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The utilisation of environmental knowledge in land-use planning: drawing lessons for an ecosystem services approach

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Abstract. Proponents of ecosystem services approaches to assessment claim that it will ensure the environment is 'properly valued' in decision making. Analysts seeking to understand the likelihood of this could usefully reexamine previous attempts to deploy novel assessment processes in land-use planning and how they affect decisions. This paper draws insights from a meta-analysis of three case studies: environmental capital, ecological footprinting, and green infrastructure. Concepts from science and technology studies are used to interpret how credibility for each new assessment process was assembled, and the ways by which the status of knowledge produced becomes negotiable or prescriptive. The influence of these processes on planning decisions is shown to be uneven, and depends on a combination of institutional setting and problem framing, not simply knowledge content. The analysis shows how actively cultivating wide stakeholder buy-in to new assessment approaches may secure wider support, but not necessarily translate into major influence on decisions.

Keywords: environment, planning, knowledge, assessment, ecosystem services

1 Introduction

Land-use planning systems have long been recognised as important mechanisms for environmental protection (RCEP, 2002). This potential can be realised through a wide set of processes—spanning policy formulation, regulation, and enforcement, at different spatial scales—but a constant thread is the opportunities that planning offers for bringing environmental knowledge to bear on decisions about development and land use. In the UK, from the early 1990s, the policy imperative of integrating sustainability into the planning system energised efforts to design methodologies for assessing and evaluating environmental resources and the impacts of decisions, which have provided important vehicles for integrating environmental knowledge into governance processes (Owens and Cowell, 2010; Rydin, 1995).

The international emergence of 'an ecosystem assessment approach' or 'ecosystem services approach'[(1)] should thus be seen as the latest in a long line of attempts to ensure that the 'true value' of the environment is considered in decision making (Adelle et al, 2012; Braat and de Groot, 2012; UK NEA, 2011, page 13). At the core of these approaches is an attempt to capture and make visible the processes through which natural ecosystems provide benefits to human society (Millennium Ecosystem Assessment, 2005; UK NEA, 2011). Proponents of ecosystem services approaches have considered how these methods connect with policy making (ten Brink, 2011), and planning is considered to offer important venues

[(1)] For simplicity, this paper refers to 'an ecosystem services' approach from hereon.

for using such approaches, whether that be for 'spatial planning of habitats' to help deliver ecosystem services (Medcalf et al, 2012; UK NEA, 2011, page 56), to plan for greener urban development (UK NEA, 2011, page 75), or in environmental assessment (Baker et al, 2013; Wilkinson et al, 2013).

The question that drives this paper is to what extent might one expect ecosystems services approaches to affect planning decisions? This is a tricky question. To date, there has been relatively little explicit use of ecosystem services approaches in planning-related activities and thus little direct evidence on which to draw (but see Campbell and Sheate, 2012; McKenzie et al, 2014). It is also tricky because the distinctive features of 'an ecosystem services approach' are nebulous, residing in claims to offer a 'comprehensive' or 'holistic' approach to understanding the various ways that ecosystems support human well-being (see discussion in Braat and de Groot, 2012). More fundamentally, what makes for 'better use of environmental knowledge' is subject to multiple interpretations (Haines-Young and Potschin, 2014; Jordan and Russel, 2014; Rich, 1997). In planning one can see (at least) two broad conceptions of 'better use' at work: one appeals to technocratic rationality, that good decisions require the 'best possible information'; the other rationale, more overtly normative, is that achieving sustainability requires *greater* weight to be placed on environmental factors. Advocates of ecosystem services typically span these rationales—for example, in claiming that "Valuing (natural resources) properly will enable better decision making" (UK NEA, 2011, page 4) and that "the natural world" is "consistently *under*valued in conventional economic analyses and decision making" (page 5, emphasis added).

Our first broad argument is that there are lessons that can be drawn from prior efforts to introduce new assessment frameworks into planning, which may be helpful in understanding the likely takeup and effects of ecosystem services approaches (see also Turnpenny et al, 2014; Wilkinson et al, 2013). But to talk of lessons immediately raises questions about the causal theories that are used to explain the relationship between (environmental) knowledge and decisions. Proponents of ecosystems services approaches have given much attention to improving the mapping, modeling, and quantifying of ecosystem services (TEEB, 2010), thus echoing persistent linear–rational models of knowledge utilisation, in which the solution to inadequate influence on decisions is to generate 'better knowledge', achieved via methodological improvements. However, as numerous commentators have noted (Adelle et al, 2012; Owens et al, 2004), linear–rational models embody a poor explanation of how knowledge *actually* affects decisions, thus offering partial lessons for institutional design.

This leads to our second argument, which is that addressing the leverage question—understanding how, why, and in what circumstances environmental knowledge comes to exert leverage over business as usual (see also Owens, 2012)—requires a theoretical framework with a more reflexive engagement between techniques for environmental assessment and the social and institutional contexts in which they are used (see Adelle et al, 2012; Carmona and Sieh, 2008; Rydin, 2010). We make a case for using concepts from science and technology studies to dissect how particular approaches to the production of environmental knowledge become bound into actions—a process in which the 'internal' qualities of knowledge are but one element of processes that also bring together an array of 'external' factors. To a degree, the designers of ecosystem services approaches have been alert to social dimensions of the production of environmental knowledge, insofar as methodologies seek to incorporate a plurality of values and appeal to transparent, collaborative decision making (UK NEA, 2011, page 14; see also Braat and de Groot, 2012). However, the desire for more open and/or deliberative modes of assessment raises a host of problems (Lo, 2011; Rauschmayer et al, 2009), and it is unclear how far such modes help the resulting knowledge gain traction in actual decision-making processes (though see McKenzie et al, 2014; Waylen and Young, 2014).

