Water Friendly Farming in Leipzig's Water Protection Zones

Cooperation, precautionary drinking water protection, organic farming

Lowering Nitrate Content

Groundwater monitoring station in the Canitz/Thallwitz protection zone

*The **Leipzig Municipal Waterworks GmbH** (KWL) provides some 600,000 people in Leipzig and the administrative district Leipziger Land with drinking water from catchments with intensive farming. The KWL pursues a dual strategy to reduce **nitrate pollution in raw water** long-term to 25 mg/l: first, the agricultural management of the **Canitz Water Estate** was converted to **organic farming** in 1992. The estate is a subsidiary of KWL and comprises approximately 800 hectares of arable and grassland, which the city of Leipzig acquired in 1907. Second, an **area-based protection plan for farmland** in the water protection zone is implemented through **contracts between KWL and local farmers**. This gives the economic incentive for conventional farms to be water-friendly.*

Area

In the ice-age brash of the glacial Mulde Valley are the most important groundwater resources near Leipzig. This source has been used for drinking water since 1912. The Canitz Water Works provides one third of the water supplied by the Leipzig Municipal Waterworks (KWL). The **water protection zone of Canitz / Thallwitz** is located approximately 30 km east of Leipzig in the valley of the Vereinigte Mulde (Tal der Vereinigten Mulde) between the towns of Wurzen and Eilenburg. It covers approximately 5,000 hectares of which almost 80 % is used for agriculture. KWL operates the two largest of its four major waterworks here. Groundwater is only protected to a minor degree by the top soillayer.

River basin district and state: Elbe; Saxony
Coordination zone: Mulde-Elbe-Schwarze Elster
Name of groundwater body: Vereinigte Mulde
Classification within the river basin and state analysis: „not at risk", however, given the proven nitrate loads the representativeness of the monitoring station is questionable; revaluation at the end of 2007.
Critical load factors and impacts: nitrate losses from agriculture, pastly due to low geological groundwater protection

Reason / Cause

The intensive agricultural use (arable farming, pig breeding) in the wider drinking water protection zones II and III around the Canitz and Thallwitz Waterworks led to **rising nitrate levels in raw water**: in the 1970s at times greater than 45 mg/l. In the 1990s, levels over 150 mg/l were detected in the aquifer itself (drinking water limit: 50 mg/l after WFD and Drinking Water Ordinance). Continuation of this trend would have made costly water treatment necessary.

Objective

The aim is to reduce the **nitrate content in raw water to 25 mg/l**.

Measures

1. The conversion of the Canitz Water Estate to organic farming:
The conversion was decided in 1991 by the KWL to prevent further agricultural pollution of groundwater. The central measures of preventive groundwater protection – as part of the organic land management of the area – are full-year land cover by a crop rotation on seven fields with legumes, cereals, root crops and feed crop as well as catch crops, the renunciation of mineral N-fertilizers and synthetic pesticides, as well as a significant reduction of stocking rate to less than 0.2 livestock units per hectare. The conversion was reinforced by actions in marketing as well as through advice and scientific backing (see below) to secure the KWL long term earnings.

2. Area-based protection plan for farmland in the KWL drinking water protection zone:
The concept includes protection requirements differentiated after hydrogeological, local and farm-type elements, and compensation payments (see box). The targets are reached **through contracts with local farmers**. In areas crucial for waterextraction five agricultural enterprises farm organically on circa 990 hectares. On a further 2,170 hectares of important catchment area, agreements limit the permitted N-balance; under-usage are rewarded. The basis is a study on the **implementation of a compensation claim for agriculture** from 2002. In Saxony the compensation obligation for land use restrictions in the water protection zones has been the responsibility of water utilities in Saxony since 2002.

