Peatland forestry - the Finnish case

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Summary

The paper discusses the different intensity levels with which mires have been used for forestry in Finland. The Finnish approach has been a progressive one since the 1960's when the National Forest Inventory (NFI) revealed that commercial wood harvesting exceeded the annual growth of forests. Research has continuously provided information for operational-scale peatland forestry. However, political steering through forest legislation (Forest Act and Act on the Financing of Sustainable Forestry) has also taken other aspects than tree growth into consideration, e.g. employment in rural areas, social equality and the harsh northern climate. During the last decade, nature conservation questions and biodiversity requirements have also come to the forefront via legislation (e.g. Nature Conservation Act) and guidelines of a voluntary nature.

At the national level, peatland forestry with a drainage area of 5.4 million hectares has increased the annual increment of tree stands growing on peatlands twofold. About 26 % of the tree growth in Finnish forests lies on drained peatlands. Peatland forests are forecast to be of crucial importance for supplying the forest industry with raw wood.

Key index words: forest drainage, wise use, sustainable wood production

Early beginnings

Some of the first drainage works on pristine peatlands in Finland were done during the famine years (1866–68). The target was both to provide work for the unemployed and to occupy new arable land. The bulk of these drained peatlands were never reclaimed for agriculture, but the sites started their succession towards forest ecosystems on drained peatland.

In the early years, large-scale drainage operations were undertaken in ways that turned out to be the wrong ones later on. Draining of low-lying, open mires for preventing spring frost damage was one of the main issues in soil amelioration in the 19th century. It was considered that water evaporation from mires would consume such amounts of energy that wet, pristine mires were believed to be susceptible to frost damage. This assumption was, however, incorrect: the thermal conductivity is actually lower in uppermost peat layer in a drained than in a pristine site. Thus the heat transfer from warmer, deeper layers is too slow to compensate the heat loss from peat surface during the cool, clear nights.

Peatland drainage was also justified for preventing paludification of surrounding mineral soils. That is why some single ditches can still be seen on the boarder zone between peat and mineral soil. Their target was to prevent the mire ecosystem from dispersing towards adjacent upland areas. Later studies have, however, shown that paludification was no longer a general phenomenon at that time. Mineral soil sites that were susceptible to paludification had already been paludified at those climatic conditions. Small-scale lateral growth of mires may, however, still take place . Small water ponds may also be filled-in forming new mires (terrestrialisation).

Target with forest drainage

In most cases in pristine mires the stagnant water creates oxygen-poor conditions into the substrate and hampers the growth of trees. With forest drainage the tree growth can essentially be increased by lowering the ground water table down to 40–50 cm under the soil surface. The suitability of a site for tree growth after forest drainage depends both on the original site and climatic zone. Most of the drained peatland sites have been at least partly forested at the time of drainage.

Towards operational-scale forest drainage

The very early drainage undertakings showed that drainage is reasonable only on mires of certain types and that the digging of ditches has to be based on careful planning. For about hundred years the suitability of a mire site for tree growth after drainage has been evaluated with a mire site type classification system originally laid out by Cajander (1913) and later on further developed for operational scale forestry.

The systematic drainage aimed at increasing the growth of tree stands on peat soil started on state-owned lands in 1908. At about the same time, some timber companies also began to drain their forestry wetlands.

The concern of the sufficiency of the country's forest resources increased when the alarming results of the first National Forest Inventory (NFI) came available in 1924. It was obvious that without a support from public finance the growth potential of tree stands especially in private forests would not be realizable. The first Forest Amelioration Act according to which public funds were set a side in the state budget for forest drainage and other forest amelioration activities was introduced in 1928. Only after this law was passed, the forest drainage started in private forests.

Because the time perspective with investments to forest amelioration is long, may be even longer than the landowner's time of property possession, it has been concluded that public support is justified. The increased cutting returns due to investments can often be realized not until after several decades. The returns may also be susceptible to risks. It has to be noticed that both the Forest Amelioration Act and Water Act (1961) have promoted to plan and carry out forest amelioration as co-operative projects between several forest owners. This is important in a country where the forest properties are relatively small in size.

Acts directing forest policy

Forest Amelioration Acts were usually only for a limited period of time. This enabled readjustment of the state subsidy when the targets of forest policy changed. The first acts spoke about promoting wood production, later on the goal changed towards better take-care of the forests growing on private land.

Some aspects other than encouraging wood production, like social and employment aspects as well as energy politics, have also been included into the law. The public support has been higher in the northern parts of the country. During the earlier times the support used to be lower for the wealthier landowners. The employment aspects have obviously contributed to the passage of the laws in the parliament. Supporting energy wood harvesting was included into the law around 1990; thus with favouring renewable energy resources the Finnish society has behaved sensibly for quite a time.

The orientation of the forest policy and the public support policy has thus changed during the decades: the focus being in the beginning on sustainable wood production (1928–1960) was changed to progressive wood production (1960–1995) and even later (1996–) towards sustainable forestry in its widest meaning.

During the progressive wood production period the activity carried the features of a nationwide campaign. This was due to the heavily expanding wood-based industry. As a matter of fact the volume of commercial felling exceeded both the growth and the maximum allowable cut of the country's forests early in the 1960s. There was evidently a threat that the forest balance would stay negative. Thus it was considered essential from the national economy point-of-view to increase the wood production. That was why the government started to workout national wood production programs where volume-based targets were given to the growth of the forests and to the amelioration activity supporting it. One of the expedients foreseen was the draining of mires for forestry.

