HOW DO WE VALUE OUR NATURAL CAPITAL?

Meeting of the Parliamentary and Scientific Committee on Tuesday 25th February

VALUING NATURAL CAPITAL

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Valuing changes in natural capital can help stop its decline – but only if we do it properly. Over the next year, the Natural Capital Committee [1] (NCC) will develop its advice further about how to prioritise action to conserve and enhance our natural assets in order to meet the Government's ambition to be *"the first generation to leave the natural environment of England in a better state than it inherited"* [2].

Throughout my career as a Government economist, my science colleagues have often accused my profession of *'knowing the price of everything and the value of nothing'*. I hope to dispel that myth and argue that the degradation of our natural environment is occurring precisely because its value is not being adequately recognised and included in our decision-making processes.

By incorporating these values into decisions made by Government, businesses and individuals, scarce resources can be used more efficiently, economic growth can be better supported, and our wellbeing can be increased. Society would be a lot better off if we valued natural capital properly.

... its value is not being adequately recognised ...

The emerging interdisciplinary field of 'natural capital' has given rise to a new set of terminology that many find confusing. This presents some, well recognised, communication challenges. Natural capital refers to those elements of nature that produce (or are of) value [3].

Natural capital is a stock concept. Any economy, be it Germany's or Gabon's, has a capital stock which it uses to produce output. This stock can be broken down into:

- produced capital (such as roads, railways, housing),
- human capital (knowledge and skills),
- social capital (trust, behavioural norms and institutions), and
- natural capital (for example, forests, water, land, soils, and wild species).

These different capitals are combined in different ways to produce goods and services that we consume. We derive value from them. Natural capital is different from other forms of capital in that we do not have to 'make it' – it is a gift of nature. Indeed, many assets (the living ones at least) are capable of sustaining themselves indefinitely, if used wisely.

However, like other forms of capital, natural capital can be overused and degraded. Investment is typically required to maintain natural assets so that they can continue to provide the goods and services from which we derive value.

Evidence demonstrates we are not investing enough in our natural capital. The UK's National Ecosystem Assessment [4] concluded that "*although UK ecosystems are currently delivering some services well, others are in long-term decline*". Similar patterns of degradation are being observed across the world. In 2005, the Millennium Assessment [5] concluded that "*nearly two thirds of the services provided by nature to humankind are found to be in decline worldwide. In effect, the benefits reaped from our engineering of the planet have been achieved by running down natural capital assets*".

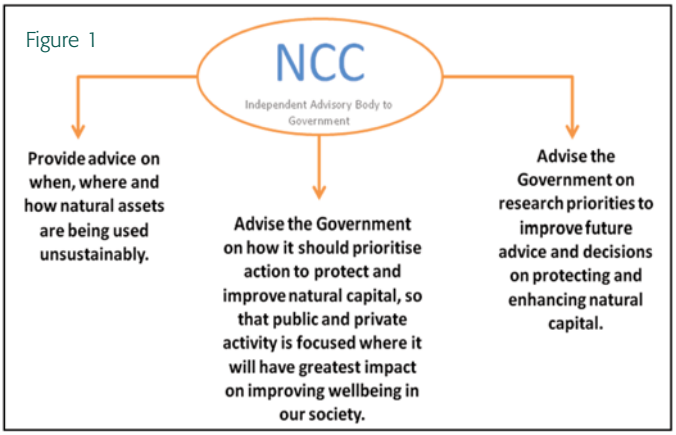
Why is this happening? Why are we failing to conserve and invest in our natural assets? The answer is a wide range of complex, interrelated factors, but a very important one, perhaps the most important in fact, is our inability to measure adequately and value changes in those assets. We don't have readily observable values. Because of this natural assets are often assigned a value of 'zero' in the decisions we take; the inevitable consequence of which is degradation over the long-term.

When economists talk about placing monetary values on the environment, it is not because we lack moral principles or because we do not recognise that nature has a value beyond

human use. It is because we want to be able to compare different things using a common unit of measurement. All of us compare different things using money every day – that is one of its main functions, and doing so allows us to make informed choices easily. This is the basic rationale for trying to value natural capital – to avoid a default value of zero and to facilitate comparison between different investments.

As a proponent of valuation, I am not recommending that we estimate the 'total value' of all natural capital. This is a futile exercise although several studies have attempted it. Most economists agree that such initiatives do not produce reliable results and are not useful for policy or decision-making purposes.

