# MTK's and SLC´s Water Programme

Towards a good status of waters

# GOOD AGRICULTURAL AND FORESTRY PRACTICES AS A BASIS FOR WATER PROTECTION

**Water protection is an integral part of responsible and sustainable Finnish agriculture and forestry. Agriculture – food production – and forestry depend on water, its hydrologic cycle, quantity and quality. According to the environmental "Ympäristöluotain" survey conducted by the Central Union of Agricultural Producers and Forest Owners (MTK) in 2020, more than 90% of farmers and forest owners named water protection as an important part of their activities.**

The state of Finnish waters is generally good. The condition of the water is monitored and classified on a regular basis. On the basis of data from 2012–2017, the ecological status of 83% of lakes (water bodies) and 66% of rivers (parts of rivers) is good or high. The worst situation regarding surface waters is in coastal waters, as only 5% of the investigated areas are in good condition and 64% are moderate.[1] More than 90% of groundwater areas are chemically and quantitatively in good condition.[2] The aim of water management is to improve the ecological and chemical status of surface waters, as well as the quantitative and chemical status of groundwater, and to prevent the state of water bodies from weakening.

The classification of the ecological status takes into account biological quality factors (such as plants and animals), as well as hydro-morphological (including water flow conditions) and physico-chemical factors, such as nitrogen and phosphorus. The chemical status of surface waters is classified on the basis of the presence of separately specified hazardous and harmful substances (such as heavy metals, plant protection products). In the classification of the quantitative status of groundwater, the impact of extraction and other human activities on the volume of groundwater is examined. The chemical classification focuses on the presence of separately defined substances that contaminate groundwater (such as nitrate, ammonium, plant protection products).

Many water protection measures are taken, but their positive impact on watercourses is often slow. In addition, reducing the discharge from agriculture and forestry to waters will be more challenging: nutrients accumulated in soil, the internal nutrient load of watercourses, as well as increased precipitation and rising temperatures as a result of climate change, will increase the need for water protection even further. Water protection measures must always be planned and implemented so as to maintain the production potential of fields and forests and ensure that they are cost effective.

The first agricultural water protection guidelines were published in 1978[3]. In 1988, MTK published, together with the Association of Agricultural Centres, a book called "Yhteinen ympäristömme – Tietoa suurimmista ympäristöhaitoista" (Our shared environment - Information on the greatest adverse environmental impact), which provides guidelines for agriculture and forestry to reduce the pollution of watercourses. SLC published the first environmental programme for water protection measures in 1990. Through Finland's EU membership, the EU Common Agricultural Policy (CAP) and its voluntary agri-environment scheme have had a significant impact on water protection in agriculture, as most farmers have implemented the programme. Focus shifted to the negative effects of forestry on watercourses in the 1980s. Roughly 90% of commercial forests have been certified[4], which means that good water protection practices are widely implemented.

# MINIMISING THE RISK OF DISCHARGE TO WATERS

**Water protection measures taken in agriculture and forestry aim to prevent the discharge of nutrients, soil particles and chemicals into surface water and groundwater.**

A large part of water pollution caused by human activities comes from agriculture and forestry. Of the total land area in Finland, 7.5% (2.3 million hectares) is used for farming, and around 86% (26.2 million hectares) is forestry land. Soil has been dried through drainage to ensure the productivity of arable land and increase forest growth. Roughly 60% of all fields are subsurface drained, and 25% have open ditches.[5] Of all forests, around 18% are forestry-drained peatlands.[6] In addition to drainage, measures affecting watercourse discharge in agriculture and forestry include fertilisation, tillage, and regeneration felling.

Finland is a divided country in many ways in terms of water protection. Eastern Finland is a lake-intensive area, while Western Finland and coastal areas are dominated by rivers. The proportion of peatlands increases towards the north, and the most clay-dominated areas are located in the south. The proportion of different land use types and production lines varies by region. In addition, landforms, precipitation and its timing, as well as measures taken in agriculture and forestry, have their own impact.

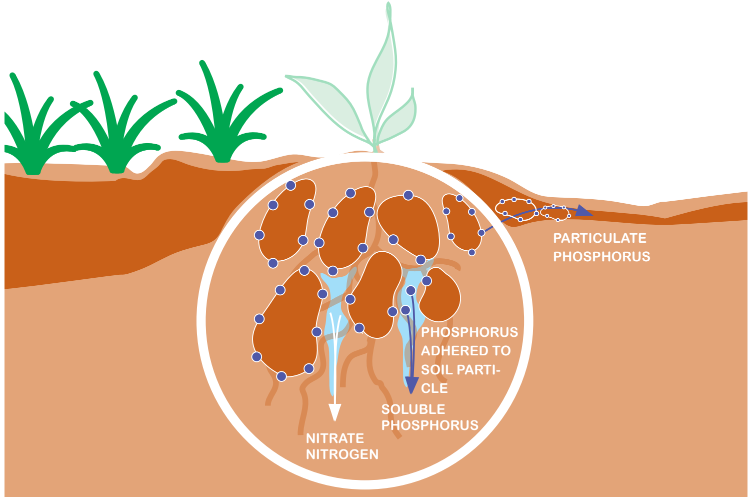
The watercourse nutrient and particle discharge caused by agriculture and forestry is called non-point loading. It can never be fully controlled, because the flow of water cannot be fully regulated in changing weather conditions. Nutrients are transported from fields and forests into waters bound to the soil particles or by means of surface runoff, as well as from fields through subsurface drains.

Arable farming accounted for 27% of the average nitrogen load (N) in watercourses and 40% of the average phosphorus load (P) in 2012–2019. The corresponding figures for forestry were 7% (N) and 10% (P). Natural background loads accounted for 42% (N) and 33% (P).[7] These proportions vary regionally, and there is annual variation due to annual weather conditions. Some of this load will eventually end up in the Baltic Sea. Therefore, water management measures are also of key importance in marine protection.

Water bodies = lake, pond, river, stream, other natural water area and artificial lake, channel and other similar artificial water area

- a trickle, ditch or spring is not considered to be a water body

Small water bodies = stream, pond, trickle, ditch, spring, small gloe lake, flad




The majority of the phosphorus in soil is attached to the surfaces of soil particles (particulate phosphorus), from which phosphorus is only released very slowly in clay soil. The release is quicker in coarser and more organic soil. Phosphorus bound to organic matter is released when organic matter is decomposed by microbes.