Our approach is to conduct a meta-analysis of three other assessment frameworks, each of which illuminates how environmental knowledge becomes (or fails to become) influential in local planning processes. The case studies are the use of 'environmental capital' frameworks in minerals planning in South East England; ecological footprinting in Cardiff, Wales; and the emergence of green infrastructure (GI) in the Republic of Ireland.[2] Each focuses mostly on ex ante assessment,[3] and working definitions of each assessment approach are given in table 1. The case studies are useful analogues to the situation facing ecosystem services approaches in many policy systems. Firstly, as ecosystem services, each assessment approach was relatively novel during the period each case study took place, enabling examination of how a technique of previously uncertain status acquires significance. Secondly, the three cases can highlight the array of factors that affect the relationship between environmental knowledges and decision making, especially in the institutional contexts of planning. In particular, each enables us to observe the effects of stakeholder engagement practices in the initial stages of methodology adoption. Thirdly, ecosystem services approaches share with the cases analysed a broadly instrumental, economistic language of environmental value (Rauschmayer et al, 2009; Stibbe, 2012).[4] Each treats the environment as 'capital', 'capacities', or 'infrastructure' that provides services to humans. Examining the fate of these

Table 1. Working definitions of each assessment approach.

Assessment approach	Environmental capital and capacity	Ecological footprint	Green infrastructure
Definition of process	to identify the stock of environmental capital that must be maintained for future generations	to measure how much biologically productive land is needed to maintain a given consumption pattern	to identify and secure multifunctional, connected areas of green space, predicated on their ability to deliver environmental, social, and economic benefits

Note: The definitions are simply for the initial orientation of the reader; we acknowledge that the definitions are open to debate, especially with green infrastructure.

[2] The methodological basis of the analysis is as follows. For the Berkshire case study data were obtained primarily from documents produced for the draft replacement local mineral plan inquiry and observation of the inquiry itself as policy matters were discussed. The case study is written up more fully in Cowell and Owens (1997), Cowell and Owens (1998), and chapter 7 of Owens and Cowell (2010). For the Cardiff case study data were derived from documents produced by Cardiff Council, for the production of the ecological footprint (EF) but also wider strategic documents, as well as semistructured interviews with fifteen council officers and elected members. The case study is written up most fully in Collins et al (2009). For the Republic of Ireland case study the analysis of GI comes from unpublished PhD research (Lennon, 2013) and is based on fifty-two interviews with an array of officers in planning, environmental protection, and other sectors conducted between 2009 and 2011, and extensive analysis of 131 documents produced primarily within the period 2008–11.

[3] That is, assessment to inform decisions not yet formally taken, although each approach could be used in the ex post monitoring of outcomes.

[4] Although the language evokes economistic and human–instrumental values, operationalising these assessment frameworks can accommodate a wider array of values. Environmental capital frameworks do not preclude that certain environmental features should be treated as 'critical environmental capital' for the aesthetic or intrinsic values of nature (see discussion in Owens and Cowell, 2010). With ecological footprinting, alongside the lexicon of bioproductive capacity is an acknowledgement that a percentage of the Earth's resources should be beyond human appropriation (Wackernagel and Rees, 1996). The ecosystem services approaches also allow for 'cultural ecosystem services' (Millennium Ecosystem Assessment, 2005).

other assessment techniques in planning thus sheds light on 'the expedience hypothesis': is it the case, as has long been argued—and that proponents of ecosystem services approaches claim (TEEB, 2010)—that only by representing the environment in economic terms will it be given significant weight by decision makers?

In the next section of the paper we outline the theoretical framework. Each case study is then analysed in turn after which in a discussion section we draw out important threads from across the cases and examine the dilemmas for collaborative modes of assessment. The conclusions take forward the insights learned to consider the factors that may affect the take-up of ecosystem services approaches in planning processes and decision making.

2 Theoretical framework

For all the criticisms raised by academics (Owens et al, 2004), it has been hard to dislodge the practical appeal of linear-rational models of knowledge utilisation, in which techniques for knowledge generation are assumed to influence decisions by dint of their internal merits in providing 'the facts'. Where they fail to exert influence, this is blamed on 'external' barriers in society (Shove, 1998), or on 'politics' (Russel and Turnpenny, 2009), or on methodological problems which undermine the 'accuracy' of the knowledge generated, for which the solution is 'better methods'. Yet the qualities of the knowledge generated are just one element in a more complex picture. To move beyond the limitations of the linear–rational model, ideas from science and technology studies can be helpful in following the practices by which authority and credibility for evaluations and assessments are actually constructed (Callon, 1986; Latour, 1987).