The biggest change in legislation controlling the use of forests and nature took place in 1997. The approach was based on the requirement of economical, ecological and social (and cultural) sustainability. These principles are directed with the relevant acts (Forest Act, Act on the Financing of Sustainable Forestry, Nature Conservation Act, and Environmental Protection Act). In addition to wood production it is aimed that utilisation take into consideration biological diversity and nature conservation aspects. Furthermore, there are also some special guidelines to be followed voluntarily, like the Finnish Forest Certification System.

It is evident that by the allocating of public funds respectively the government has tried to direct the decision making of private forest owners to go along with the forest political aims. Forest research has in its turn tried to provide decision makers with appropriate knowledge although the government and parliament may have, however, every now and then ended up to a political consensus quite far from that recommended by the independent research.

Drainage techniques

Forest ditches were planned to form a unit network of ditches. Drainage ditches (lateral ditches) have almost exclusively been open ditches, dug as 80–90 cm deep and 35–50 m apart. They collect the water from the drainage area to the collector ditch leading the waters through the main ditch towards the natural water course. The trap ditches (cut-off ditches) collect the surface water from surrounding land.

Up to the early 1950s, forest ditches were dug manually. Mechanised forest drainage commenced with the introduction of forest ditch ploughs. Ploughing was the dominant method in drainage in 1955–1967. Tractor diggers became the principal ditch digging equipment in 1969; the same year when the area annually drained reached its maximum. The digging was done with a bucket scoop, the cross-section measurements of which conformed to the standard forest ditch dimensions. Nowadays an excavator on its own prime mover equipped with wide tracks is the most common techniques used in ditch network maintenance.

Peatland forests as a notable part of commercial forests

Based on the successive National Forest Inventories (NFI) it is possible to evaluate the economic significance of forests growing on peatlands. According to the NFI 10 (2004-06) an area of 9.0 million ha (34 % of the total forestry land) is considered to be either pristine mires or mires drained for forestry. The area drained for forestry is approximately 5.5 million ha, of which 4.9 million ha are drained peatlands and 0.6 million ha are nowadays drained mineral soils, which have evidently been thin-peated originally.

Drainage and forest fertilising of mires and peatlands have considerably increased the total volume and annual increment of peatland forests (Korhonen *et al.,* 2007):

		Total volume, million m^3	Annual total increment, million m^3
NFI	3 (1951-53)	252	9.9
NFI	7 (1977-84)	291	14.9
NFI	8 (1986-94)	377	17.4
NFI	9 (1996-03)	479	21.2
NFI	10 (2004-06)	496	24.0

About 24 % of the total stand volume of forests grows on peatlands the mean volume being about 78 m^3 ha^{-1}, which is clearly less than the mean volume on mineral soil sites (106 m^3 ha^{-1}) The difference is explained at least partly by the fact that the focus of the development class distribution of tree stands on peatlands is still in young thinning stage stands where as mineral soil sites have higher share of mature stands approaching regeneration.

The total annual increment of peatland forests measured in the NFI 10 was 24.0 million m^3 which is 24.4 % of the total growth of our forests. The majority of the growth is gained in the stands growing on drained areas. The mean annual growth on forest land was 4.6 m^3 ha^{-1} on peatland sites and 4.9 m^3 ha^{-1} on mineral soil sites.

The majority of the total round wood harvested from drained peatlands is coming from thinning cuttings. If realizing the maximum cutting possibilities the annual sustainable removal from peatlands will increase in the period 2005–2025 so that the removal from peatlands is over 20 % of the total round wood annually harvested. After that the share harvested from peatlands starts to decrease (Nuutinen *et al.,* 2000).

The significance of the domestic wood supplies will even be emphasised if the import of raw wood from Russia is declining as expected. The claims to expand the nature protection (strictly preserved) areas and the positive attitude to biological diversity even in commercial forests mean that the industrial wood has to be produced on an area constantly diminishing. These trends indicate that wood from peatland forests has evidently to be acknowledged.

All the calculations done presuppose that the necessary silvicultural measures are done in due time and that the drainage condition is taken care with ditch cleaning. The realization of the sustainable cutting possibilities requires also advanced harvesting technology suitable to cutting and forest transportation in conditions with low bearing capacity. The forest owners have as well to adjust their hopes only to a level of moderate stumpage prizes.

Maintenance of drained areas

An area drained for forestry is an unstable ecosystem, and its state of drainage requires continuous follow-up, and especially so after wood harvesting. It has to be ascertained whether the poor stand development is due to insufficient draining or low nutrient status of the site. According to the NFI 9 about 10 % of the drained area is unsuitable for tree growth (Tomppo 2005).

The new guidelines for the Best Management Practices for Peatland Forestry compiled by the Forest Development Center Tapio give criteria for the evaluation of the suitability of a site and a stand for future amelioration and silvicultural measures based on the expected growth and the financial benefits. It is also seen that both forest owners and wood harvesting organizations follow fairly well the legislation and voluntary guidelines.

The future of peatland forestry

Peatland forests will thus play a highly important role in the delivery of raw wood for industry. The major challenge for peatland forestry is connected to wood harvesting from the areas having a low bearing capacity. At the present, an intensive development of the machines appropriate for wood harvesting from peatlands is under vigorous progress. Wood harvesting and ditch network maintenance (mainly ditch cleaning) has to be performed tightly coordinated. The Act on the Financing of Sustainable Forestry presupposes that the water protection questions have to be carefully taken into consideration in connection with planning and performing the ditch network maintenance.

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