Figure 1



However, woodlands provide a whole series of other things that are of value to us – they sequester carbon from the atmosphere, they regulate water flows in catchments and provide spaces for outdoor recreation, to name but a few. By including the value of these benefits in planting decisions, the amount and location of new woodlands would look different to a situation where only the value of timber and the forgone losses in agricultural output are considered. Professor Ian Bateman (a member of the NCC) and colleagues from the University of East Anglia have modelled these issues and conclude that society could be hundreds of millions of pounds better off each year by taking into account carbon and recreational values in new woodland planting decisions[8].

... Natural capital is different from other forms of capital ...

Neither are proponents of valuation attempting to estimate values of changes in natural assets so that they can be assigned a price and exchanged for cash[6]. Price and value are very different things. Let me illustrate using woodlands as an example. Few would disagree that they are an important and very valuable natural asset. But how important and how valuable are they compared with schools, roads or hospitals[7]? That is the investment decision we always face.

Woodland areas are obviously a source of timber when harvested and the price of timber acts as a good indicator of timber value. In order to produce timber, the skills and expertise of foresters are needed (human capital), along with reproducible capital (saws and machinery) and natural capital (good soils, water and the tree species themselves).

... natural assets are often assigned a value of 'zero' ...

THE NATURAL CAPITAL COMMITTEE

The Natural Capital Committee has been set up to advise on this vital issue. Figure 1 outlines its terms of reference.

The Committee has recently published its second *'State of Natural Capital'* report which has three key messages:

1. Some assets [*in England*] are currently not being used sustainably. The benefits we derive from them are at risk, which has significant economic implications;

2. There are substantial economic benefits to be gained from maintaining and improving natural assets. The benefits will be maximised if their full value is incorporated into decision-making; and,

3. A long-term plan is necessary to maintain and improve natural capital, thereby delivering wellbeing and supporting economic growth.

Over the next year, the NCC will formulate advice and recommendations to Government about how we should conserve and invest in our natural assets. We will explore issues including: national and corporate accounting; developing better ways of measuring changes in natural capital; improving the use of cost-benefit analysis; and, importantly, how Government, businesses and society might approach formulating a long-term plan to improve our natural assets.

These initiatives will make a significant contribution to improving our knowledge and informing management action to conserve our natural assets. What is already clear is that if we continue to ignore their true value and fail to tackle the growing pressures that are being placed on them, we will surely be much worse off.

References

1 The Natural Capital Committee is an independent advisory committee set up by the Government to advise on how society can take better account of the value of nature and ensure this value fully informs decision-making. More information can be found at www.naturalcapitalcommittee.org.

2 HM Government (2011) *The Natural Choice: Securing the value of nature.* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228842/8082.pdf

3 NCC (2014) Towards a framework for measuring natural capital. Working Paper 1. www.naturalcapitalcommittee.org.

4 UK National Ecosystem Assessment (2011) Synthesis and key findings. http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx

5 http://www.millenniumassessment.org/en/index.html

6 See article by George Monbiot, http://www.theguardian.com/commentisfree/2012/aug/06/price-rivers-rain-greatest-privatisation.

7 See Lázaro-Touza, L. & Atkinson, G. (2013) Nature, roads or hospitals? An empirical evaluation of sustainable development preferences, Ecological Economics, 95, 63-72.

8 The details of which can be found the NCC's second State of Natural Capital report and the forthcoming UK National Ecosystem Assessment Follow-On (NEAFO) project.

The Committee also heard from Professor Rosie Hails MBE, Science Director for Biodiversity and Ecosystem Science at the Centre for Ecology and Hydrology (CEH).

She is a member of the UK government's 'Natural Capital Committee', as well as a member of the Advisory Committee on Releases to the Environment (ACRE).

A summary of her presentation will appear in the next issue.

HOW DO WE VALUE OUR NATURAL CAPITAL?

VALUING NATURAL CAPITAL

Professor Brett Day
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Economists and ecologists are not obvious bedfellows. The world of the power-dressing economist, pre-occupied with issues of finance, investment and growth, would seem to have little in common with that of the welly-wearing ecologist, engrossed in the complex interactions of the natural world. Over recent years, however, an unlikely alliance has developed between the power-dressers and the welly-wearers centred on their mutual concern for natural capital.

Natural capital comprises that wide array of environmental assets and processes that directly or indirectly contribute to the well-being of people. That's a lot of stuff. The air, oceans, land, soil, rivers, minerals and forests are all examples of natural capital: each contributes in some way to a flow of benefits. Sometimes those flows are in the form of tangible entities (economists would call them goods) like coal, timber or fish. Sometimes those flows are in the form of less tangible entities (services) such as through the regulation of floods, the breakdown of waste and pollution or the existence of natural areas in which to enjoy recreational time.