An important perspective is Latour's (1986) translation model of power in which power is not something possessed, inherently, by ideas or knowledge, but an effect of the translation of an order, concept, or idea into the actions of a chain of agents. The key, then, is to assess how knowledge claims become incorporated into the actions, values, and projects of others. To understand this, Latour distinguishes between positive and negative forms of argumentation, or 'modalities' (see Murdoch et al, 1999). A 'positive modality' is an argument that takes debate away from the messy, contestable conditions under which knowledge was produced, and makes it sufficiently solid that actions may be based upon it (Callon, 1986; Latour, 1987, page 23). 'Negative modalities', conversely, are arguments which focus on the conditions under which knowledge was produced, opening up challenges to the methods, data, assumptions, and motives of the researcher (Latour, 1987, page 23). Sustained negative modalities may lead to inaction, as an entity—like an assessment of ecosystem services—fails to change the frame of reference for others. In practice, environmental knowledge or assessments could become entrained in positive or negative modalities, but the point is that their fate is an uncertain, collective, and social process. So, rather than believing that the use of (environmental) knowledge can be explained in terms of factors internal to the overt content of science, and its ability to speak accurately for the character of nature, we need to recognise the role of external, social, and economic factors in stabilising connections between knowledge and action (see for example Pellizzoni, 2001; Robertson, 2012). The task for analysts of assessment techniques, then, is to trace the various elements that come together to make environmental knowledge irresistible: both those elements within the knowledge-gathering exercise (including measurements of environmental parameters, valuations, texts, other studies, and applications) and beyond (including policies, strategies, discourses, and individual people embodying various forms of authority—technical and political) (Callon, 1986; Latour, 1987).

The multiplicity of elements that may be relevant is immediately clear in open and politicised decision-making settings such as planning (Murdoch et al, 1999). Through the apertures available for consultation, many land-use decisions have an adversarial quality,

entailing contestation of the knowledges on which prospective decisions might be built, including the findings of assessments. However, although knowledges used in planning may be subjected to various forms of political and societal scrutiny, if they survive them, these same processes can also help to create positive modalities. Surviving the stages of consultation, cross-examination, and formal approval can enable policies and the knowledge that underpins them to "combine irresistible forms of knowledge with political legitimacy", which subsequently make them less negotiable in a wider range of contexts (Murdoch et al, 1999, page 196). So, for example, if environmental knowledge serves to justify the formal adoption of protective *policies* for a particular environmental feature—a habitat or a sensitive wildlife population—then there is less scope legitimately to challenge that knowledge when the policy is used to regulate individual development proposals. There is a multiscalar dimension to this, too, in that knowledges that become inscribed into national policies may configure planning processes at lower tiers.

A key dynamic in struggles to secure the status of new knowledge and assessment techniques is to institute them into decision-making processes in ways which mean that they must be considered, and cannot lightly be set aside. A useful concept for interpreting institutionalisation is that of "an obligatory passage point" (Latour, 1987, page 162; also Callon, 1986), which can be defined as something indispensable within a network through which other actors would have to pass to attain their aims, fettering them in some way. For example, the evolution of environmental impact assessment has been characterised by both methodological developments in impact prediction and evaluation and the evolution of procedural requirements to ensure that decision makers demonstrably take assessments into account (Caldwell, 1984). Rendering assessment processes into obligatory passage points is simultaneously social and artefactual, in terms of inscribing the requirement to undertake or consider an assessment into documents and procedures, which (in theory at least) gives them durability across decision-making settings in other locations and sectors.

In using the concept of an obligatory passage point, two further issues arise. Firstly, and routinely neglected by analysts of environmental assessment techniques, is that cementing the status of a new technique, and linking it to action, may also entail *dis*associating decision makers from other forms of knowledge (see Russel and Turnpenny, 2009), or demoting other modes of assessment. This is very true of planning, in that planning processes often need to mediate multiple and conflicting social, economic, and environmental factors (see discussion in Carmona and Sieh, 2008), including the knowledges attached to policies emanating from different sectors of government. Consequently, securing commitments "to follow certain rules or consent to certain procedures is unlikely to be consensual" (Clark and Majone, 1985, page 16). Holding the line around particular forms of assessment—including new environmental assessment processes—may thus depend on the opportunity structures (Kitschelt, 1986) for participation that surround planning processes, and which groups and interests are most effective in accessing them (Cowell and Owens, 2006). Secondly, this potential for tension may impact on what exactly it is that is 'obligated' by the creation of an obligatory passage point around a new form of assessment, which returns us to debates introduced above about the merits of widening stakeholder engagement in assessment design and practice (see Adelle et al, 2012). As our analysis shows, seeking to enroll wider support for a new assessment methodology may be bought at the expense of limiting the extent to which the methodology and any findings exert leverage over key stakeholder priorities.

Concluding this discussion, we can see how science and technology studies provide a series of concepts for researching the effects of environmental assessment techniques in planning. It alerts us to how building a stable relationship between knowledge and action (to create arguments with 'positive modality') can depend on constructing associations

between an array of entities, both 'within' the assessment exercise and beyond. It also highlights the dilemmas faced by those seeking to institute new assessment processes as an obligatory passage point in decision-making systems, through which key decisions must pass. We now apply these concepts to our case studies.

