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Theme 2: Potential effects of intensified forestry as a climate mitigation measure on surface water quality in acid sensitive catchments

The threat of climate change has led to a focus on forest management techniques to increase carbon sequestration as a climate mitigation measure. Fertilisation of forests and increased removal of biomass have been proposed. But these and other forest practices may have undesirable effects on surface water quality. In naturally acid-sensitive areas such as much of Fennoscandia a particular concern is acidification due acid deposition in combination with forest practices that increase removal of base cations and leaching of nitrate from the soil.

Here we apply the biogeochemical model MAGIC to the coniferous-forested catchment at Birkenes, southernmost Norway, to simulate the effects of scenarios of forest fertilisation and intensive forest harvest on soil and streamwater acidification. The model was calibrated to the 40-year monitoring data for water quality, soil and vegetation and then used to simulate fertilisation and clearcutting of the mature forest by either conventional stem-only harvest (SOH) or whole-tree harvest (WTH).

The simulations indicate that while forest fertilisation increases forest growth, it results in higher leaching of nitrate following clearcut. The 5-10 year pulse of nitrate following clearcut was larger with SOH than WTH, but over the longer term, under SOH the water quality recovers faster than under WTH. This is because WTH causes larger acidification of surface water relative to SOH, due to greater depletion of base cations, nitrogen and carbon from the soil.

This modelling study at Birkenes demonstrates that intensified forestry may cause substantial effects on surface water quality in acid-sensitive areas. It must be noted, however, that the Birkenes study represents an extreme case with 100% clearcut of a catchment. In reality only a small fraction a catchment will be cut each year, and it is usual to establish buffer zones along streams with permanent flow troughout the year. Even though the effects following harvest can be substantial in first-order streams, the signals are relatively short-lived and are rapidly weakened further downstream in stream networks. Nevertheless, it is important that forest and environmental managers carefully consider surface water sensitivity to acidification when selecting sites for fertilisation and making decisions on harvesting methods.

Reference: Valinia S, Kaste Ø, Wright RF. Intensified forestry as a climate mitigation measure alters surface water quality in low intensity managed forests. Manuscript in review.

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SURFER – Surface waters: The overlooked factor in the forestry climate mitigation debate.

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