Amongst economists, there has been a growing understanding that natural capital is as fundamental to economic activity as other productive assets such as built and human capital. Unlike those other assets, however, natural capital is rarely owned … who owns the atmosphere, or the oceans, or processes of nutrient cycling? As a result, the flow of goods and services coming from natural capital, especially those of a less tangible variety, are rarely paid for in markets … who pays for clean air, or the pollination services provided by insects, or a walk in the woods? Since these goods and services are provided for free, their value to society is easily overlooked. Until recently, policies and projects have been evaluated with only cursory consideration of their impacts on natural capital. That is regrettable since ignoring those impacts can lead to poor decisions, decisions that fail to acknowledge the very real losses that people endure when flows of non-market environmental goods and services are damaged.

… services coming from natural capital are rarely paid for in markets …

For ecologists the great value of the natural world has always been self-evident. Rather, the issue has been one of conveying their concerns in a language that resonates with policy makers. When presented with hard figures on the beneficial impact of a proposed policy on profits, jobs and economic growth it's all too easy to ignore counterbalancing costs enumerated in, for example, hectares of lost natural habitat, declines in species diversity or increases in pollutant concentrations.

Some twenty years ago, economists and ecologists made their first tentative attempts to work together in understanding natural capital.

… the banner of the ecosystem services approach …

Ecologists were able to explain to economists the mysterious workings of the natural world. Now it would be possible to estimate how flows of environmental goods and services might be affected by changing policies. Economists brought a toolkit of non-market valuation methods which allowed ecologists to express the value of the natural world in terms of hard cash. Tentative collaborations turned into major projects and from that a whole new area of academic pursuit has evolved, brought together under the banner of the ecosystem services approach.

From the outset, the UK has been a leading player in this. We now have an established forum for the exchange of ideas and the development of research capacity through NERC's Valuing Nature Network. DEFRA's Natural Capital Committee provides a high-profile conduit for those ideas to be communicated to government. Countless reports and research publications emanate from UK academics (Hoepner et al, 2012). Indeed, the latest large-scale UK contribution comes in the form of the National Ecosystem Assessment – Follow On (NEAFO) project whose final report will be released later in 2014.

One of the analyses in the NEAFO project resulted from the work of myself and colleagues at the University of East Anglia (Bateman, Day et al, 2014). Complementing our own expertise in economics, climate and hydrology with that of ecologists from the University of Aberdeen, the British Trust for Ornithology and the Forestry Commission, we set out to build a computer programme that could estimate the impact of policy decisions on the value of ecosystem service flows across Britain over the next fifty years. Affectionately nick-named TIM (The Integrated Model), this programme links state-of-the-art models of economic, ecological, climate and hydrological subsystems in one spatially-explicit super-model of ecosystem service flows in Britain.

TIM's central focus is the capital asset of land. Policies that change decisions concerning the use of land (whether it is dedicated to agriculture, forestry, nature or to housing and factories) have far-reaching ramifications for ecosystem service flows. For example,

dedicating land to agriculture results in outputs of food that can be sold in markets for a profit. At the same time, intensive agricultural practices harm bird populations and generate diffuse pollution that damages freshwater ecosystems. Alternatively, displacing farmland with woodland reduces food production but generates a flow of timber, another market good that can be sold for profits. Woodlands also provide a habitat for birds, provide a wonderful recreational resource for people and have the potential to lock up carbon from the atmosphere. The beauty of TIM is that it brings all these different consequences together, turns them into economic values and allows policy makers to explore the impacts of land use policy through one interface.

... reduces food production but generates a flow of timber ...

While there have been other attempts to create integrated models of land use (Schaldach and Priess, 2008) none has been as ambitious, detailed or far-ranging as TIM. TIM's most innovative feature is that rather than simply calculating the particular changes in ecosystem service value flows resulting from a particular change in policy, TIM has the intelligence to search across different options and design policies that generate the most value. That intelligence requires intense data-processing made possible by TIM's use of high-performance computing hardware and high-speed computational algorithms.

To illustrate TIM's capabilities, the UEA-led research team explored proposals to significantly increase the area of woodland in England, Scotland and Wales (IPF, 2012). The analysis considered a case study in which each country plants 250,000ha of new woodland (roughly 3% of land area) over a 50 year period. TIM examined the costs and benefits of planting in every location in Britain and through its computing intelligence was able to identify planting locations which maximise values.