3 Case-study analysis

3.1 Berkshire and 'environmental capital assessment'

Our first case study lies within enduring conflicts in South East England about the extraction of construction minerals (especially sand and gravel), as local planning authorities struggle to mediate the relationship between government policies for minerals supply and the environmental impacts of extraction. It is into this context, during the early 1990s, that we see the infiltration of concepts of sustainable development, the meaning of which was initially the subject of much debate. Significantly for our analysis, much of this debate about meaning unfolded through efforts by planning authorities to operationalise sustainable development in new assessment approaches.

A prime illustration is the Royal County of Berkshire, in its role as mineral planning authority. During 1992–93, Berkshire was drafting a new Minerals Local Plan for the County (RCB, 1993) and considering how to accommodate their share of projected national demand for construction aggregates. Demand projections were produced by central government and given to Regional Aggregates Working Parties for each region, which used them to devise apportionments (shares) for each mineral planning authority within the region. Berkshire was concerned about the environmental consequences of finding ever more extraction sites but concluded that to make provision for aggregates production at the rates indicated for them in their apportionment (2.5 million tonnes per annum) would be unsustainable, because it would breach the 'environmental capacity' of the county.

The Council reached this conclusion with the use of a methodology that involved assessing the environmental suitability of potential extraction sites (RCB, 1993, paragraph 3.8), with three main stages (Babtie Group Ltd, 1993a):

- traditional sieve analysis, to exclude national, county, and local designated areas felt to impose "overriding objections in principle to mineral extraction" (RCB, 1993, paragraph 4.14);
- a process of 'strategic choice' in which concerns about cumulative effects and the desirability of opening new areas to extraction fed into the identification of 'preferred areas' for minerals extraction;
- an element of public engagement, through two rounds of consultation on the preferred areas.

In rolling out this assessment process, Berkshire sought to operationalise a 'strong' interpretation of sustainability (see Costanza and Daly 1992), "which does not degrade the total stock of environmental resources" (Babtie Group Ltd, 1993b, paragraph 27). 'Strong' interpretations of sustainability question economic orthodoxies that all forms of capital are substitutable, requiring instead the protection of environmental features and functions that provide vital and irreplaceable values ('critical environmental capital'); and conservation of the overall value of the broader environment ('constant environmental capital'). Together, these principles define the 'environmental capacity' of an area for development: as the planners put it, "Berkshire's assessment of the County's environmental capacity therefore reflects the County Council's judgements about the critical and compensatable environmental capital of the County" (paragraph 60). These debates are more nuanced than is outlined here, but the key point is that through this approach sustainable development was framed as an exercise in the identification of environmental limits, with the corollary that growth should be steered to respect them. Given their analysis, Berkshire's plan made provision for levels of aggregates supply falling by 3% per annum from 1996 through to 2011.

Berkshire's assessment exercise was essentially internal to the planning department, and there were not at that time any published, formalised, sustainability assessment techniques which were deemed suitable. The mode of policy creation was essentially 'assess–decide–announce–defend', with little ex ante deliberation with wider interests. However, Berkshire did seek to enroll other elements to secure their arguments—notably the authority of national minerals planning policy. Although national guidance to mineral planning authorities maintained that it "is essential that the construction industry continues to receive an adequate and steady supply of aggregates" (DoE, 1994, paragraph 9), it also stated that the preparation of plans "provides an important opportunity to *test* the practicality and environmental acceptability at the local level" of the regional apportionments (paragraph 58, emphasis added). This testing role was claimed to allow planning authorities some choice of assessment strategy.

Although labeled as 'strong sustainability', for the new plan policies to acquire regulatory legitimacy, the draft plan itself needed to survive the obligatory passage point of public inquiry and cross-examination. In the inquiry Berkshire's draft minerals plan was subject to intense opposition, especially from quarrying interests which were deeply critical of the Council's failure to meet their share of national demand projections, and set about unstitching the authority of the methodology. The capital-based analysis became subject to negative modalities.

In his report the plan inquiry inspector sided with the industry, criticising Berkshire for giving insufficient weight to the need for aggregates, and for seeking to prioritise environmental considerations in defining the level of provision. He did accept the testing role of local plans, and found the county's explanation of environmental capacity and its conception of sustainable development to be 'persuasive' (Brundell, 1994), but the county would have to "demonstrate very clearly the reasons why it cannot maintain a production of 2.5 mt/year beyond 1996" (paragraph 3.2.6). The inspector concurred with objections made by the industry that concepts of 'environmental capacity' and 'critical environmental capital' had (at that time) no specific standing in government planning policy on sustainable development. It was also problematic that the logic of designating critical environmental capital led Berkshire to treat certain environmental factors as absolute constraints "even though mineral working would be permitted … in terms of national policy guidance" (page 13). More fundamentally, although the inspector had no difficulty with the deployment of subjective judgment in selecting the preferred areas for minerals extraction, for him this very subjectivity meant that there would always be differences in judgment about the values of particular sites, which could also change over time. He deduced from this that Berkshire's assessment of environmental capacities could not appropriately determine production levels, which should follow the guideline figure.