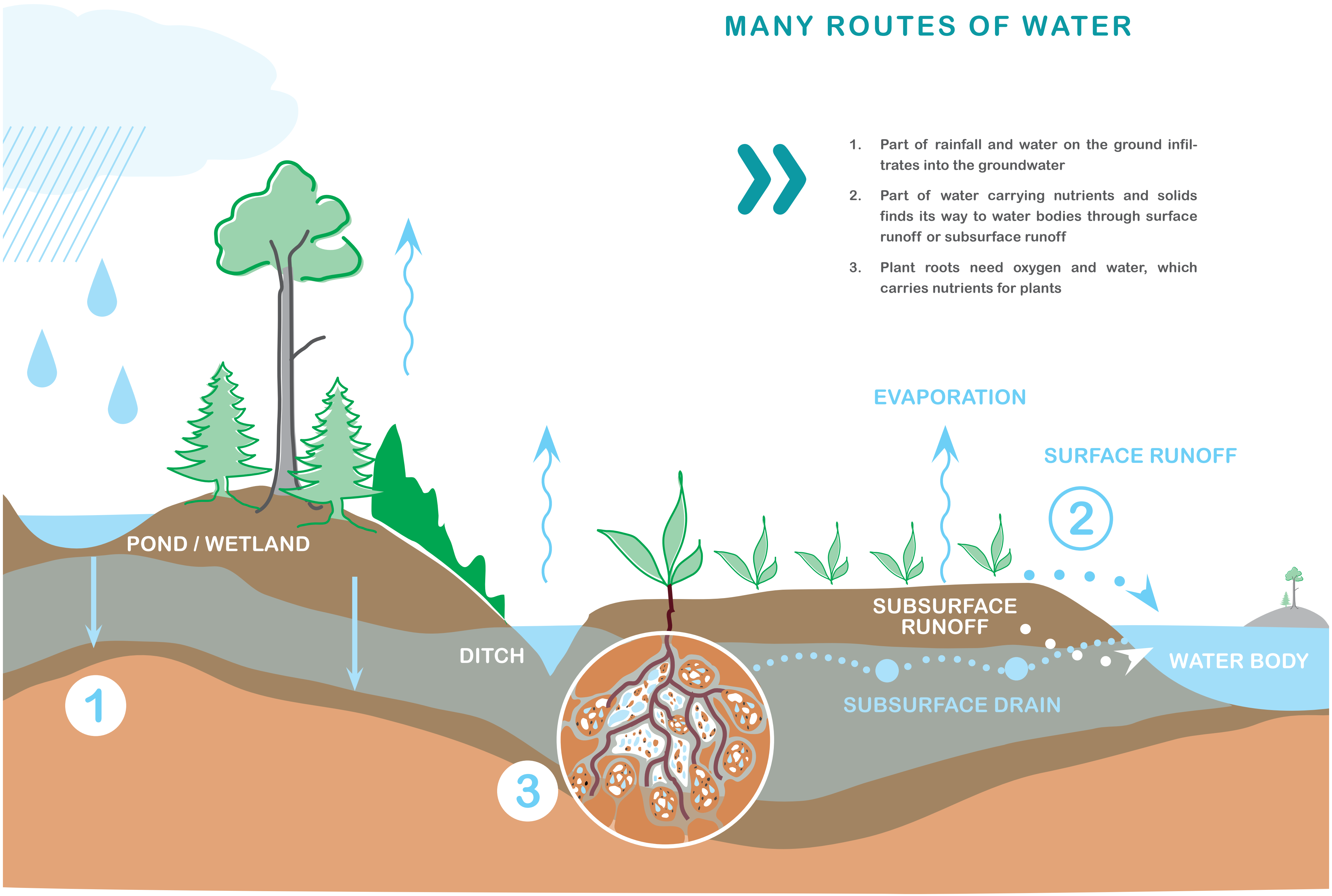
The majority of the fertiliser phosphorus is accumulated by sorption mechanisms on the surface of soil particles (iron and aluminium oxides in clay soil, organic matter), from which soluble phosphorus (phosphate phosphorus) is released into soil solution by equilibrium reactions. The more water there is in the ground, the greater the release. The more soluble phosphate phosphorus there is available for plants in the soil, the more phosphorus is released from sorption sites.

For the eutrophication of water bodies, soluble phosphate phosphorus is more harmful, because it is directly available for algae. Algae can use roughly 20–60% of particulate phosphorus.[8] Soluble phosphorus loads are particularly affected by the phosphorus content in the soil, whereas the risk of the loading of particulate phosphorus is associated with erosion.

Crops take nitrogen from the soil in the form of nitrate or ammonium. However, the majority of all nitrogen in the soil is organic, i.e. bound to organic matter. When microbes decompose organic matter, ammonia nitrogen is released, which is quickly converted into nitrates in oxygen-rich soil. In inorganic fertilisers, nitrogen is usually directly soluble in the form of ammonium nitrate. Nitrate is particularly problematic in terms of water pollution, because it is barely retained in the soil, as it is easily leached away with water. The risk of ammoniacal nitrogen leaching is reduced by its retention in the soil.

# MANY ROUTES OF WATER

1. Part of rainfall and water on the ground infiltrates into the groundwater
2. Part of water carrying nutrients and solids finds its way to water bodies through surface runoff or subsurface runoff
3. Plant roots need oxygen and water, which carries nutrients for plants



# THE BALTIC SEA

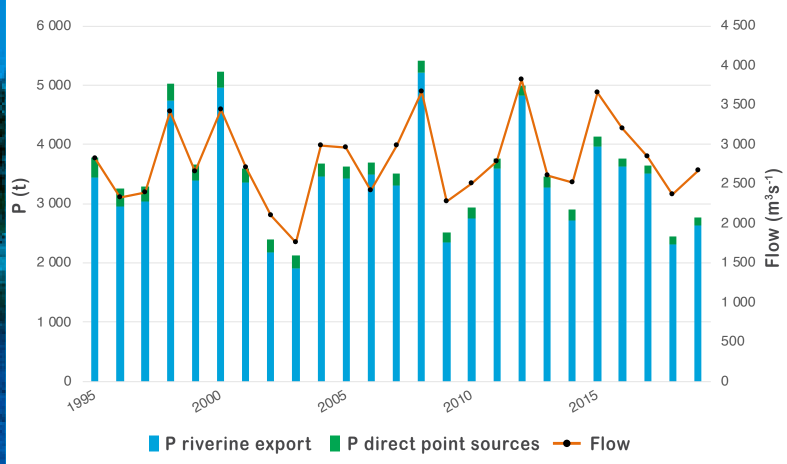
The Baltic Sea area is slightly larger than Finland, and its catchment area is about four times larger than the surface area of the sea. The Baltic Sea is enclosed by nine countries, while its catchment area extends to 14 countries. The Baltic Sea is also very shallow, as its average depth is only 54 metres.[9]

The large catchment area and the high number of population, as well as the slow change of water, explain the sensitivity of the Baltic Sea to eutrophication. Eutrophication began to intensify in the 1960s. In order to reduce nutrient pollution, improvements started from wastewater treatment. In Finland, non-point load from agriculture were discovered in the 1980s, when the first research results were obtained from leaching test fields *in situ.*

As pollution decreased, the sea began to recover in the late 1990s. When phosphorus is used in the catchment area, it takes an average of 30 years before it ends up in the sea or is retained tightly in the soil or the sediment layers of water bodies. In the sea, phosphorus remains for another 30 years in water and in surface sediment layers, causing internal loading, before it is buried deep in the bottom sediment layer or is carried to the North Sea.[10] This significantly slows down the impact of actions taken to reduce loading on the state of the Baltic Sea. In addition, climate change will continue to slow down the recovery of the sea even further.