Figure 1 illustrates some of the key findings of that analysis. The left hand side map shows where Britain's new woodlands should be planted if the only ecosystem service flows considered are those whose values are readily observable in market transactions. In this case, the calculus reduces to a simple comparison of the value of timber production with the value of agricultural output. As shown on the map, the conclusion of such an analysis is that the best place to plant new woods is in remote upland locations where the value of displaced agricultural output is at a minimum. Even so, because profits from timber are generally lower than those from farming, the policy still yields an overall negative sum of about £134m per annum: an amount which taxpayers would have to pay in compensation to farmers in order to induce them to allow the afforestation to go ahead.

There are other, generally positive, ecosystem service flows that result from this proposed afforestation: carbon sequestration, the creation of recreational opportunities and improvements for wildlife and in water quality. Since those ecosystem services are ignored in the analysis, the choice of planting locations does little to ensure these value flows are optimised. For example, planting trees in upland locations often disturbs carbon-rich peat soils releasing large quantities of carbon into the atmosphere. When taken together, the values resulting from these additional ecosystem services are insufficient to offset the market costs of the scheme. Accordingly, overall, the taxpayer incurs a net loss of roughly £66m per annum (see details in Table 1). In short, locating new woodlands without considering wider ecosystem service benefits results in poor decisions and negative value for money to the taxpayer.

The right hand side map of Figure 1 shows where new woodlands would be located if decisions took into account both market-priced and non-market ecosystems service flows (the analysis shown particularly considers carbon and recreation values). Relative to the previous map, a dramatic shift is evident in the location of Britain's new woodlands, bringing them off remote upland peat areas and adding a 'green fringe' of woodland around Britain's major population centres.

As Table 1 shows, since we would now be planting on more productive farmland, initial financial outlays more than double to £287m per annum. However, the value of avoided and stored greenhouse gases increases substantially. Likewise, recreation values increase massively due to the much greater accessibility of these new woodlands. Overall, non-market values increase more than ten-fold such that value for money changes from negative to a very strong positive balance of over half a billion pounds per annum.

... taxpayers would have to pay in compensation to farmers ...

The impact of these different approaches to decision-making is perhaps made most visible through Figure 2 which illustrates the location of new woodlands relative to the two largest urban centres in England: London and the West Midlands. In both cases the use of market prices alone to determine planting locations results in a

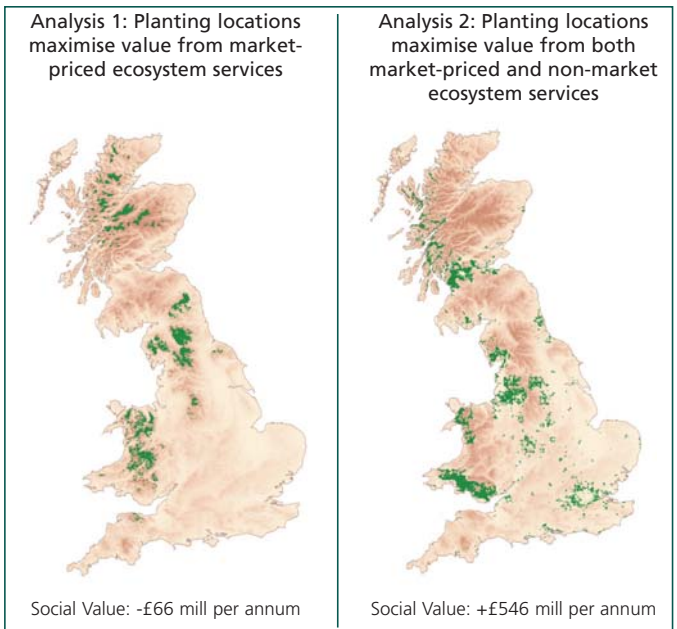

Figure 1: Britain's new woodlands - the location and total social value of planting 250,000 ha of new woodland in England, Scotland and Wales over the next 50 years.

Table 1: Market, non-market and total social values of planting Britain's new woodlands under two decision rules (£million per annum)

	Analysis 1: Planting locations maximise value from market-priced ecosystem services	Analysis 2: Planting locations maximise value from market & non-market ecosystem services
Market Value	-£134	-£287
Non-Market Value	£68	£833
Total Social Value	-£66	£546

Table Notes:
- Market values = agricultural and timber output
- Non-market values = greenhouse gases and recreation (water quality impacts and impacts on wildlife are quantified but not monetised although afforestation improves both of these measures);
- Total social values = Market values + Non-market values
- Greenhouse gas values priced using low range carbon equivalent prices (see Bateman, Day et al., 2014)

References

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complete absence of woodlands around these urban centres, primarily because the recreational values of woodland are ignored. In contrast, when wider ecosystem services are accounted for, optimal planting decisions result in woodland fringes being generated around each city and town in the region: a policy that would create a legacy of multipurpose, high value woodlands for generations to come.

