REESTABLISHING OF LAKES

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Description
Lakes are areas being permanently covered with standing water and consist of both open water areas and the shallow lake shore zone with higher vegetation (e.g. Phragmites). Very small lakes with an area below 1,000 m^2 are named ponds. If new lakes or ponds are created where they were placed before being drained away we are working with reestablishing of lakes.

Rationale, mechanism of action
An important aim with reestablishing former drained lakes is to increase the retention potential for nutrients in order to reduce the loading to downstream water bodies. Another aim is to improve the biodiversity and recreational value of surface waters.

Applicability
The phosphorus loading of lakes is in the form of dissolved or particulate P. Particulate P will be deposited in lakes due to sedimentation, whereas part of the dissolved inorganic P will be taken up by the biomass of phytoplankton or macrophytes produced in the lake [1]. Higher trophic levels in the lake (zooplankton and fish) can build in part of dissolved inorganic P and part of the P will deposit in the lake sediments as organic P or inorganic P. Sooner or later part of the deposited particulate P will be released from the lake sediments due to desorption processes or mineralization of organic material. Another part of the deposited P will be unavailable and will permanently immobilized. The amount of P re-circulated and immobilized depends on local conditions in the catchment and lake being dependent on factors such as: i) periods of anaerobic conditions in lake sediments; ii) ratio of iron to P in sediments; iii) residence time of water in lakes; iv) depth of lake; inlet P concentration, etc. [2].

Reestablisment of lakes will totally increase the retention of phosphorus and nitrogen as lakes naturally in a steady state condition (constant nutrient loading) will retain nutrients. The most important factor for nutrient retention in lakes is the residence time for water in the lake – the higher residence time the greater the retention of nutrients [2,3,4]. The retention of nutrients is also dependent on the amount of nutrients delivered to the lake. Clear water lakes have proven better in retaining nutrients than turbid lakes possibly due to more macrophytes and oxygen in the clear water lakes than in the turbid and eutrophicated ones. Clear water lakes will also have a larger recreational and natural value than eutrophicated and turbid lakes.

Effectiveness, including certainty
Knowledge on the retention of nutrients in lakes builds on many years of mass-balances for a great number of different lake types and many different empirical models have been developed [2,5,6,7]. The nutrient retention varies both intra- and inter-annually as well as from lake to lake depending on nutrient loading, water residence time, lake depth, eutrophication state, etc. Danish evidence on the efficiency of reestablished lakes is given in [7]. The monitoring of these reestablished lakes show a retention of total N amounting to between 100 to 250 kg N per hectare per year and a retention of total P amounting to 1-3 kg P per hectare per year.

Time frame

In principle a reestablished lake will start to retain nutrients from the onset. However, a period with net release of P from the former rewetted soils can occur if they contain high amounts of 'old' agricultural P and are low in iron content [6]. Another factor that may be important is a release of P from the former terrestrial vegetation and a hydrolysis of easily decomposable organic matter in the buried soils under water in the new reestablished lake. On a longer time scale the reestablished lakes will retain nutrients like natural lakes and the retention potential for nitrogen and phosphorus can be calculated from lake nutrient models [2].

Environmental side effects
Reestablished lakes will generally increase the biodiversity of the area and will often have a large stand of birds which are of great recreational value.

Relevance, potential for targeting, administrative handling, control
Reestablished lakes will increase the recreational value of an area and this will often show up in increased pricing of the houses and land area lying down to the lake. Management will not be needed in reestablished larger lakes above a certain minimum size, whereas smaller lakes as ponds may need management in the form of excavation of bottom sediments to prevent that the pond disappear due to sedimentation.

Costs: investments, labor
The costs of this option relates to the costs of: (1) establishing the project proposal, (2) getting hold of the land, (3) reestablishing of the lake and (4) possible maintenance, etc.

References

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