It is estimated that 33% of waterborne total phosphorus to the Baltic Sea is from natural background sources, and 45% is phosphorus previously accumulated in the soil and inland waters. Direct inputs of sewage from coastal cities account for 8%. The remainder comes from e.g. current phosphorus fertilisation and other wastewater sources.[10]

Arable farming accounted for 31% of the average nitrogen load from Finland into the Baltic Sea and 44% of total phosphorus load between 2012 and 2019. Forestry accounted for 7% of nitrogen and 11% of phosphorus. Corresponding figures for natural background loads were 39% (N) and 30% (P).[7]




> Finnish total phosphorus loads in 1995–2019 (Source: Räike/Syke 12.10.2020).

The majority of load from Finland into the Baltic Sea comes through rivers. There is significant variation in input due to weather conditions. The impact of load-reducing measures is easily hidden by the variation in load caused by changes in runoff. Therefore, changes need to be reviewed in the long term.

# FOCUS ON THE SOIL FERTILITY IN AGRICULTURE

The better crops can utilise the nutrients provided, the smaller the risk of leaching will be. This requires that the fertility of fields is high.

A well-functioning soil structure and water management are the basis of the fertility of soil and, at the same time, the first step in water protection. The nutrient load risk can be reduced by suitable crop and cultivation techniques. It is also important to take care of crop protection, as healthy crops utilise nutrients effectively. Nutrients transported away from fields cause financial losses for farmers. Water protection activities carried out in fields can be supplemented, for example, using wetlands, chains of bottom dams and other structures that retain nutrients and soil particles as close as possible to the source of the discharge.

Transported soil particles from fields into ditches increase the maintenance need for ditches and causes eutrophication, siltation and shallowing in watercourses, affecting their organisms. The impact of livestock on watercourses is largely linked to the use of manure as fertiliser and to possible point loads from outdoor exercise yards of livestock.

Most of the nutrient load from fields occurs outside the growing season. This must be taken into account in the selection of measures that reduce runoff, alongside with the properties and location of parcels, cultivation activities and the type of load that is intended to be reduced, as well as the cost-efficiency of the measures. Furthermore, it is an advantage if emissions into the air can be reduced at the same time (by the measures like the injection spreading of slurry, catch crops) or biodiversity can be increased (such as buffer strips, nature-based solutions for drainage).

Clay soils are fertile and effectively retain nutrients. Finland's soil is naturally poor in phosphorus, and excess phosphorus fertilisation was previously needed, particularly in clay soil, to ensure plant growth. In certain places, this has led to high phosphorus contents considering water protection. Furthermore, clay soil is sensitive to erosion, which means that nutrient-rich soil particles are transported into water.



In peatlands, nutrients are poorly retained in the soil. Nitrogen leaching from peat fields is usually higher than from mineral soil. The natural phosphorus retention capacity of peatlands is very low, which increases the risk of leaching of soluble phosphorus. After fertilisation, the risk of nutrient discharge from undecomposed, recently cleared peat fields is particularly high.

The decomposition of peat increases the water retention capacity of peat, which is why drainage must be effective in order to remove any excess water from fields. The adverse impact of farming on watercourses can be reduced by carrying out measures concerning drainage and cultivation methods that slow the decomposition of organic matter: decreased soil tillage, increased grass cultivation, more specific fertilisation and maintaining the groundwater level as high as possible, if soil bearing capacity is enabled for cultivation and if fertility is maintained. In addition, attempts to clear new peatlands should be abandoned.[11]

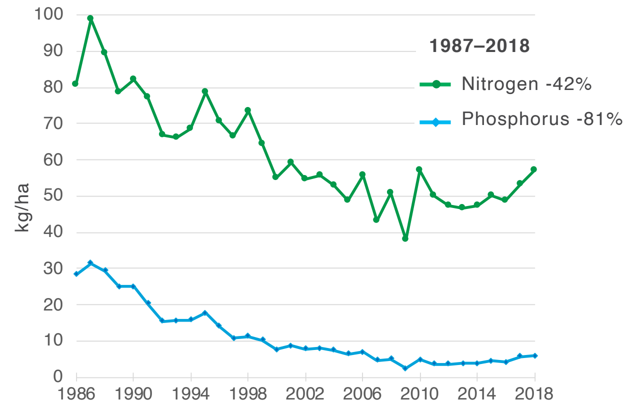
Monitoring has shown that plant protection products do not cause any extensive problems in surface waters in Finland. Finnish farmers have knowledge of different products, and the registration of products defines sufficiently protective restrictions on the use of the products. However, concentrations of plant protection products have been found from rivers and also from lakes in predominantly agricultural areas.[12] Finland sold the third fewest plant protection products used in agriculture (kg/ha) in Europe in 2018.[13]

The agri-environment-climate scheme (previously agri-environment support) supports farmers' actions in water protection in agriculture. Key achievements include the improved use of nutrients and the extent of erosion-reducing plant cover during winter. According to the environmental impact assessment of the Rural Development Programme for Mainland Finland (2014–2020), phosphorus discharge in agriculture has decreased by 18% and diffuse nitrogen discharge by more than 10%, compared with the beginning of the agri-environment support (1995–1999). Examined at a national level, N and P balances have decreased, and the phosphorus content measured by the soil fertility analysis, representing plant available phosphorus, have started to decrease, which has reduced nitrogen and phosphorus losses. The decrease in soil tillage has reduced erosion and nitrogen leaching. The impact on total phosphorus losses is not unambiguous, because decreases in tillage increase the leaching of dissolved phosphorus when phosphorus accumulates in soil surface layers.[14, 15, 16]

## Agricultural measures to reduce erosion and nutrient discharge into waters

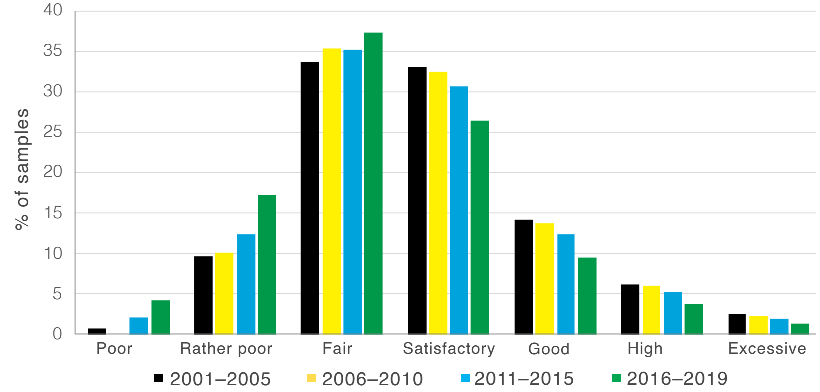
- Maintenance of soil fertility: good structure and well-functioning drainage, liming
- Balanced and necessary use of nutrients based on plants' needs
- Fertiliser placement, split nitrogen fertilisation, precision agriculture
- Options for the tillage intensity (ploughing – conservation tillage – direct seeding)
- Plant cover during winter
- Catch crops
- Vegetated field edges, buffer strips and zones
- Crop protection, careful use of chemical crop protection products
- Manure spreading by placement or rapid soil application
- Soil amendments like gypsum, structure lime, wood fibres
- Controlled drainage, controlled irrigation
- Nature-based solutions for drainage, including two-stage channels
- Wetlands
- More specific animal feeding
- Parcel arrangements

> Nitrogen and phosphorus balances in 1986–2018 (Source: Luke/ Statistics 16.9.2020).