Whatever one thinks of the inspector's distinction between 'subjective' and 'objective', this case shows the difficulties of cementing the status of novel assessment frameworks within established institutional settings, not least the tendency of key actors to defer to the authority of existing planning policy as the arbiter of how conflicting interests should be weighted. As Berkshire found, the adoption of analytical concepts and frameworks did not obviate the need, when identifying 'critical environmental capital' in the field, to make judgments about what matters and why. Yet this overt recognition of judgment becomes an invitation for criticism, which is taken up where the new assessment approach is used in ways which challenge prevailing policy norms around growth. For Berkshire's arguments to 'win' also required a demotion in the status of other environmental knowledges—minerals demand projections and apportionments—but failed to do so. What held the status of the projections-led policies in place was their quantitative, statistical basis; their derivation in part from economic growth projections; the authority of national government endorsement; and the legitimacy conferred on the apportionments by regional-level agreement.

Consequently, the figures became difficult to resist by the time they entered local planning arenas (see also Murdoch et al, 1999).

If one adopts a short-term, linear–rational perspective of knowledge utilisation, then Berkshire's use of environmental capital-based techniques could be seen as a failure. However, in planning, as in other spheres, the influence of knowledge can be longer term and less direct (Cowell and Owens, 2006). Subsequent revisions to national minerals planning policy gave greater emphasis to recycled and secondary aggregates (ie, reusing waste products), more overt concern for efficiency in use by the construction industry, and placed more weight on environmental constraints—all of which Berkshire had pressed for (DoE, 1994). A loosening of the grip of 'predict and provide' minerals planning did take place, and arguments about the unsustainability of such policies—informed by the analyses of Berkshire and others—were a factor.

3.2 Ecological footprinting in Cardiff

In contrast to environmental capital frameworks, the EF has become a much more established assessment technique worldwide. It generates a proxy measure of human demands on the environment by assessing how much biologically productive land and sea is appropriated to maintain a given consumption pattern (Wackernagel and Rees, 1996). It shares with environmental-capital-based approaches an attempt to pull together diverse environmental information into a specific assessment framework, though the EF arguably goes further by converting data on human demands on the environment into a single unit—'global hectares' (gha) per annum, for a given population. By calculating the gha needed to support a person, city, or country—and comparing this with the 'fair, sustainable share'—the EF can be used to represent the extent to which any given social unit is causing ecological 'overshoot' (see, for example, WWF, 2006).

Our case study focuses on Cardiff Council, where the initial use envisaged for the EF stems from the particular motives of officers within the Council's Sustainable Development Unit (SDU). In 2000 officers were looking for mechanisms to reinforce preexisting environmental integration institutions to better mainstream sustainability within a strongly prodevelopment local authority (Hooper and Punter, 2006). The EF was seen as a device for "taking the local element and linking it to the global element" for the emergent local sustainability strategy (CCC, 2000), as well as "one of the tools … that provided a bit of rigour" (interview, SDU, 2006).

To drive forward the EF, SDU officers were aware that they faced a dilemma. On the one hand, an acknowledged attraction of the EF is its capacity to take complex debates about sustainability and 'keep things simple' for citizens and decision makers (Barrett et al, 2004). On the other hand, SDU officers also believed it necessary to be able to defend the EF methodology and its results, in terms of data inputs and the complex and contentious assumptions underpinning the calculation. Their strategy for securing commitment deliberately sought to align an array of actors around the EF work. One element of their strategy was to involve staff from key departments including waste, transport, and tourism in collecting and validating data for the calculation of Cardiff's footprint. By harnessing this, the project team hoped to deflect possible negative modalities around the quality of the data. Another element was to make use of hierarchical authority structures within the Council. The SDU thus appealed to senior managers who were exploring big changes in the direction of Council policy—such as the waste department, who were keen to wean the city away from disposal in rapidly filling landfill sites—to see how the EF could support their agendas. Taking the EF work through Council scrutiny committees and other arenas, allowing officers and politicians scope to contest the technical and political dimensions of the EF, was also deemed to help confer legitimacy and solidity on the status of the methodology.

One can see how the initial institutionalisation of EF measures depended greatly on the skilful deployment of organisational knowledge by SDU officers. However, constructing a network of support ultimately reflected and *generated* ambiguities in the nature of Cardiff Council's commitment to the EF.

A key problem is that, when Cardiff's initial EF results came to be released during 2004, SDU officers realised quickly that it was "not a good news story"[(5)] for the Council's dominant development agendas. The results showed that Cardiff residents had a higher EF (5.59 gha per capita) than the UK average (5.35 gha per capita) (Barrett et al, 2005). That the EF seems to increase with income (Weidmann et al, 2006) also challenged comfy win–win conceptions of sustainable development. These were troubling results for a council committed to growth and boosterist discourses of international competitiveness (Collins and Flynn, 2005; Hooper and Punter, 2006). Rather than suggesting that business as usual was implicated in environmental crises, SDU officers stressed the importance of presenting the EF results in ways that were 'nonthreatening': "this isn't an antigrowth … thing" (interview, SDU, 2006). In meetings with other officers and in more open council debates the managerial use of the EF was emphasised—for example:

> "I think it's saying, look, this is the impact of *x*, *y*, or *z*; we can still have new development, but how can we reduce the impact as much as possible?" (interview, economic development, 2007).

