Recovery of the Lakes in Central Switzerland: Programme based on Article 62a Water Protection Act
Lessons learned by the federal agencies

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Situation of the “Midland” lakes today

Considerably improved conditions
Lake Sempach and Lake Baldegg < 30 mg P / m³ water
→ Measures within the lake (aeration, assisted circulation)
→ Agricultural measures
→ Prohibition of P in laundry detergents, removal of P in sewage treatment plants since the late 1980s.
→ Other reasons?
Contents

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1. Rehabilitation programme according to Art. 62a Water Protection Act

Article 62a Water Protection Act (1999):
Swiss Confederation may provide financial support for cantonal rehabilitation projects

Requirements:

a) Measures are necessary (existing pollution)
b) Inclusion in a rehabilitation programme
c) Measures are not economically feasible
1. Cornerstone of implementation

- Financial support by the Swiss Confederation: max. 80% of the costs
- Swiss Confederation sets guidelines
- Flexibility for the cantons in choosing the measures
- Duration of the projects: unlimited, periods of 6 years
- Achievement of objectives: during the first two periods (12 years)
- Payments only for measures that help achieve the objective
  - Changes in the structure of farms
  - Technical measures (e.g. direct seeding)
  - Production measures (e.g. natural meadows)
1. Federal financial contribution

Financial contributions to the cantons:

• Coaching: 50 %, max. 20,000 SFr for project planning
• Basic procurement: 30 % of the allowable costs (Art. 64 of the Water Protection Act) for the determination of \( Z_u \), delimitation of the project area, simulation of nitrate leaching etc.

Financial contributions the farmers:

• Max. 80 % of the allowable costs, depending on the characteristics of the substance, the planned reduction and the measures chosen
## Current projects according to Art. 62a Water Protection Act

<table>
<thead>
<tr>
<th>Number of projects</th>
<th>Area affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate projects</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>4,725 hectares</td>
</tr>
<tr>
<td>Phosphorus projects</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>14,007 hectares</td>
</tr>
<tr>
<td>Projects on plant protection products</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2,452 hectares</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
</tr>
<tr>
<td></td>
<td><strong>21,184 hectares</strong></td>
</tr>
</tbody>
</table>

| Total cost of all projects (paid and authorised) | 67 million SFr |
| Costs for the Confederation (78%) | 52 million SFr |
| Total cost of P projects | 45 million SFr |
Overview of the phosphorus situation
3 Lakes – 3 rehabilitation projects

Lake Hallwil
project area: 3786 ha
initially: 50 mg P/m³ - objective: 20 mg P/m³
project started: 2001

Lake Baldegg
Project area: 5600 ha
initially: 100 mg P/m³ - objective: 30 mg P/m³
project started: 2000

Lake Sempach
Project area: 4621 ha
initially: 40 mg P/m³ - objective: 20 mg P/m³
project started: 1999
Requirements regarding phosphorus

Requirements for standing water-bodies according to Appendix 2 of the Ordinance on Water Protection:

- No numerical requirements for P
- Requirements concerning water quality, such as:
  - the nutrient content must only allow a medium production of biomass; special natural relationships are reserved
  - no low oxygen conditions and no unfavourable pH value
- The oxygen content of the water must at no time and at no depth within the lake be less than 4 mg/l O₂

Objective in projects according to Art. 62a Water Protection Act

Phosphorus content less than 20 mg/m³ in thoroughly mixed free water

*However: this target value depends on the properties of each lake.*
Measures

- Buffer strips (at least 5m)
- Retention ponds
- Nutrient balance-sheet ≤ 100%
  Max. P output / year
- Direct seeding
- no winter fallow period
- soil analyses
- good timing of manure application
- adjustment of crop rotation
- structural adjustments
- further training
Measures and contributions

- **Lake contract** *(packet of measures)* 300 SFr / ha
- **Reduction in P use** *(< 100 %)* 15 SFr / kg of $P_2O_5$ not applied
- **Direct seeding** *(e.g. maize)* 300 SFr / ha
- **Mulching** *(potatoes)* 400 SFr / ha
- **Buffer strips** 900 SFr / ha
- **Erosion protection strips** 2,000 SFr / ha
- **Reduction in animals** *(pigs, poultry)* individual contribution
- **Areas of non-intensive use** 900 SFr *(valley)*
  1,200 SFr *(pre-Alps)*
- **Structural adjustments** structural costs
- **Retention ponds** construction costs
- **Innovative projects** 5,000 to 20,000 SFr
Changes in P concentration (Lake Baldegg)

Beginning of project
Changes in P concentration (Lake Sempach)

Mittlere Phosphorkonzentration im Sempachersee
1980 - 2009

- mittlere Phosphorkonzentration in mg/m³
- Ziel: weniger als 30 mg/m³ Phosphor im ganzen Wasserkörper

Phosphorkonzentration während der Winterzirkulation 26 mg P/m³
Achievement of objectives - agriculture

Legal framework provisions apply pressure:

- P Ordinance of the Canton of Lucerne; in force since 24.09.02 through intervention of Confederation → fulfilment of contract demanded
- FOAG mandate 2005: Baldegg + Sempach; 2006: Hallwil (with binding objectives and intermediate objectives of 20 or 30 mg P/l)
- Number 2.1 of Direct Payment Ordinance since 2007: Farms in a catchment area from which nutrients are removed must only fertilise with phosphorus in accordance to the soil → 80 % of requirement for D and E types of land
  - Condition without compensation
Achievement of objectives - agriculture

+ Implementation goals of project achieved by agriculture
+ Measures are to be considered as effective
+ “P reduction” in soils underway
+ Optimum achieved by “voluntary” participation
  – Increased number of animals despite P Ordinance
  – Accumulation in soil remains high

➤ Measures to reduce livestock density in lake catchment areas
➤ High P supply to soils continues in part;
➤ potential loss of P
➤ Farms have (still) carried out little structural adjustment
Decrease in algal-available P

Klima unabhängige Modellrechnung für die Einträge von algenwirksamem Phosphor in den Sempachersee aus dem gesamten Seeziegungsgebiet 1986 bis 2006
Median der Jahresabflüsse = Standardabflussjahr = 1990

- bodenbürstiger Phosphor
- Ziel P-Eintrag weniger als 4.7 t/Jahr
- Linear (bodenbürstiger Phosphor)
Lessons learned Nottwil

Soil related P input and water flow
Achievement of objectives - water protection

+ Concentrations of $P_{\text{total}}$ reach historic lows
+ Objective reached surprisingly quickly
  – Natural spawning of whitefish is not yet possible

- What are the reasons?
- What would happen if no measures were taken within the lakes? (aeration, induced circulation)
- Correlation between P content and amount of inflow
- What is the effect of sediment input on the P balance-sheet?
- Other aspects
Uncertain interpretation

- Basic principles of the project: pessimistic assessment
- Particulate P is increasing
- Dissolved P is decreasing
- Total P in lakewater is falling

- How great is the error in the calculation of loading?
- Is more P being stored in the sediments? Why?
- Does assisted circulation play a part (e.g. more P in the outflow, improvement of the balance-sheet)?
- Increased inflow quantity correlated with particulate P?
Conclusions

- The lakes are becoming increasingly healthy
- The canton and farmers are making a big contribution
- Rehabilitation programmes are showing effects
- Awareness of farmers is increasing
- Big “investments” are necessary
- Necessity of political conviction at all levels
- Unanswered questions: task for research
- In future, structural measures are necessary
Thank you for your attention

With a joint effort by those involved in agriculture, water protection, spatial planning and politics, the objective will be achieved!