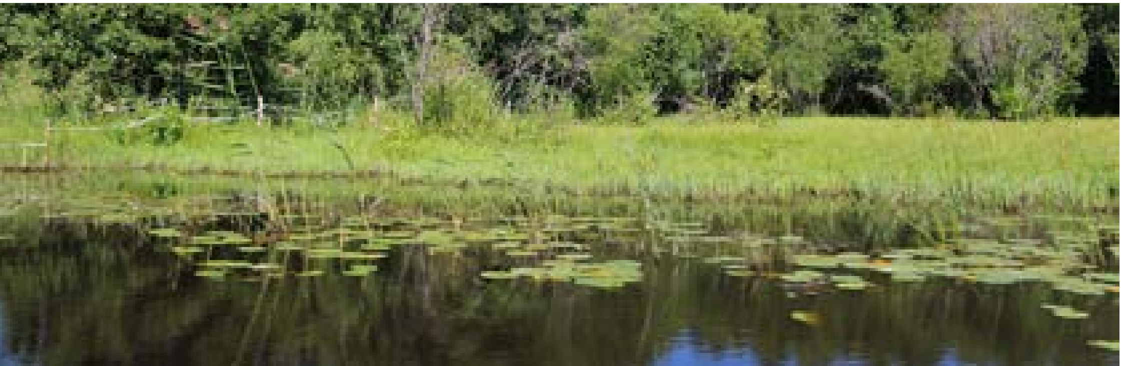

N and P balance = N and P inputs to the field – N and P removed with the harvest from the field

> Change in phosphorus status of cultivated soils in 2001–2019 (Source: Eurofins Viljavuuspalvelu 27.10.2020).




- Improving the fertility of the soil (structure, drainage, liming, balance of nutrients, crop rotation). After high harvested yields, there are less nutrients left that are exposed to leaching as possible in the soil.
- Facilitating the implementation of water management and soil improvement projects in leased land by developing the subsidy system and by encouraging landowners to longer lease agreements.
- Targeting cost-effective water protection measures at areas and parcels with the highest discharge risks.
- Increasing the effectiveness of the measures by assessing the most significant factor causing discharge on a case-by-case basis and targeting measures to reduce discharge especially with this factor.
- Improving the efficiency of the use of nutrients in arable farming through precision agriculture to reduce the nutrient losses per kilogram biomass harvested.

- Regulating the maximum volume of phosphorus fertilisation for crops by means of fertilisation legislation on the basis of the regularly measured P content of soil.
- Increasing plant cover during winter, particularly using perennial crops, catch crops and crops sown in autumn, but also by utilising stubble. At the same time, it must be ensured that soluble phosphorus leaching does not increase significantly.
- Increasing the grassland area, particularly in erosion-sensitive clay areas and peatlands. Using crops in biogas production and using the nutrient-rich digestate as a fertiliser for crops.
- Reducing the need to clear new fields by developing feed trade between farms, by encouraging the reception and further processing of manure, as well as by means of parcel arrangements or rotation. In addition, reassessing restrictions on the use of livestock manure, e.g. using liquid fractions with a low phosphorus content separated from manure when the P content of the soil is high.
- Boosting the recycling of nutrients and increasing the further processing of manure in areas with high domestic animal production. During further processing, regulating the nutrient content of products to better correspond to the needs of crops.
- Using different base structures, surface materials and the removal of manure to ensure that no point loads are discharged from outdoor exercise yards into waters.
- Extensively utilising the opportunities of digitalisation in a more detailed planning and implementation of cultivation. Increasing contracting services and equipment sharing so that the latest technology can be used more easily on farms of all sizes.
- Converting poorly productive parcels into areas that promote biodiversity or for forestation.



# SOLUTIONS FOR WATER MANAGEMENT IN PEATLAND FORESTS

**The proportion of discharge from forests is the highest in head water areas where forestry may be close to the only form of land use. Load of forestry from peatland forests is larger than from forests in mineral soil.**

Nutrients and organic carbon are transferred into watercourses as a result of natural background leaching and forestry measures.

Of different forestry activities, watercourse load is due, in particular, to remedial ditching, regeneration, soil preparation and fertilisation. Regarding the impact of forestry on watercourses, solid loads are more significant than nutrient loads. The largest single source of discharge from forestry into watercourses is solid matter, which contains phosphorus and nitrogen, carried through runoff remedial ditching.

Felling and fertilisation mainly cause nutrient discharge. Nitrogen leaching is caused in conjunction with forest regeneration.

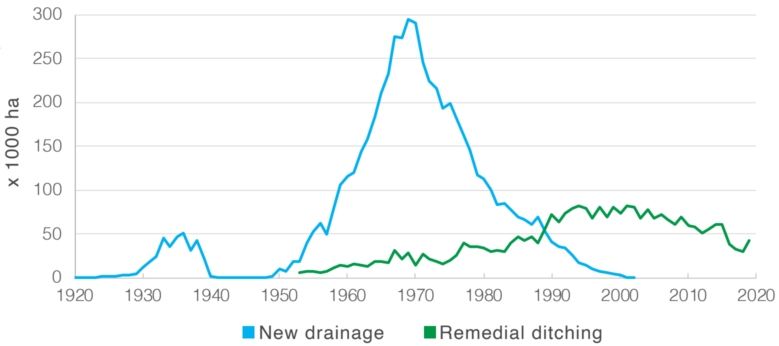
By preventing the access of nutrients into watercourses, eutrophication can be combated. Reducing solid loads prevents water bodies from becoming cloudy and also bottom siltation. The importance of water protection measures in forestry is emphasised in peatlands, in the vicinity of watercourses and in groundwater areas.

Peatland forests are an important part of Finland's forestry. As a result of drainage activities, one quarter of the growth of Finnish forests and the total volume of the growing stock are in drained peatland areas. However, there is significant regional variation in this proportion. No new drainage is carried out in forests. In old drainage areas, ditches are remedied to control water management and to safeguard the growth conditions of trees. In the next few years, a large number of peatland forests will enter the regeneration phase. Not all of them can be regenerated without water management arrangements. However, more information is needed on how to ensure the regeneration of forests without increasing discharge in watercourses.

The need and options for remedial ditching are increasingly considered in peatland forestry. Comprehensive planning aims to identify the simultaneous need for silviculture, remedial ditching and water protection and other environmental management. In addition, the profitability of the project must be assessed.

Continuous cover silviculture has been proposed as one option for remedial ditching, in which case evaporation from trees keeps the water level sufficiently low. According to silviculture recommendations, a sufficient wood volume is 125–150 m³ per hectare.[17] Thick peatland forests in Southern Finland often have natural properties for continuous cover silviculture.

> Trends in forest drainage in 1920–2019 (Sources: S. Joensuu/Tapio Oy 19.10.2020, Luke/Statistics 27.10.2020).




Of the drained peatland forests, 840,000 hectares have remained practically poorly productive or practically unprofitable considering wood production.[18] These sites can be left in the state of restoration under the terms of the Forest Act. In this case, discharge from previous drainage will decrease over time, without generating any new load from remedial ditching. The areas can be used for overland flows, where applicable. In addition to solids, overland flow fields retain nutrients. Active restoration can be carried out when it is ensured that it does not increase pollution in watercourses or greenhouse gas emissions.