These narratives surrounding the EF reveal the enduring power of a neutral, technical rationality within what Shackley and Darier (1998) describe as strategies of 'seduction', whereby actors can use strong and weak claims for (their models) in order to generate and sustain support (Ravetz, 2003, page 66). In certain situations it seems appropriate to present assessment techniques and their results as accurate representations of a problem which requires corrective action, and in others as simple aids to thinking about the world (when the consequences seem unpalatable and controversial). Integral to this flexible representational strategy was the fact that there were no externally imposed rules mandating that Cardiff Council measure its EF or respond to the results in a particular way—it was a 'space of negotiation' (Murdoch, 1998). Given this freedom of manoeuvre, senior figures could not be forced to act on the EF results but needed to be persuaded of its merits (Collins and Flynn, 2007, page 304).

Such representations maintained positive modalities for the EF in Cardiff and proved successful—to the extent that, from 2002 to 2007, the EF spread from an aspiration in the Sustainability Strategy to a series of commitments in corporate policy. It became inscribed as a headline indicator in the Community Strategy: symbolically, at least, a key document in council planning structures. The Council also supported further EF evaluations of sporting events held in the city. However, the representation of the EF as a managerial tool also framed the import of 'the facts' and deflected attention from any troubling moral injunctions. Thus, the Council's Policy Action Plan inscribes a commitment to *measure* Cardiff's EF, and to *use it in policy formulation*, but not to reduce it (interview, SDU, 2007). If the EF is an obligatory passage point, it is a modest, flexible obligation.

The fate of the EF in Cardiff also shows the problems that arise when collaboratively constructing networks of support for new assessment techniques without dislodging or demoting existing forms of knowledge. Council officers from a range of departments were mostly very supportive of the EF. Few were immediately concerned by the methodological assumptions or data quality: a sanguine attitude attributable, in part, to the prior efforts of SDU officers to engage colleagues in the collection of data for the footprint calculation. However, another explanation for the lack of methodological concern is that few other officers identified any direct, immediate relevance of the EF concept to their sectoral priorities.

[(5)] Academic researcher, personal communication, 2006.

Departmental managers saw the Council's corporate commitments to 'measure and use' the EF as symbolic rather than obligatory, and insufficient to displace attention from those key performance indicators or financial constraints which actually fettered day-to-day decisions (Carmona and Sieh, 2008). In tourism, for example, this was 'visitors and spend'—business planning objectives that "come from a corporate level" (interview, tourism, 2007). With little prospect of the EF challenging business as usual, negative modalities simply did not erupt, but effects on decisions have still been muted.

Ironically, it was within the home department of the SDU—Strategic Planning and Neighbourhood Renewal—that doubts about the applicability of the EF were most clearly expressed. Here, officers had to meet Cardiff Council's self-imposed corporate commitment to use the EF for producing the Local Development Plan (interview, Strategic Planning, 2007). Some doubted whether the EF would fit with existing assessment regimes—in particular, the need to subject the draft plan to statutory processes of strategic environmental assessment. This generated concern about the additional costs and added value of including EF in the assessment process, with it being seen as an extra layer of bureaucracy [as Baker et al (2013) noted of ecosystem services approaches].

Concerns were intensified by the fact that development plans attract more critical, external scrutiny than corporate strategy documents, creating anxieties about the 'better quality data' and the 'greater depth' that an EF for the plan assessment was therefore deemed to require (interview, strategic planning, 2007). Officers questioned whether the EF, and its focus on tracing the effects of production and consumption, would generate impact knowledge that could be used to defend adjudications between different spatial development options, such as whether to concentrate new housing development on brownfield sites or go for selective greenfield release. Consequently, while data on Cardiff's EF are used as one component of the baseline for 'Cardiff's sustainability status' (Cardiff Council, 2011), the size of the footprint does not feature among the 'key environmental trends and issues' to which the latest draft plan is responding, and links to policy options are hard to discern (Cardiff Council, 2012). However, a perceived ability to assist the spatial decisions of planning has been a positive factor in the uptake of our next case-study assessment approach—GI.

3.3 Green infrastructure in the Republic of Ireland

The institutional arrangements for planning in the Republic of Ireland differ from those in the UK, as do the wider constellation of actors that permeate the process. There is an even greater reliance on the European Union as a driver of environmental policy and a younger, less developed tradition of environmental conservation activism. However, the dilemmas affecting sustainability and planning have commonalities. As in the UK, many environmental professionals and campaigners are exercised by how to elevate the status of nature conservation and green space in a prodevelopment context: GI was seen to serve this role, in that it provided an approach to the identification and securing of connected areas of green space. In this sense, GI was defined as

> "a strategically planned and managed network featuring areas with high quality biodiversity (uplands, wetlands, peatlands, rivers and coast), farmed and wooded lands and other green spaces that conserve ecosystem values which provide essential services to society" (Comhar, 2010, page 11).

The 'take off' of GI discourse in Irish planning can be dated to 2008, and the organisation of an international conference on GI by Fingal County Council, at which an array of international presenters and actors from all levels of Irish government were brought together. The following years witnessed a rapid and widespread translation of the GI concept into an array of policy documents, including statutory planning policy at

national, regional, and local levels. Supportive statements have appeared in other advisory documents produced by the planning profession and conservation bodies.

