drained around 1750 by a system of channels and ditches for cultivation. The drainage system was continuously extended. Up to 1990 huge cultivation projects were carried out, e.g. the Weser-Elbe-waterway and several pumping stations for permanent drainage of the area. Drainage was followed by a permanent increase in land use intensity up to the early 1990s. The consequence of this intensive agricultural use was to reduce the peat thickness from 2–3 m in 1750 to 0.4–0.6 m in 1995 (ALTERMANN & REFIOR, 1997). The soils of the degraded fens contain only relict amounts of peat as a result of 200 years of agricultural use. The soil containing a peat layer are classified as Histosols. They cover about 36% of the Droemling.

Soils at stronger degraded sites surrounding the Histosols are classified as Mollic Gleysols.

Land use and associated conflicts and concerns

The Droemling is an important agricultural, recreational, and drinking water supply area. Up to the early 1990's the Droemling was intensively farmed. Intensive livestock farming (dairy cattle and beef) with highly fertilized meadows and grassland was characteristic for the central part of the Droemling. The degraded fen sites and the surroundings were intensively tilled and used for arable crops (rye, barley, corn, oil-seed rape) with high fertilizer input.

Land use changes were initiated with the establishment of the nature park in 1990 and a nature reserve area (280 km^2). Intensive cultivation was converted into extensive (unimproved) forms of pasture and arable. Land use changes were accompanied by raising ground water tables according to the demands of breeding wader birds and peat conservation. In selected parts of the central Droemling intensively used grassland was converted into natural succession including the re-wetting of the remaining peats.

The German government encourages farmers to manage their fields and meadows according to the requirements of nature conservation. Financial incentives were offered for a land-management compatible with the conservation of landscapes and wildlife species. As a further action, the government of Saxony-Anhalt purchased land in sensitive areas to ensure nature protection. Traditional intensive agriculture was hindered by the measures of re-wetting and nature conservation. Furthermore, farmers were afraid because they expect deteriorating grassland quality as a result of the conservation measures. The re-wetting of selected patches was discussed controversially in the northern part of the Droemling. Some inhabitants used the argument that flooding frequently damages cellars in settlements. However, these effects are insignificant. These are several other reasons for some still existing conflicts between farmers and the nature reserve authority.

The Droemling region is one of the most important water protection areas of Saxony-Anhalt, because about 50% of the amount of water used for artificial groundwater recharge in the "Colbitz" water plant originates from the Droemling. Ground water of this region is cleaned for potable water supply of the Magdeburg urban area with its 400,000 inhabitants. Hence, aspects of surface water quality are of special interest in the Droemling.

Lacking natural precipitation especially during summer poses a potential threat to water quantity and quality. In both drained and re-wetted areas the ground water table decreases and the peat layer becomes aerated. Especially under such changeable conditions (switches from waterlogged to aerated conditions) the potential for P mobilisation may be increased. Negative effects on the surface water quality due to increased concentrations P and dissolved organic matter (DOM) must be expected.

Selection of experimental sites

In accordance with the Droemling nature park authority, six sites representing the present day patchwork of land use were selected:

Site 1: Long-term intensive crop farming with high fertilizer input (mineral soil)

Site 2: Long-term intensive grassland farming with high fertilizer input (mineral soil)

Site 3: Change in land use from long-term intensive crop farming to an unimproved grassland (mineral soil)

Site 4: Unimproved grassland (extensive grassland farming with low input) (organic soil)

Site 5: Natural succession of intensively used grassland with a raising groundwater table (organic soil)

Site 6: Alder forest (organic soil) (see Figure 2.5).

The first study was started immediately before initiation of the land use change at site 3 in 1996. Site 5 was left unimproved and re-wetted since 1993. According to the objectives of PROWATER the investigations were focussed on sites 4, 5 and 6 with organic soils. For comparison selected results from sites 1 to 3 will be also included and discussed in the present study.

Previous research

Relevant investigations started in the early 1990s. They have shown the peat oxidation and other significant changes in soil structure, and the eutrophication of drainage water. It was concluded that there is an urgent need to raise ground water tables for fen conservation. On the other hand, water balance calculations have shown that there is insufficient water for the re-wetting of the whole Droemling fen area. Therefore, the re-wetting of Histosols is realistic only for selected areas with an existing water regulation system (with sluices to hold back drainage water). The effects of changes in land use and an increase in groundwater table on N, P and soil organic matter in soil, soil solution, and groundwater at six differently used sites were investigated in the first stage of the Droemling project financed by the Ministry for Regional Planning and Environment of Saxony-Anhalt (1995 – 1998). Changes in land use from intensive crop production to unimproved pasture reduced N and P leaching from soil into groundwater. The alder forest results in much higher inorganic N and DOC contents in soil and water than grassland because of more enhanced degradation of the peat layer under this forest. Increasing groundwater tables partly decreased mineral nitrogen content of the topsoil, however peat decomposition continued due to deep water tables in summer. These deep summer water tables caused high mineralization peaks followed by temporarily high nitrate contents in groundwater at sites with an existing peat layer. Higher water tables increased P and C contents in the groundwater due to a decreased redox potential, which increased P solubility, and intensified leaching of DOM from the peat. Probably, varying moisture conditions (low water tables in summer and higher ones in winter), especially pronounced at the alder forest site, were additional reasons for high P and DOC concentrations in seepage and groundwater.

Equipment and measuring programme

The sites were equipped with automated field research station and dip wells (see 2.3).

2.2.5 The Biebrza River Valley Basin (Poland)

Geographical and geological setting

The Biebrza Wetlands lie in the Northeast of Poland in an extensive ice-marginal basin, the Valley of the Biebrza River, some 195,000 ha in area (Figure 2.6). The Biebrza Valley area has a low population, lack of industry and extensive agriculture. As a consequence, these areas remained in the natural state, constituting the greatest swampy complex in the Central Europe. The wetlands occupy an area of 116,000 ha, some 60 % of the total area. The Biebrza features several types of mire. The dominant type is fen, which accounts for some 76 % of the wetland area. The waterlogged organic-mineral areas occupy 19 % and organic marshes 4 %; remaining wetlands are alluvial mineral marshes. The geological structure of the area is poorly understood. Some isolated bore-holes show mainly tertiary rocks between 80 to 100 m thick. The first water layer is built from sand with an infiltration coefficient from 1 to 20 m d^{-1}. Its thickness is 15 to 25 m.

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