19 March 2013
Thematic Issue 37: Ecosystem-based Adaptation

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Source Ford, C.R., Laseter, S.H., Swank, W.T. & Vose, J.M. (2011) Can forest management be used to sustain water-based ecosystem services in the face of climate change? *Ecological Applications.* 21(6): 2049-2067.

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Forest management for climate change adaptation must fit the context

Forest management could help adaptation to climate change through its effects on water supply. A long-term US-based study has analysed the impact of forested land use changes on water flow into streams and rivers. It indicated that converting forests from deciduous to pine trees could help water storage in extreme wet conditions, but may be unsuitable in droughts. As such, it recommends tailoring management decisions to the context.

Forests are valuable providers of ecosystem services related to water supply for humans and wildlife. However, climate change can directly alter the amount, type and timing of precipitation, such as rain and snow. It can also have indirect effects via changes in temperature and CO_2 levels that can increase water use by plants and decrease the water flow into streams and rivers.

Some of the negative impacts of climate change can be counteracted through forest management. Changing tree species can change the amount of water released to the air from leaves ('evapotranspiration') and the amount of water trees catch from precipitation ('interception'). Both these processes affect the amount of water stored in trees and therefore the amount that reaches waterways via the trees' roots.

The study aimed to quantify the interaction between climate, forest management and stream flow by analysing 75 years of data from six watersheds in the US with changing management strategies. On two watersheds there had been a conversion from deciduous forest to evergreen plantation, whilst two other watersheds experienced continuous clearcutting where all or most trees were removed. Another watershed had experienced clearcutting and the growth of wood from stumps and roots (coppice), whilst on the final watershed woody vegetation had been removed and allowed to grow back naturally (old-field succession).

In the year following the management change, all watersheds experienced a significant increase in the level of stream flow, ranging from a 19% increase under old-field succession to 70% under clearcut and coppice.

In the majority of the watersheds, there was a noticeable impact of management. For example, under old-field succession and clear cutting strategies there was a shift to trees with high evapotranspiration rates that use more water in wet years and provide the soil with a greater water storage capacity, reducing stream flow. For old-field succession, the age of the returning forest could also be a factor, as fully-developed trees are likely to use more water. In the two cases where evergreen trees were planted, stream flow was reduced in both wet and dry years, which may be due to the greater interception of precipitation by these trees.

The results indicate that forest management can be used to help adapt to climate change, but potential trade-offs must be considered. For example, converting to dense pine forests could mitigate high flows and flood risk in wet years, but in the drier years this could exacerbate drought. As such, it is critical to assess the context to make the most appropriate choice of management and vegetation.