Correctly targeted fertilisation increases tree growth. Peatlands are ideal for ash fertilisation because there is no shortage of nitrogen. As tree growth accelerates, evaporation also increases, which means that remedial ditching is not always needed to lower the water level.

When carrying out silviculture activities, a buffer zone is left next to water bodies. No soil preparation can be carried out, no fertilisation, no undergrowth can be cleared and no stumps can be removed in the buffer zone. This reduces the transfer of solids, nutrients and mercury into water bodies. Buffer zones are particularly important, when considering small water bodies. The width of buffer zones varies according to the properties of the location, such as soil erosion sensitivity, slope and vegetation. Many aquatic organisms also benefit from forest buffer zones that shade water bodies. In land areas, buffer zones dominated by deciduous trees, in particular, have a positive impact on biodiversity.



Regeneration and soil preparation are often carried out almost simultaneously, which makes it difficult to separate the resulting load in watercourses from one another. The most common soil preparation methods are screefing, harrowing and mounding, as well as variations of them. The correct selection of the soil preparation method and the alignment of soil preparation traces reduce the detachment of solids and the transfer of nutrients away from the soil preparation area. The aim is to ensure that the ground surface breaks as little as possible, but enough so as to ensure the birth of a new tree generation quickly and reliably. When selecting a suitable soil preparation method, the soil type, landforms and the tree species being regenerated must be taken into account.

The effects of soil preparation in mineral soil on watercourses are usually fairly minor, compared with peatlands.[19] The best solution for mineral soil is to regenerate new trees that bind soil particles and nutrients as quickly as possible. This also applies to regeneration in peatlands. However, water management is important in order to ensure the growth of seedlings.

- Avoiding drainage and land breakage in areas with the highest risk of solid matter and nutrient leaching (such as eroding ditches, flood areas).
- In peatland forests, considering and implementing remedial ditching on a ditch-specific basis, however, maintaining the previous ditching depth, while securing tree growth.

- Utilising continuous cover silviculture and ash fertilisation in peatland forests as an alternative to remedial ditching.
- Leaving drained, low yield peatland forests in the state of restoration in accordance with the Forest Act. Developing active restoration methods, such as feeding water to dried natural peatlands in order to restore their water balance.
- Only carrying out forest fertilisation by using slowly dissolving nitrogen fertilisers during the growth season. Ensuring that fertilisers are not spread over ditches and water bodies.
- Leaving buffer zones of varying widths next to water bodies as considered on a site-specific basis, also taking into account biodiversity issues.
- Using soil preparation methods that break the land as little as possible but are sufficiently effective in terms of forest regeneration.
- Using cost-effective water protection structures that are suitable for each specific site and combinations of such structures. Using the most recent research data about methods comprehensively.
- Supporting the adoption and utilisation of various spatial datasets and digital services in the planning of measures carried out in forests (such as comprehensive planning of remedial ditching, forest machine trail planning).

**Measures to reduce erosion and nutrient discharge in forestry**

- Regulating the depth of ditching and preparation
- Ditch breaks and uncleaned ditches
- Sedimentation pits and ponds
- Flow control and damming structures
- Wetlands, overland flow area
- Buffer zones next to water bodies
- Continuous cover silviculture and maintenance of evaporating trees
- Selection of fertilisers and the fertilisation method
- Conservation tillage



# GROUNDWATER IS CRUCIAL FOR SOCIETY AT LARGE

**Groundwater is susceptible to pollution because water resources are often close to the ground and the soil is penetrating in groundwater areas. Preventing groundwater and soil pollution is important because cleaning contaminated groundwater is difficult and expensive, if not impossible.**

Clean groundwater plays a key part in society in terms of the water supply. Between 60 and 65% of the domestic water used by Finns consists of groundwater, some of which is artificial groundwater.[20] A key basis for groundwater protection is the absolute ban on groundwater pollution as laid down in the Environmental Protection Act. It is also forbidden to endanger groundwater. In addition, the volume of groundwater must be protected. Dry weather periods in recent years have shown that groundwater levels can lower significantly, resulting in restrictions on the use of water. Groundwater areas are mainly forests, and they are widely used in forestry. Fields account for less than 6% of groundwater areas.[21]

In agriculture and forestry, groundwater is taken into account as part of established operations. Risks posed to groundwater by agriculture are prevented by, for example, the nitrate decree, crop protection legislation and regulations laid down in the environmental permits and notification decisions of livestock housing concerning, for example, fertilisation, manure handling or the use of chemicals. In groundwater monitoring, the most important risk factors in agriculture include banned pesticides and ammonium nitrogen.[22]

In forestry, the quality of groundwater is secured in groundwater areas that are important and suitable for the water supply by refraining from the use of plant protection products, the removal of stumps and fertilisation. However, ash fertilisation is possible in peatlands. When planning ash fertilisation in groundwater areas, however, it is advisable to first contact a groundwater specialist of an ELY Centre. Drainage in groundwater areas calls for caution, as drainage may endanger the quality of groundwater and change its volume. When operating in groundwater areas, it must be ensured that no fuels or oils can enter the soil. Machinery must be equipped with spill containment equipment in the case of breakage.

In addition, the special needs of groundwater areas must also be taken into account in soil extraction, digging and construction. Up-to-date information about groundwater areas must be easily available and maps must be accurate. The boundaries of groundwater areas should also be specified regularly by means of topographic surveying.


**According to the Water Act, groundwater cannot be owned, but under certain conditions, it is controlled by the party that owns the water or land area in question.**

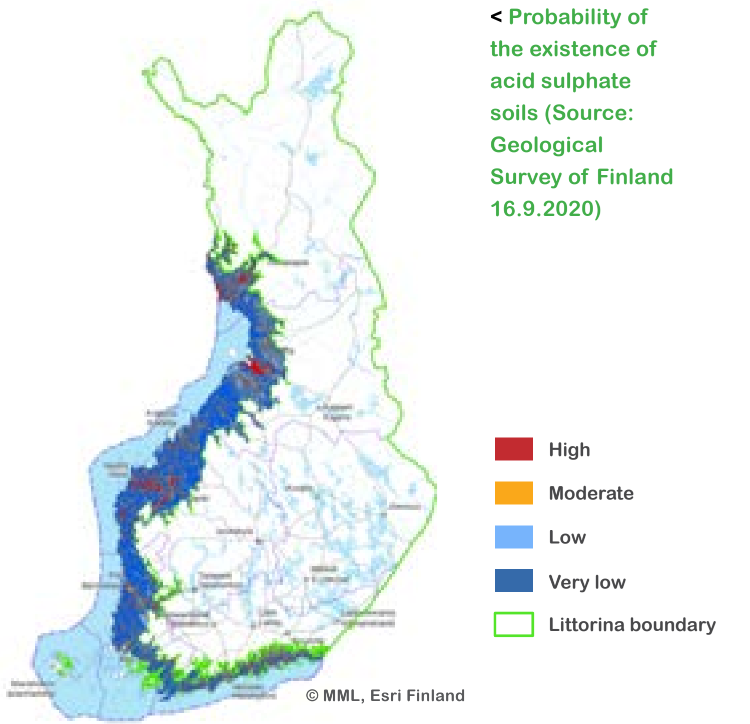
**In its 2025 future document, MTK has stated that Finnish water must be kept under Finnish control.[23]**