On the face of it, GI has become more firmly inscribed into planning policy documents in Ireland than was the case with environmental capital or EF approaches in the UK [indeed, the GI concept also features in national planning policy in England (DCLG, 2012, paragraphs 99 and 114)]. In Ireland, however, this institutional accommodation of GI approaches cannot be attributed straightforwardly either to the exercise of hierarchical authority—in which national and regional bodies adopt the concept first, which then cascades 'down' to local planning arenas—or to a linear, cognitive response to 'evidence' of the utility of GI planning approaches to the natural world. Rather, it emerged through the creation of a 'discourse coalition' (after Hajer, 1995) of planning practitioners and allied professionals.

A powerful attractant was the concept's specification as 'infrastructure', with its connotations of indispensability, which enabled those advocating greater attention to the environment to attach a 'narrative of necessity' to green spaces. For example, the national sustainable development council claimed that GI "should be viewed as critical infrastructure for Ireland in the same way as our transport and energy networks are as vital to sustainable development" (Comhar, 2009, page 39). It also helped that, like the EF, the idea of GI had an intuitive appeal. Proponents of GI reflected on how the concept proved easier to explain to those in economic or transport sectors of planning than 'ecological networks' or even 'biodiversity'—environmental concepts with which many practitioners had hitherto been wrestling (see, eg, DCC, 2008; DoEHLG, 2008).

In contrast to the EF case study, the discourse of infrastructure allowed GI to resonate with planning rationalities in ways which made it appear more immediately bureaucratically useful (Rydin, 2010). Not only is 'infrastructure' something that planning officers are familiar addressing, but it lends itself to map-based representation and familiar spatial tools like GIS. Enrolling support for GI was helped by the fact that many could imagine how GI could be proactively designed, made, and managed to support and address the problems of development. As one interviewee put it, GI planning is seen to entail the deployment of "the old processes of survey, analysis, plan" (interview, 2011).

The growth in networks of support for GI is also attributable to its flexible meaning. A review of references to GI in Ireland show GI being positioned as a solution to long-standing planning problems associated with:

- providing, protecting, and enhancing ecological networks;
- providing green space and recreational facilities (for walking, cycling, etc);
- legitimising space provision for flood plains and sustainable urban drainage systems;
- ameliorating urban heat island effects;
- providing an attractive setting for development and attracting visitors and inward investment;
- implementing EU directives on water and biodiversity.

This flexibility allowed a diverse set of practitioners to subscribe to the GI 'storyline' (Hajer, 1995, page 13), from tourism promoters, to conservationists, to those concerned with economic development (eg, KKCC, 2010), but also helped to signify that GI provided an 'integrated' way of dealing with environmental, economic, and social goals, in which environments constituted a multifunctional resource. Moreover, a clear characteristic of GI discourse, in policy documents and interviews with practitioners, is a presumption that the multiple tasks to be performed by green spaces could, through GI, be rendered compatible (GCC, 2011).

Importantly, discourses of GI did not diffuse in a free-floating way through different arenas. This was a social process, in which studies, documents, conferences, and various

other less formal meetings were *actively* created, through which proponents sought to explain to others how GI could resolve an array of policy problems. One particular heritage officer in Fingal County Council played a key role, both in introducing the concept to Irish policy in the 2008 conference and in cultivating connections with other interests.

This story of GI in Ireland provides a rather different account of the interactions between policy, knowledge, and the take-up of new assessment methods, in which symbolic meanings, policy framings, and representational work are preeminent. Rather than expecting the construction of new environmental knowledge to be the starting point, in which new methods yield 'better data' that in turn influence policy, almost the reverse has happened. Promotion of the concept of GI in Ireland has been undertaken without any specific, technical evaluation of the sort associated with, say, the UK National Ecosystem Assessment. Instead, calls for, inter alia, the "[i]dentification, quantitatively and qualitatively of the economic and social benefits of ecosystem services delivered by Green Infrastructure" (Comhar, 2010, paragraph 23) have *accompanied* the inscription of GI into policy, not preceded it.

That said, the position that GI had attained in Irish planning by 2012 was ambivalent. Networks of support have been constructed, forging a 'positive modality' in which the concept has received enthusiastic embrace, and thus been written into planning policy, all with minimal criticism. Latitude of interpretation has facilitated this network extension. However, whereas GI emerged initially as a framework for securing the conservation of *ecological* networks and reversing habitat fragmentation, the concept has since been positioned as a solution to numerous problems—economic and developmental as much as environmental. It is also clear that GI has resonated most strongly in planning contexts experiencing development pressures, especially the wider Dublin metropolitan area, as a device for greener management of urban expansion and infill. It is yet to be seen whether 'GI planning approaches' will deliver gains for conservation or legitimise losses of presently undeveloped spaces. And whatever the apparent firmness of professional and policy support for GI approaches in Irish planning, this does not of itself mean that the concept provides a mechanism for adjudicating between priorities when it is discovered—as inevitably will be the case—that not all the 'services' expected from GI can be delivered, simultaneously, from the same spaces.

4 Discussion

We now turn to make some comparative reflections across the case studies, the key features of which are summarised in table 2. In each case, the limitations of linear–rational models of knowledge use is clear, in that the take-up and effects of novel environmental assessment frameworks cannot be understood simply in terms of any technical qualities of the methods themselves in organising 'the facts'.

