Benefits of falling nitrogen pollution understated, report says

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Falling levels of nitrogen in the atmosphere across Europe may be much more economically beneficial than previously believed, according to a recent study.

Indeed, scientists think the UK alone benefits by around £65 million a year. Levels of atmospheric nitrogen have fallen by around a quarter in Europe since 1990, mostly because of tighter rules on emissions from engines and industry. Scientists are still working to understand the consequences.

This is difficult, because excess nitrogen affects the benefits that nature gives us (known as 'ecosystem services') in many different ways – some positive and some harmful. For example, nitrogen is an important plant nutrient, which means services that depend on plant growth, such as

crops and timber from woodlands, will benefit from more of it in the atmosphere. Conversely, falling nitrogen levels will harm these services - so cutting pollution costs the economy money.

Too much nitrogen harms other ecosystem services, though. For example, it reduces plant biodiversity and tends to favour the growth of rough, weedy vegetation like nettles and coarse grasses, which many people think makes the landscape look scruffy. Too much nitrogen therefore reduces our enjoyment of nature.

The study, published in the journal Ecosystem Services, is the first to take a comprehensive look at the impact of falling nitrogen levels on a range of ecosystem services and hence on the economy. Previous studies have tended to focus on 'provisioning' services like timber production and 'regulating' services like carbon sequestration, which are relatively easy to value. They have done this at the expense of 'cultural' services like tourism and appreciation of the natural environment. These do have value, but are harder to measure and quantify.

This paper is the first systematic attempt to value nitrogen's effects across a broad range of ecosystem services, taking these cultural services into account and weighing their impact alongside that of provisioning services. It reveals that by looking only at those services which are easy to value, we run the risk of seriously underestimating the benefits of falling atmospheric nitrogen.

'Ours is the first study to try to value air pollution properly from an ecosystem services perspective,' says lead author Dr Laurence Jones of the Centre for Ecology & Hydrology (CEH). 'We took examples from the range of provisioning, regulating and cultural ecosystem services - two of each - and calculated the overall costs and benefits to the UK. If you only look at the provisioning services there is a big loss in value because atmospheric nitrogen is effectively free fertiliser and we are

now getting less of it. But to get the whole picture you look at a wider range of ecosystem services.'

The authors reviewed the effect of nitrogen on numerous kinds of ecosystem service, including both obvious benefits like timber production and water purification to less well-studied ones like production of game for shooting on moorlands and of wool on semi-natural grasslands; the genetic diversity of wild species; aesthetic appreciation of flowering plants; and anglers' enjoyment of healthy rivers.

They then calculated the value of declining nitrogen deposition on six representative services, and concluded that timber and livestock production saw an annual drop in value of £6.2 million, and lower absorption of greenhouse gases due to slower plant growth cost the economy a further £15.7 million a year. But the benefits of cultural services like good sites for fishing and people's increased enjoyment of nature are much greater, amounting to an estimated £87.7 million.

Not everyone agrees that you can compare a cultural benefit such as people getting more enjoyment from fishing with a more concrete cost for a market good like timber. But Jones says many environmental economists argue that this is the only way to get a full picture of a change's effects - we need to accept that the methods used to value each are different, but try to take this into account so that their results can be compared.

To value cultural services, the authors took data from earlier studies on how much people value a diverse environment with many species. These asked subjects how much they'd be willing to pay to protect either 'charismatic' organisms like birds and butterflies or 'non-charismatic' ones like moths and plants, which don't tend to attract such public enthusiasm. Jones and colleagues wanted to be conservative, so they

based their calculations on the values for non-charismatic species - if they'd used values for charismatic species, the benefits for cultural services would have been roughly five times higher.

This study looked only at atmospheric nitrogen deposition; it did not take into account nitrogen released directly onto our landscapes, which continues to be a serious problem, for example harming biodiversity by adding excessive nutrients to rivers and coastal waters.

Jones is now carrying out follow-up work for Defra, which co-funded this study. He and colleagues at CEH are focusing on improving this method of ecosystem services valuation to cover a wider range of services, and looking at other pollutants such as sulphur and ozone. They are assessing the impacts of future scenarios of pollutant emissions for Defra, and developing 'damage costs' (the cost caused by each tonne of pollutant emitted in the UK) for use in policy appraisal.

More information: L. Jones, A. Provins, M. Holland, G. Mills, F. Hayes, B. Emmett, J. Hall, L. Sheppard, R. Smith, M. Sutton, K. Hicks, M. Ashmore, R. Haines-Young, L. Harper-Simmonds. "A review and application of the evidence for nitrogen impacts on ecosystem services." *Ecosystem Services*, Available online 7 October 2013, ISSN 2212-0416, dx.doi.org/10.1016/j.ecoser.2013.09.001

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