- Preventing the need for chemical plant protection products by means of good cultivation methods, such as diverse crop rotation. Ensuring that a broad range of plant protection products approved for groundwater areas and special crop production is available and used only for a verified need in compliance with regulations and guidelines, and delivering outdated products and products removed from registers to a collection point for hazardous waste. Promoting and developing biological crop protection and precision crop protection.
- Ensuring the appropriate storage and use of liquid fuels, oils and other chemicals, and checking the condition of liquid fuel tanks on a regular basis. Ensuring that no liquid fuel remains in tanks removed from use.
- Ensuring that taking soil for domestic use does not pose a risk to groundwater. Permission in accordance with the Land Extraction Act must be obtained for soil extraction.
- Ensuring that groundwater is protected in construction, or seeking alternative locations from outside groundwater areas.
- Carrying out conservation tillage in groundwater areas of class 1 and 2 when regenerating forests.
- Not extending remedial ditching beyond the original drying depth in forests. If ditches need to be made deeper due to the feeding of water, it must be ensured that groundwater discharges into ditches are prevented through careful planning and implementation.
- Ensuring the landowner’s rights and opportunities to utilise water. Developing commercial activities related to clean water. Supporting the maintenance of the distribution of domestic water under Finnish ownership.
- Developing and piloting market-based operating models in which water cooperatives and limited liability companies pay compensation to landowners for special measures that maintain the quality and quantity of groundwater.

# ACID SULPHATE SOIL REQUIRES SPECIAL MEASURES IN WATER PROTECTION

**Acid and metal leaching is at its highest when heavy rains follow a long period of drought, during which the groundwater level has been exceptionally low.**

The coastal area contains acid sulphate soils. When the soil dries, sulphur-containing sulphide layers oxidize and when rewetting they generate sulphuric acid, which lowers the soil pH below four. Sulphuric acid acidifies the soil and runoff water, and dissolves metals from the soil that are harmful to aquatic organisms and cause deaths in fish. An adverse impact on aquatic organisms is usually caused jointly by acidity and toxic metals.[24]




< Probability of the existence of acid sulphate soils (Source: Geological Survey of Finland 16.9.2020)

An adverse impact can be prevented by keeping the groundwater level high enough so that there can be no oxidation. Well-functioning methods used in agriculture include, for example, controlled drainage and irrigation, as well as bottom dams. In the most problematic land, perennial grasslands or other crops requiring a smaller drying depth can be grown.

In forestry, remedial ditching and soil preparation should not extend to sulphide-containing soil layers. For the same reason, sedimentation pits and ponds should not be used as water protection structures in acid sulphate soil. The risk of acidic leaching is highest when drainage mounding is used. The risk of acidic loads must also be taken into account in logging, forest road construction and the removal of stumps.[25]

Water protection measures suitable for acid sulphate soil include digging and clearing buffers in feeder drains, bottom dams and pipe weirs, as well as small-scale overland flow fields in collector and discharge drains.[25]

- Using survey data and promoting the availability of up-to-date survey data in the planning and implementation of measures.
- Promoting the introduction of controlled drainage and other measures that reduce the acidity of agricultural land, and favouring grasslands that require a lower depth of drainage.
- Taking into account water risks resulting from acidity in forest remedial ditching and soil preparation.

# CLIMATE CHANGE CHALLENGES THE WATER MANAGEMENT AND QUALITY OF WATER

**Agriculture and forestry can help to mitigate climate change, but at the same time they need to adapt to changes.**

As a result of climate change, precipitation is expected to increase during winter. Autumn and winter floods will become more common and intensify, while spring floods will decrease in most parts of the country. The risk of nutrient loading will increase during winter and autumn. The risk will be particularly high during mild winters, when plant cover does not bind nutrients and the soil is not frozen. Not as much snow will accumulate as before, and the snow cover period will be shorter, especially in Southern and Central Finland. Similarly, the period when lakes are covered by ice will be shorter. Precipitation is also expected to increase in summer due to heavy rains, while evaporation and the earlier start of spring may still reduce the amount of water in summer. During summer and early autumn, groundwater levels may be lower.[26,27] Drought may cause significant harm to our livelihoods and, for example, the need for irrigation may increase. The risk of an adverse impact caused by acid sulphate soil is also expected to increase as extreme weather conditions are becoming more common. In addition, the need to control plant pests will be even greater.[28]

Direct forest and field ditches retain a small amount of water, and the high flow speed of water removes soil from channels. Drought and floods will also increase challenges. The methods of nature-based solutions for drainage can reduce the risk of erosion and nutrient loads. Wetlands retain leached nutrients, balance flood peaks and can act as an irrigation water storage.

Higher autumn and winter precipitation and floods will increase soil structural problems in fields and the risk of erosion, as well as nutrient and pesticide leaching. The wintering of crops may become more difficult. Drought periods or heavy rainfall during the growing season will have an impact on yields, in which case the nutrients given may remain unused. It is possible to prepare for these by increasing the amount of organic matter in the soil and by taking care of water management to improve the structure of the soil. The significance of crop rotation, crop selection, split nitrogen fertilisation and plant cover during winter will also be emphasised. As the growing season extends, catch crops can grow even longer after harvesting.

In forests, harvesting, remedial ditching and soil preparation will become more difficult as the soil becomes wetter and a frost-free period lengthens. This also increases the risk of erosion and nutrient loads. In the future, the timing of the planning and implementation of measures will be more significant.

- Preparing for flood risks through water management planning and the restoration of the channel network.
- Anticipating increasing flows already in the dimensioning of ditches and water protection structures.
- Increasing natural water construction, such as two-stage channels in fields and forests.
- Increasing water and nutrient retention structures, such as wetlands and sedimentation ponds.
- Considering the increased need for irrigation when restoring and building ditches, wetlands and other such structures.

> In two-stage channels, the water depth will remain reasonable with smaller flows in the small main channel and, in the case of flooding, water may rise to floodplain built on one or both sides.

# TOWARDS CATCHMENT AREA LEVEL PLANNING AND IMPLEMENTATION

**Catchment area level planning and project implementation offer new opportunities for water management, but it must be voluntary for all parties.**

Currently, water management projects in agriculture and forestry are carried out at a parcel or project level at the landowners' initiative, for example, and there is little coordination between individual projects. In the future, it will be necessary to promote water management planning at a catchment area level alongside individual projects.[5] When considering on a broader scale, it is easier to identify the most high risk areas, assess the overall impact of water management projects and better control changes in runoff and nutrient and particle loads, and prepare for the flood and drought risks associated with climate change. However, individual projects will continue to have their place. Extensive planning may take a long time for various reasons, while the arterial and local drainage of a field or forest area may be urgent to ensure the continuity of operations.

In planning at a catchment area level, the size of the target area may vary, but, often, the impact of planning and water management measures improves as the area grows. All parties involved in catchment area should participate in planning that takes into account not only the risks, but also the needs of the parties. Cooperation provides better opportunities than projects of individual parties to combine and dimension measures and agree upon their implementation and the maintenance of ditches and other structures, such as wetlands or overland flow fields. At the same time, parcel arrangements can offer new opportunities for implementation. In addition, it is important to agree on the division of implementation and maintenance costs at the ratio of benefits and disadvantages.

