



Forests provide clean water

Water is an important part of the forest landscape. Fresh-water in streams or ground-water originating from forested areas is clean compared to water from intensive agricultural areas. The frequency of human intervention in the forest ecosystem is low and the use of pesticides and fertilisers is minor. The forest land in the Nordic countries is generally managed to reduce negative impacts on forest waters. Joint Nordic research shares and produces knowledge on how to minimise forestry impacts on water.

Forest by water

The areas close to streams, lakes and other water bodies have special functions in the landscape (Fig. 1). They filter water from upslope areas, host (rare) species dependent on moist conditions, and often hold more carbon in soil organic matter than upslope forests. Also, part of the biodiversity within streams is dependent on forest cover over and around the stream. We estimate that 2-3% of the forest area is close to water (less than 10 m away). More attention should be paid to this particular part of the forest.

Local risks of impacts

As long as the tree cover is intact, forest management impacts on water are usually very small, but at final felling there are risks for local negative impacts such as increased nutrient leaching and sediment transport. The cutting of trees reduces water evapotranspiration and thereby significantly increases the runoff. Higher runoff on bare soils or soils prepared for planting may lead

to erosion and transport of soil and organic particles (sediment) to streams or lakes, which is detrimental to aquatic life. Nutrient leaching to groundwater and streams increase, especially the leaching of nitrate. Elevated nitrate leaching lasts until new vigorous vegetation is established (up to 5 years in the south, whereas in the north of Fennoscandia, the temporal pattern is largely unknown). When the new forest is established it will remain a strong sink for nutrients for decades (in the south) to a century or more (in the north).

The impacts increase with the scale of the felling operation within a catchment. If only a



Photo: Eva Ring, Skogforsk

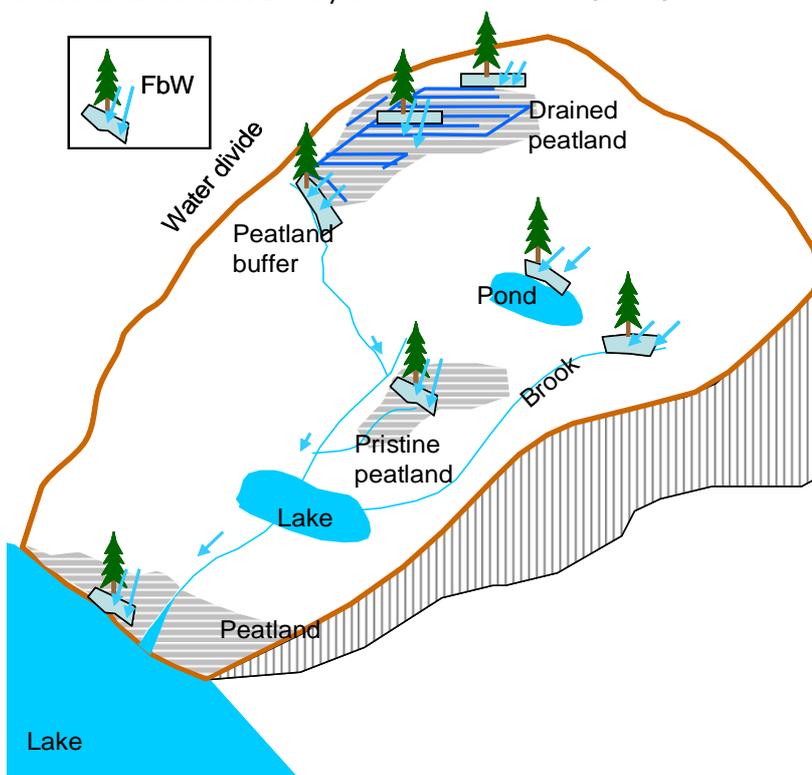


Figure 1: Forest by Water (FbW) comprises several structures in the landscape and may make up 2-3% of the forest area. Water flows through these pieces of forest before reaching the water bodies. Drawing Ari Laurén



Buffer strip along a Finnish lake. Photo: Erkki Oksanen, METLA

small fraction of the forest upslope is felled the risks for impacts on nutrient leaching are small, whereas if all upslope forest is felled negative impacts on water are likely.

How to reduce impacts?

By planning the scale and timing of the felling operation also with regard to the forest waters, negative impacts can be reduced or avoided. One available instrument is to leave forest buffer strips close to surface waters at final felling. The width of such buffer strips should for example depend on the slope of the land, the soil type and the size of the area cut that supply water to the buffer. If large enough, the buffer will have the capacity to reduce sediment and nutrient exports to streams or lakes. Further, it may at times function as refuge for forest wildlife until the new forest is established. We need to know more about the function of buffer strips and if (or how) this function is maintained in the long-term. New research on the design and management of buffer strips will emerge over the coming years. Other management options are to minimise soil disturbance in wet areas, such as off-road driving close to streams and lakes, and to perform soil preparation activities

along the contour lines of slopes to avoid soil erosion.

Air pollution increases impacts

External inputs from air pollution such as strong acids, nitrogen and heavy metals may modify the protective function of forest. In Denmark and South Sweden, some forests may leach nitrate to the groundwater even before cutting, although in smaller amounts than from agricultural fields. Nitrogen and heavy metals accumulated over a rotation period may be released after final felling and negatively affect water quality. Nitrate



In Iceland, research on the impacts of forest cover on stream quality is currently investigated. Photo: Bjarni Sigurdsson, Iceland

leaching after clear-cutting is observed to increase with nitrogen deposition. Some studies suggest that leaching of the heavy metal mercury (and its toxic organic form) also increase after final felling.

Climate change

In Fennoscandia, the precipitation amount and the frequency of heavy rains are predicted to increase along with a temperature increase. Potentially, this may increase the nutrient and sediments loads to freshwater. However, with increasing knowledge, forest management might be improved to counteract such increases.

Centre of Advanced Research on Ecosystem Services (CAR-ES)

CAR-ES is a virtual centre supported by SNS - the Nordic Forest Research Co-operation Committee for the period 2005-9. CAR-ES coordinate Nordic research on forest management impacts on the major environmental services: carbon sequestration, water protection and biodiversity. CAR-ES share, compile and produce the knowledge needed for decisions on forest management with respect to environmental services.

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Further information

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