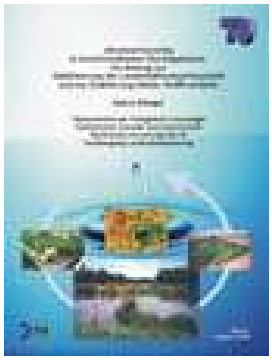
Recycling of waste water in cultivated wetlands - abstract

Nature is a dynamic process, which leads to sustainable ecosystems as long as the development is untouched by mankind. Our society is basicly depending on a "working landscape", delivering food and drinking water of high quality as well as on its creating balanced local and regional climate. The sustainability of these natural functions is the basis for our own future, even if the massive use of fossile energy sources (e.g. for globale transport of food) implicates the illusion of a society without frontiers, given by nature.
It is necessery to use a holistic approach for understanding the basic processes in nature. The Energy-Transport-Reaction-Model (ETR), developed by Prof. Dr. Ripl, explains these processes, driven by the energy pulse sun $\Rightarrow$ earth, with its daily and annual variation. The vegetation on earth and open water areals work as a buffer for the incoming energy pulse by evaporation of water (day) and condensation (by night), on a lower scale also by photosynthesis and growing of biomass. Explained as a thermodynamic system, ecosystems balance the variation of the energy flow, which is at the same time the basis for their own existence.
The more perfect ecosystems are structurized, the more they are able to balance the energy flow. That is indicated by balanced surface temperatures, local water cycles and minimized matter losses. This "sustainability" is a result of the development of ecosystems, understood as thermodynamic systems; it can be described as the "inner logic of nature".
In Central Europe, landscape developed after the last glacial period to a balanced system, dominated by forests and wetlands (e.g. north east germany: over 90% forest in the 6th century, BORK et al. 1998), characterized by minimized losses of minerals and nutrients (RIPL 1995).
The growth of human civilization in Europe was based on the use of wood and the "cultivation" of land for dry agricultural methods and lead to a devegetation with a first culmination point in the 13th century (minimum of forest areals = 20%, BORK et al. 1998). This change of landscape caused higher matter losses by erosion and chemical degradation of the upper soils (outwashing of Ca, K, Mg, mineralisation of organic substances). On the other hand the changes in the continental water cycle caused increased climatic extremes like droughts and storm waters.
The areal of forests stabilized again at a level of 30-35% in the 19th and 20th century. At the same time, farmers and engineers began with the last step of "cultivation", the so-called "melioration" (draining of the landscape), in lowlands and former moors, forced by society (financial help e.g. in West Germany from 1956-1987 for draining of over 10,000 km² land, KAHLENBORN & KRAEMER 1999). From this time, especially the 1950s – 1970s, the local water cycle was deeply disturbed. In the federal states of Brandenburg and Mecklenburg-Vorpommern over 5,200 km² of moors were drained. Today, the loss of basic cations is about 880,000 tons per year in the catchment area of the Havel river in Brandenburg. This is a increase by 50-100 times, compared with sustainable nature systems (RIPL 1995).
This "melioration" caused, together with global climate changes, a dramatic fall of rain volume in the summer months, leading to irreversible damages in the "rest"-vegetation, especially in the north-eastern German landscape (e.g. Uckermark in north Brandenburg). In the last 30 years, the probability of summer-droughts increased by factor five! In summer, the average precipation decreased by 10-15%.

High irreversible matter losses, a dramatic decrease of vegetation cover, increased probability of droughts – all these factors are typical for a desertification process in the landscape, caused by an agriculture and water management, which destroyed the self-optimizing processes in nature instead of using them. We are now at a point of change. The conventional agriculture needs to be changed into a sustainable one, which has to minimize matter losses and to take care of a solid local water cycle for the generation of a balanced climate on the european continent.
Cultivated wetlands are one part of a sustainable landscape. They work as a matter sink and thereby make possible the retention of matter losses from agricultural areas (retention of N: 0,6 – 1 ton per ha; P: 40 – 80 kg per ha). At the same time they are of great importance as high-evaporation-zones for the creation of a balanced local climate (evaporation up to 1400 mm per year; precipitation in East Germany: 500-600 mm). Wetlands can in addition be used as retention zones for storm water. There is a lot of possibilities for using the wetland biomass. Especially reed (*phragmitis spec.*) can be cultivated and used as a regenerative energy source. The production of biomass can be expected between 8 and 12 tons per ha in East Germany. The production costs have been calculated with 50-60 DM per ton.
The use of cultivated wetlands for recycling of nutrients from communal waste water is a promising experiment which offers economic advantages for both farmers and little villages. The linear waste water system in Brandenburg leads today to matter losses of e.g. 13,000 t N and 2,500 t P per year. This system is expensive (up to 18 DM per m³ water) and not sustainable. Building up waste water wetlands could be the first step towards a sustainable landscape, followed by riverine wetlands.
The concept „landscape of the future" proposes to give an example for planning the development of landscapes. The project for a little village in north Brandenburg (900 inhabitants) combines a waste water recycling wetland of 5 ha with about 20 ha cultivated wetlands in a lowland near the village. Both are designed for the production of reed which will be used as an energy source on the reconstructed estate in the village center. Another areal of 20 ha will be designed as an example for sustainable agriculture. It is planned to test new and old "forgotten" methods of agriculture, eg. "Raised Fields", Agroforestry, Conture Strip Farming. On the other hand it is a place to test new plants and their characteristics, like the use of *Elodea canadensis, Lemna minor*. The project is planned in cooperation with local partners and will work as an local Agenda-21-project.



BÜNGER, M. (2000): Abwasserrecycling in bewirtschafteten Feuchtgebieten. Ein Beitrag zur Stabilisierung des Landschaftswasserhaushalts und zur Etablierung lokaler Stoffkreisläufe. Diplomarbeit am Fachgebiet Limnologie, Institut für Ökologie und Biologie, Fachbereich „Umwelt und Gesellschaft" Technische Universität Berlin; eingereicht am 14.08.2000; Note: 1,0 [56 Abbildungen, 27 Tabellen]
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