Comprehensive planning also takes better account of the requirements set by the habitats of aquatic organisms and fish. In certain situations, it may be necessary, for example, to restore the structure of a channel. However, if loads from a catchment area continue to be strong, the benefits of restoration may be short-lived. The migration of fish may be restricted by many obstacles in channels. The impact of the removal of a single obstacle will be minor, if most of the others remain in place. Large-scale planning and implementation of measures can make this easier.



**Catchment area = an area from which surface waters and groundwater are discharged at a specific point into the sea, lake or channel**

**The water retention capacity of the catchment area is a key factor in controlling flows and nutrient leaching.**

- Promoting operating models that cross sector-specific boundaries in water management at a catchment area level, and developing and implementing these models in cooperation with landowners, research, administration, entrepreneurs and other parties in the area.
- Developing the fair distribution of costs of drainage and other water management projects at the ratio of benefits and disadvantages.
- Creating an incentive scheme that offers motivation for the implementation of cost-effective joint projects.
- Identifying and reducing any bottlenecks in water protection funding, administration and legislation. Ensuring funding for water protection in agriculture and forestry by using various mechanisms.
- Promoting the activities of drainage communities to implement controlled and regular maintenance, for example, by developing drainage management.
- Renovating water bodies and small water bodies to reduce internal loads and promote biodiversity in joint projects, in which case the overall impact can be better taken into account.
- Considering fish migration and the living environments of endangered aquatic organisms, for example, when digging and renovating ditches, and when installing various structures, such as culverts and weirs, in ditches. Removing any obstacles for migratory fish when renovating roads.

# MORE IMPACT FROM DATA, ENGAGING DECISION-MAKING AND COMMUNICATION

»

Up-to-date research and monitoring data is needed to identify the effectiveness of water protection measures and to target activities. Training, advisory services and other communication convey information.

Agriculture and forestry, along with their operating methods, are constantly changing. In order to identify the impact of the changes on watercourses, high-quality research based on practical needs is required. In addition, continuous and long-term monitoring of watercourse discharge is needed to monitor the practical impact of the measures. As weather and soil conditions vary in different parts of Finland, the monitoring network and research fields must cover the entire country. Loads of soluble phosphorus and particulate phosphorus should be monitored separately, as their impact on water bodies is different and the risks of their losses are reduced by different means. Modelling complements the measurements. Combined, these help in the selection, targeting and dimensioning of water protection measures.

The goals and obligations set for industries to reduce watercourse pollution must be based on research data. Research results based on minor data and partly contradictory research results make it difficult to select the best practices. Basically, the methods and measures to be selected must be tested in different conditions, be cost-effective and be compatible with other farm operations.

To disseminate research results, high-quality advisory and other communication services are needed. In addition, investments are needed in training provided for producers, advisers, other entrepreneurs in the industry, as well as administration and researchers. It is important that the latest information is fully utilised.

More information should be communicated to consumers about the nutrient load and erosion risks into waters caused by agriculture and forestry and the measures taken to reduce risks. Information should also be collected about activities not included in general statistics. It is important that consumers have a realistic picture of today's agriculture and forestry, for example, supporting their purchasing decisions.

Water and the use of water, as well as the measures affecting water and its use, are regulated in several acts and decrees. Key national regulations on the use and protection of water are the Water Act (587/2011), the Environmental Protection Act (527/2014), including a ban on the contamination of groundwater, the Act on the Organisation of River Basin Management and the Marine Strategy (1299/2004) and the nitrate decree (1250/2014). The Åland Islands is autonomous in matters related to the use of water, agriculture, forestry and the environment. The most important provisions that steer the use of water are Vattenlagen för landskapet Åland (1996:61), Vattenförordningen för landskapet Åland (2010:93), and Ålands landskaregerings beslut (2016:41), which regulates nitrate emissions from agriculture. It is essential that the legislation affecting water protection is predictable, its interpretation is balanced and a clear line can be drawn between different acts.

- Increasing high-quality and relevant research based on long-term field studies. Also utilising information to further develop loading models.
- Maintaining a regionally comprehensive, continuous, long-term monitoring network for water quality in order to highlight any delayed impact and to identify any impact of weather factors.
- Participating in the development of modelling by, for example, providing farm-specific information. Promoting the evaluation of the cost-efficiency of measures as part of the modelling process.
- Developing a farm-level tool to assess, for example, the impact of farm operations on watercourses.
- Increasing education in water management and water protection in agriculture and forestry at educational institutions in the sector and developing educational material.
- Increasing training regarding the practical application of the Water Act and the Environmental Protection Act, promoting advisory services and communicating information on best water protection practices.
- Ensuring the availability of high-quality advisory services.
- Increasing communication toward consumers on water protection in agriculture and forestry.

**Source**


[1] YMPARISTO.fi. State of the surface waters https://www.ymparisto.fi/en-US/Waters/State_of_the_surface_waters. [13 October 2020]

[2] Ministry of the Environment 2019. Water management measures are necessary to improve the state of groundwater. Press release, 17 December 2019. https://www.ymparisto.fi/fi-FI/Vesi/Vesienhoitotoimet_tarpeen_pohjavesien_ti(53453)

[3] Water protection guidelines for agriculture. Suomen Vesiensuojeluyhdistysten Liitto r.y. Offprint *Ympäristö ja Terveys* 1/1978.

[4] PEFC.fi. PEFC in numbers. https://pefc.fi/pefc-numeroina/. [13 October 2020]

[5] Häggblom, O., Härkönen, L. et al. 2020. Maa- ja metsätalouden vesitalouden suuntaviivat muuttuvassa ympäristössä. Publications of the Ministry of Agriculture and Forestry 2020:6.
http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/162211/MMM_2020_6.pdf?sequence=4
Also available in English: *Water management guidelines for agriculture and forestry*.
https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/162417/MMM_2020_12.pdf?sequence=1&isAllowed=y

[6] Finér, L., Lepistö, A. et al. 2020. Nutrient and organic carbon export from forests to watercourses 2020 – Final report of MetsäVesi-project. Publications of the Government's analysis, assessment and research activities 2020:6. http://urn.fi/URN:ISBN:978-952-287-826-7

[7] VEMALA – a water quality and nutrient load model system for Finnish watersheds, status on 28 October 2020.