The NEAFO project demonstrates how far the study of natural capital and ecosystem services has come. Interdisciplinary teams of economists and natural scientists are now working together using state-of-the-art models and computing methods to provide decision makers with a solid evidence base upon which to make policy decisions about the natural environment. The way things are going, we could well find that the next generation of economists are as comfortable in a pair of muddy wellies as they are in their pin-striped city suits! What a horrible thought!!

... woodland fringes being generated around each city ...

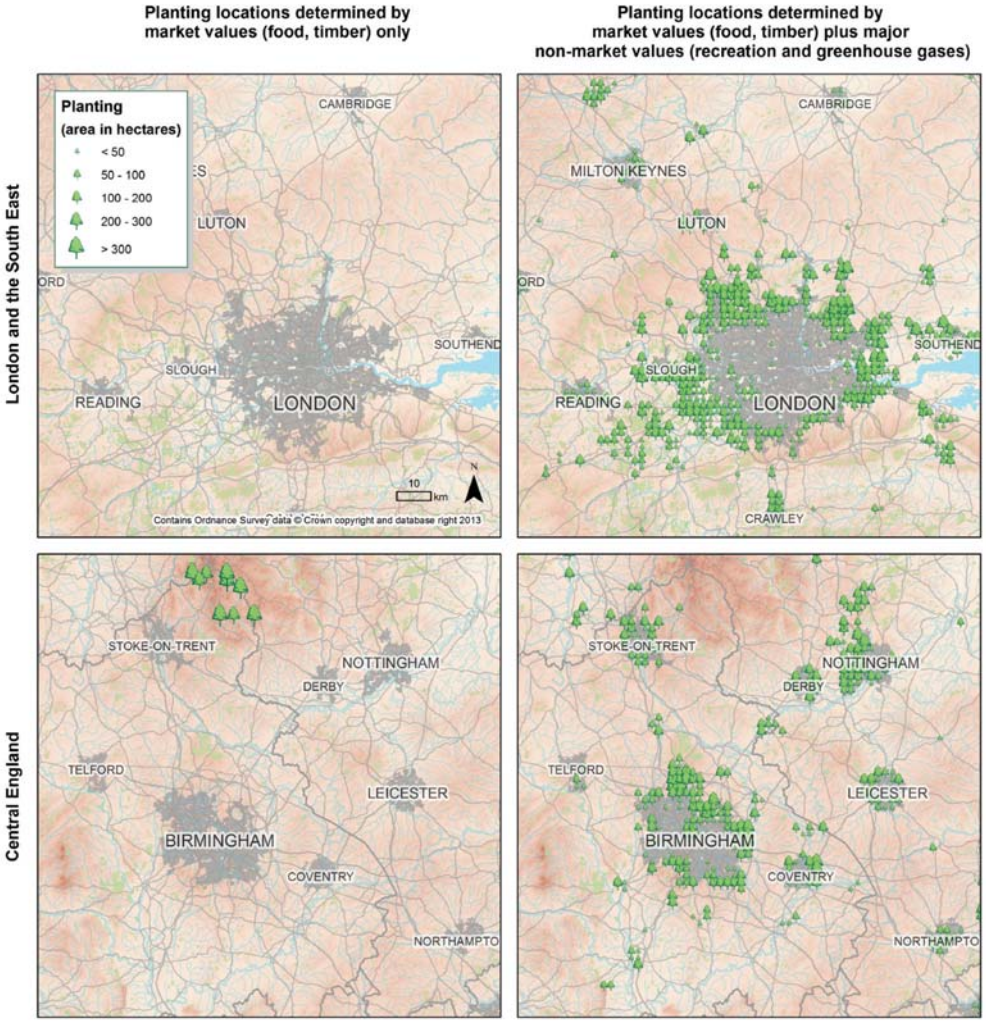

Figure 2: New woodlands for Britain's urban centres: The location of new woodland around London (upper row) and Central England (lower row) if planting locations are determined by food and timber alone (left hand column) and food and timber, plus recreation and greenhouse gases (right hand column).