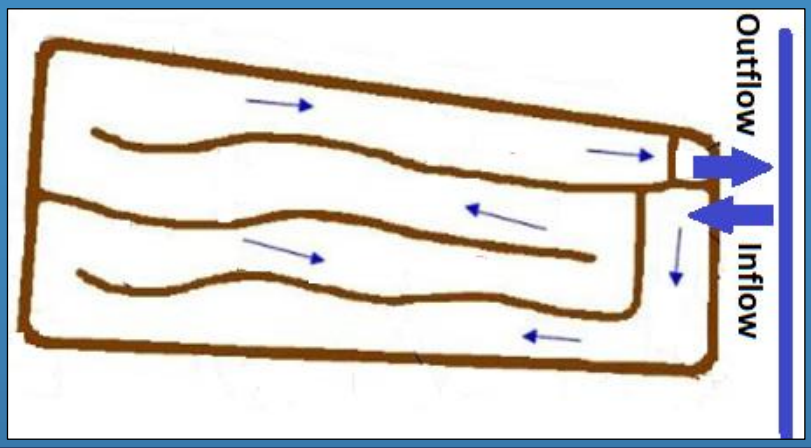
FACTSHEET

FARM CONSTRUCTED WETLANDS FOR WATER RETENTION



Key information

A Farm Constructed Wetland provides temporary water storage and can be used to provide water for irrigation. As it can retain water, it can also be used to lower flow peaks.

Target audience: farmers, general public.

This project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement No 858735.

A. Brief Introduction:

Farm Constructed Wetlands (FCW) is a type of Nature Based Solution (NBS) which can be used for retaining and reducing nutrient concentrations in water affected by agriculture. The aspect of nutrient retention is covered in a separate factsheet.

For water retention, runoff waters are directed to the wetland and this water can be used later for irrigation when needed. The FCW can provide temporary storage during intensive rain events, which may reduce flood peaks and associated downstream problems. Additionally, during the storage, water infiltrates into the ground and therefore it can increase water content of the surrounding areas and contribute to groundwater recharge.

The innovative aspect of FCW for water retention is, in comparison with tanks or pumping of groundwater, the fact that it is an NBS which also provides a number of ecosystem services as beneficial side effects, and that it can deal with variable flows typical of agricultural drainage water.

The wetland can be designed in different ways depending on local conditions and the relevant objectives for the specific case/farm. However, it should be noted that wetlands for water retention would normally be Free Water Surface (FWS) wetlands.

B. Design concept:

FCW should be designed based on a) the irrigation needs and b) an estimation of economically optimal size, i.e. volume considering:

a) the irrigation needs depend on the crops grown in the farm and the typical maximum water deficit plus safety margin based on annual climate variations and the accepted risk level.
b) the optimal size depends on the one hand on costs of construction and operation of the wetland and on the other hand on crop prices and the increased yield.

These above considerations would lead to a design value of the volume (m^3) of the wetland.

From a water retention point of view, the actual design geometry (layout) of the wetland is of no relevance. However, there are usually constraints in the availability of land along with supplementary ecological and social objectives which affect the design.

C. Technical information:

The main requirement for construction of FCW is primarily accessible land, preferably with soil of lower quality so that it does not affect negatively agricultural production. Also there should be land nearby where the excavated soil can be moved. Part of this soil can be used in order to construct embankments of the system. The equipment needed is excavation machinery. A more detailed investigation and design is necessary to take into account local topography and the need for special structures at inlet and outlet. Especially, if water is to be retained for peak flow reduction, a basic structure for flow control should be included. If the inflow to the wetland is

expected to have a high load of coarse particles, it is beneficial to have a deeper settling area near the inlet, which will simplify sediment removal.

Operation and maintenance of the FCW would normally not require any manpower or skills more than what is available on a farm. The wetland will gradually fill with sediments which need removal depending on the amount of erosion. Also vegetation which grows in the wetland might need removal from time to time to allow sufficient water storage.

The **monitoring** of the FSW wetland could be kept at a minimum of checking the water level on a staff gauge. In order to have better control of actual water volumes stored, as well as inflow and outflow, recording gauges could be installed. Moreover, water level in the aquifer can be monitored through piezometers.

D. Costs and Benefits:

The **cost of construction** of a FWS wetland is dominated by the cost of excavation and transport of removed soil. On a farm it is normally possible to shift the soil within the property, and therefore the excavation costs dominate. Typical rough estimates for Sweden (2022) mention a cost of 100 00 – 200 000 SEK/ha. Subsidies (90%) can be received, see section E.

Cost of operation and maintenance are usually quite low. Depending on the design of inlet and outlet there will be no or only limited actions necessary to regulate the flow. Maintenance involves supervision of the dam structure and harvesting vegetation as necessary. In Sweden also these costs are subsidized at 5000 – 8000 SEK/ha.

The **farming benefits** of wetlands for water retention must be evaluated for each case, depending on climatic conditions as well as crop type and market situation. One important aspect of the decision process related to the investment in a wetland, is to consider the potential risk of drought based on climate change projections.

The **environmental consequences** of a constructed wetland are beneficial. It would normally contribute to increased biodiversity as well as retention of nutrients. In order to optimize these processes, the design has to include relevant aspects. See also the separate Factsheet on Farm Constructed Wetland for Nutrient Retention. Moreover, these systems become semi-natural after a certain period of time, meaning that flora and fauna start to regulate themselves and no interventions from that point of view are needed.

The **social consequences** of a constructed wetland are beneficial. It offers a variation in the landscape, a demonstration site that can be used for teaching or research activities, and a possibility for increased leisure activities. Depending on the accessibility of the land, these positive effects may affect the general public or the landowner only.

E. Challenges and opportunities

The potential **technical limitations** for FWS wetland are few. The main restriction concerns the soil type. If the soil has high hydraulic conductivity it will be necessary to line the wetland with an impermeable film to ensure water for irrigation. A small slope from the inlet towards the outlet point is necessary in order to enable water flow. These systems are usually long-term solutions and can be used for several decades.

The **legal requirements** vary from country to country. In Sweden the construction of an FWS wetland is considered to be a "water activity" (Swedish*: vattenverksamhet*). This requires a permit from the Environmental Court for wetlands with area > 5 ha, while for wetlands with area < 5 ha only a report to the County Board is required.

Sometimes it is possible to get **subsidies** for the construction of wetland. Also in this case procedures vary between countries. In Sweden it is possible to apply for construction or restoration of wetlands. Normally the subsidy would cover 90 % of the costs. At present (November, 2022) there are three programmes, which support wetlands. Swedish national funding is available from LONA (https://www.naturvardsverket.se/lona) or LOVA. Support from EU is funneled via the Swedish "*Landsbygdsprogrammet*". It should be noted that, in order to get subsidies in Sweden, it is necessary that the wetland is designed to fulfil some environmental objectives besides the retention of water.

Evidence-base for using wetlands for water retention is solid (TRL 9), and uncertainties are only related to local circumstances and the outcome of a cost-benefit analysis in the particular case.

F. Reference and demonstration:

The short video "Wetlands in the WATERAGRI Project – Lund University" gives an introduction to wetlands with a focus on nutrient reduction.
https://www.youtube.com/watch?v=TpemgfRuCaE

For more information see for example the European NWRM Platform.
http://nwrm.eu/measure/basins-and-ponds

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