Actors / Procedure

As early as 1907, the city of Leipzig acquired about 800 hectares in the catchment area of the planned Canitz/Thallwitz Waterworks in order to influence local land use. While the land had been intensely cultivated by different legal entities after 1945, land rights were retransferred to the city after 1990. A city council decision in 1991 gave the Waterworks the contract of agency for the Canitz Estate. The conversion to organic farming started in 1992 and was concluded in 1994 (initially under Gäa certification, since 2004 under the Bioland certification). At the end of 1994, the Canitz Water Estate GmbH was founded as a wholly owned subsidiary of the KWL.

Area-based protection plan for farmland in Leipzig Waterworks (KWL) Water Protection Zones

1. Organically farmed land Protection Zone II 5 Enterprises (contracts)	ca. 990 ha
2. Limit of the N-balance surplus Parts of Zone IIIA resp. III 7 Enterprises (contracts)	ca. 2,170 ha
3. Compensation Scheme (SächsSchaAVO) Parts of Zone IIIA resp. III as well as IIIB and IV 26 Enterprises, 12 of which with contracts	ca. 6,050 ha

Results / Assessment

The success of the project is based on the two-pronged approach of the Leipzig Waterworks, grounded in the **goal-oriented adapted land management**. On the basis of balance-related substance flow analysis (hydrogeological PC workstation), control of land use through agreements with local farmers is possible. This has resulted in a reduction of the nitrate concentration in raw water from 40 mg/l to an average of 24 mg/l.

The heart of the project formes the Canitz Water Estate: The **assurance of clean groundwater recharge** is the first operational objective of the GmbH. In the University of Halle/ Wittenberg project „Optimization of organic farming with the goal of securing long-term raw water quality", management-related nitrate leackage potential was identified (see box). The fall nitrogen stocks in the soil zone from 0 to 90 cm decreased from 100 kg of available mineral nitrogen (Nmin) per hectare to 30 to 40 kg per hectare. Scenario calculations aid further adaptation of organic farming methods with the objective of drinking water pollution control.

Organic farming enables **water protection-oriented, yet profitable farming** (price superiority of products, the use of funds for agri-environment schemes), follows an **established comprehensive body of legislation** and offers the advantage of a small-scale control effort for water utilities.

Ratios of N-balance on Canitz Water Estate lands, comparing the annual average (in kg N per ha of agricultural land)
(Jäger et al., 2004)

time period	1981-1990	1994-2004
nitrogen removal		
N-deprivation	140,3	111,7
yield	125,7	83,8
nitrogen influx	**205,5**	**105,4**
N-input mineral fertilizer	80,9	0
N-input organic fertilizer	59,1	9,4
there of manure	4,9	0
symbiotic N-fixation	18,6	35,8
N-input straw and green manures	14,6	27,9
N-immission	30	30
N-input seeds and seedlings	2,3	2,3
balance		
N-balance (soil balance)	**51,4**	**-2,5**
change in soil nitrogen content	13,7	-3,8
losses (related to plot)		
ammonia losses from organic fertilizer	5,8	0,1
denitrification losses	27,6	5,1
nitrate leaching	41,4	7,6

Crucial, according to Jäger et al. (2004), is not organic farming per se, but a **water-protection-oriented management** with catch crop cultivation, adapted cropping patterns and production processes as well as relatively low amount of livestock. Conventional agriculture can also be water protection oriented, but under the agricultural policy and economic conditions this succeeds only in some farms.

Costs / Financing

Since 2002, the KWL have settled the **statutory compensation payments** for changes of land-use practices in their water protection zones (based on SächsSchAVO). The since developed cooperative, goal-oriented water-law compensation scheme manages compared to the previous, rather general compensation by the state of Saxony, with significantly lesser financial burden and no additional prohibitions.

In addition, during the phase of conversion to organic farming, the KWL balanced loss of income in the form of area-based compensatory payments to the effected (external) companies. KWL calculations show that these expenses were **about seven times lower than the cost for technical treatment of drinking water**, which would have taken an investment of 19 million euros.

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Literature / Links

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