[8] Puustinen, M., Tattari, S. et al. 2019. Nutrient recycling in primary production and its effects on the state of surface waters – final KiertoVesi project report. Reports of the Finnish Environment Institute 22/2019. https://helda.helsinki.fi/handle/10138/304956

[9] ITÄMERI.FI. https://www.marinefinland.fi/en-US. [13 October 2020]

[10] Baltic Sea Centre 2019. Phosphorus in the catchment – actions taken today create tomorrow's legacy. Policy Brief.
https://www.su.se/polopoly_fs/1.436152.1556289104!/menu/standard/file/PolicyBrieflegacyPlow.pdf

[11] Myllys, M., Regina, K. et al. 2014. Turvemaiden viljelyn ympäristöhaittojen vähentäminen. (Reducing the adverse environmental impact of peatland cultivation.) Maataloustieteen Päivät 2014. (Scientific Agricultural Event 2014.)
Presentation and poster summaries. Kuisma, R. et al. (eds.). Bulletin of the Scientific Agricultural Society of Finland, no 31. p. 120.
https://journal.fi/smst/issue/download/5991/570

[12] Karjalainen, A. K., Siimes, K. et al. (eds.). 2014. Maa- ja metsätalouden kuormittamien pintavesien haitta-aineseuranta Suomessa. Seurannan tulokset 2007-2012. (Monitoring harmful substances in surface waters loaded by agriculture and forestry, and monitoring results 2007–2012.) Reports of the Finnish Environment Institute 38/2014. https://helda.helsinki.fi/handle/10138/153152

[13] Luke 2020. Use of pesticides.
https://www.luke.fi/ruokafakta/en/field-crops/use-of-pesticides/. [15 October 2020]

[14] Yli-Viikari, A. (ed.). 2019. Maaseutuohjelman (2014-2020) ympäristöarviointi. (Environmental assessment of the Rural Development Programme (2014–2020).) Natural resources and bioeconomy studies 63/2019. https://jukuri.luke.fi/handle/10024/544713

[15] Yli-Viikari, A., Heikkinen, J. et al. 2019. Ympäristötavoitteet olivat Maaseutuohjelman painopisteenä: mitä saatiin aikaan? (Environmental goals as a focus point in the Rural Development Programme: What was achieved?) National summary of the environmental assessment of the Rural Development Programme.
https://mmm.fi/documents/1410837/1516691/Kansalaistiivistelm%C3%A4_Maaseutuohjelman+arvionti_ravinnekuormitus+ja+ilmastotoimet.pdf/b54d7ba1-624b-ff66-f145-68b3e53a1f7b/Kansalaistiivistelm%C3%A4_Maaseutuohjelman+arvionti_ravinnekuormitus+ja+ilmastotoimet.pdf

[16] Rankinen, K., Cano-Bernal, J. et al. 2020. Vesistökuormitukseen vaikuttavat tekijät valuma-alueilla MYTTEHO-loppuraportin liite 3. (Factors affecting watercourse loading in catchment areas, final MYTTHEHO project report, Annex 3.). https://jukuri.luke.fi/handle/10024/545599

[17] Äijälä, O., Koistinen, A. et al. (eds.) 2019. Metsänhoidon suositukset. (Silviculture recommendations.) Tapio publications.
https://tapio.fi/wp-content/uploads/2020/09/Metsanhoidon_suositukset_Tapio_2019.pdf

[18] Sihvonen, M. 2020. Heikkotuottoiset ojitetut suot – ennallistakaa vai ei? (Poorly productive drained peatlands – to restore or not to restore?) https://www.luke.fi/heikkotuottoiset-ojitetut-suot-ennallistaako-vai-ei/. [16 October 2020]

[19] Laine, T., Luoranen, J. et al. (eds.). 2019. Metsämaan muokkaus : kirjallisuuskatsaus maanmuokkauksen vaikutuksista metsänuudistamiseen, vesistöihin sekä ekologiseen ja sosiaaliseen kestävyyteen. (Forest land preparation: a literature review of the impact of soil preparation on forest regeneration, watercourses, and ecological and social sustainability.) Natural resources and bioeconomy studies 58/2019.
https://jukuri.luke.fi/bitstream/handle/10024/544645/luke-luobio_58_2019.pdf?sequence=5&isAllowed=y

[20] Britschgi, R., Rintala, J. et al. 2018. Groundwater areas – a guide for their designation and classification and preparation of protection plans. Environmental Administration Guidelines 3/2018. https://julkaisut.valtioneuvosto.fi/handle/10024/161164

[21] Emails, 21 September 2020, R. Britschgi/Syke and 18 September 2020, Å. Möller/Finnish Food Authority

[22] YMPARISTO.fi. Pohjavesien määrällinen ja kemiallinen tila. (Quantitative and chemical state of groundwater.) https://www.ymparisto.fi/fi-fi/vesi/Pohjavesien_tila. [15 October 2020]

[23] MTK 2017. Kohti MTK:n uutta vuosisataa – Tulevaisuusasiakirja 2025. (MTK towards a new century – 2025 future document.)
https://www.mtk.fi/documents/20143/173098/MTK_tulevaisuusasiakirja.pdf/62bb6c8b-4f37-1fad-81fc-60c55c79d5e5

[24] Härkönen, L. & Nieminen, T.M. 2019. Mitä ovat happamat sulfaattimaat? (What are acid sulphate soils?) Lecture during the "Happamat sulfaattimaat maa- ja metsätaloudessa" (Acid sulphate soil in agriculture and forestry) seminar https://lansi-suomi.proagria.fi/sites/default/files/attachment/2._harkonen_mita_ovat_happamat_sulfaattimaat_12.4.2019.pdf

[25] Nieminen, M., Hökkä, H. et al. 2016. Metsänhoito happamilla sulfaattimailla. (Forest management in acid sulphate soil.) Natural resources and bioeconomy studies 12/2016. https://jukuri.luke.fi/bitstream/handle/10024/532317/luke-luobio_12_2016.pdf?sequence=6&isAllowed=y

[26] Ilmasto-opas.fi. www.ilmasto-opas.fi/en. [13 October 2020]

[27] Veijalainen, N. 2020. Ilmastonmuutoksen vaikutuksen vesivaroihin ja kuivuuteen Suomessa. (Impact of climate change on water resources and drought in Finland.) A presentation at a climate seminar for agriculture in Southwest Finland. https://varsinais-suomi.mtk.fi/documents/197812/0/Vaikutukset+vesivaroihin+ja+kuivuuteen_Veijalainen.pdf/1d3077b6-21e1-c008-2435-65cce43d9ce4?t=1581335850912

[28] Peltonen-Sainio, P., Sorvali, J. et al. 2017. Sopeutumisen tila 2017. (State of adaptation in 2017.) Ilmastokestävyyden tarkastelut maa- ja metsätalousministeriön hallinnonalalla. (Climate resilience analyses with the administrative scope of the Ministry of Agriculture and Forestry.) Natural resources and bioeconomy studies 18/2017.
https://jukuri.luke.fi/bitstream/handle/10024/538722/luke-luobio_18_2017.pdf?sequence=1&isAllowed=y

**More background literature:** https://www.mtk.fi/vesiohjelma.


**Photos**
p. 1 Minna Keränen
p. 3 Annika Öhberg
p. 5, 6, 7 Liisa Pietola & Leena Mikkola
p. 8, 9, 11, 20, 22, 27, 29, 31, 32 Airi Kulmala
p. 14 Katariina Latva
p. 17 Anna-Rosa Asikainen
p. 23 Markku Ekdahl
p. 25 Jenny Jyrkänkallio-Mikkola

# TOWARDS A GOOD STATUS OF WATERS

- through agricultural and forestry practices that reduce loads
- using cost-effective and well-targeted water protection solutions
- through catchment area-specific planning
- by applying more precise research data and by increasing know-how

SLC

The Central Union of Swedish-speaking Agricultural Producers in Finland (SLC)
www.slc.fi | 2020

MTK

The Central Union of Agricultural Producers and Forest Owners (MTK)
www.mtk.fi | 2020