In line with our theoretical framework in section 2, the use of novel assessment frameworks—the task of assembling and maintaining technical credibility and legitimacy—is shown to be a social process. Most immediately, all of our case studies confirm the importance of "policy entrepreneurs" or "skilled intermediaries" (Commission on the Social Sciences, 2003, page 9) in forging associations between important actors, explaining the potential utility of the assessment framework to other local actors, and addressing negative modalities: planning officers in Berkshire; officers from the SDU in Cardiff; and planning and heritage officers from Fingal County Council, in Ireland. Similarly, if ecosystem services approaches are to be mainstreamed, one should expect this to arise because they are conveyed by actors, willing and able to negotiate their role within particular institutional settings, including perhaps defending the results through the rigours of committee meetings and inquiry cross-examination, not because such approaches are innately persuasive to all relevant parties.

This recognition of the role of intermediaries is not to individualise the knowledge utilisation process, or see it as purely 'local'. In each of our cases 'local' action (or inaction)

Table 2. Key analytical features of the case studies.

Evaluation technique or concept	Environmental capital and capacity	Ecological footprint	Green infrastructure
Context and time frame of case study	Berkshire County Council Minerals Plan (1993–94)	Cardiff Council, local strategic decision making (2000–12)	Republic of Ireland planning policy (2008–present)
Status of assessment framework or concept at time of case study	derived from economic theory; generalised support for sustainable development in national policy	increasingly standardised methodology; supported by Welsh Government as indicator of sustainability	emerging international concept; no clear methodology
Mode of construction	mostly internal, expert (planning department); some legitimacy sought from government policy followed by testing in plan inquiry	deliberately collaborative, with officers across the council and elected members; seeking institution in nodal policy documents	deliberate engagement/networking across planning/heritage sector in Ireland, focusing on officers
Use and impact of assessment framework	direct instrumental use failed; argumentation informed wider shifts in national policy	used to inform and 'enlighten'; unclear effect on corporate direction; background role in planning	used to raise profile of ecosystems services perspective in planning policy formulation; impact as yet uncertain
Now an obligatory passage point? (as of 2013)	no—little explicit reference to these methods in UK planning policy	yes—but commitment by Cardiff is to remeasure and 'use', not reduce the ecological footprint	yes—inscribed in regional and local planning policy

around the use of environmental knowledge in particular settings was shaped by wider networks, including distant actors and policy resources. Thus, one component of the mobilisation of support for GI in Ireland was the incorporation of 'good practice' from other European countries, both in policy guidance and through speakers at GI conferences. Berkshire sought to enroll national policy support for the integration of sustainability into planning in building credibility for their approach. Much also depends on how other actors use the opportunity structures of planning. Although Berkshire attained a limited degree of NGO support for their capital-based approach in the early 1990s, the use of capacity-assessment techniques in housing planning later in the decade was frequently reinforced by countryside and amenity NGOs active in local planning arenas (Murdoch, 2004). In Wales national NGOs have been assiduous in pressing for the further measurement of the EF, keeping it on the Welsh Government's agenda, but expend little time pushing local governments actually to use the measurements in decisions.

Agency is shaped by the institutional structure of the decision-making context, which shapes the translation of environmental knowledges into actions (Wilkinson et al, 2013). Our case studies show how, in land-use planning, the need to make authoritative adjudications about different *spatial* solutions is especially important. Assessment frameworks that map features of the environment at spatial resolutions relevant to decision makers may have more traction. This certainly helps explain the enthusiastic support for GI in Ireland. Concepts that lack an appropriate spatial resolution may encounter resistance; and, although studies have used the EF to assess different development options (see Holden et al, 2004), problems in calculating the EF for preferred spatial scales tempered enthusiasm among Cardiff's planning officers. There is undoubted interest in spatialising ecosystem services approaches through

GIS and mapping exercises (eg, Medcalf et al, 2012), though how far ecological "system boundaries" (Braat and de Groot, 2012, page 10) can be aligned with the site-based logic and political boundaries of planning will prove important.

Similarly, environmental assessment techniques inevitably bring with them not just knowledge but particular norms, values, and problem framings, and these too greatly affect in which venues new assessment approaches are adopted, and the use that is sought from them. This is important, as we noted earlier, given the multiple—and often conflicting—rationalities of knowledge circulating in planning, from ostensible desires for 'better information' to overtly normative rationalities to give the environment greater priority. Our cases show how assessment techniques which mobilise conceptions of environmental limits have resonated most strongly in locations where popular politics and institutional norms embody a sense of threat to the countryside and wider environmental quality. One saw this in South East England, home not just to the Berkshire case but also successive attempts by local planning authorities to use capacity-based conceptions of sustainability to challenge growth (Counsell, 1999). While the EF had an ambivalent impact on policy in progrowth Cardiff Council, it has had stronger effects elsewhere. In the city of York there has been local political concern about urban expansion and traffic growth, and here the council took the decision to institute a community strategy target not just to 'consider' and 'measure' the EF but to *reduce* it.[6]

These patterns of environmental knowledge utilisation, revealed by the decentralised operation of land-use planning, highlight a major problem for any argument that new assessment techniques, including ecosystem services approaches, will simply diffuse across practice and correct any undervaluation of the environment in decision making. Instead, what we see is that initial take-up—and the most assertive use—occurs mainly in places that *already* shared the framing that the environment was undervalued in decision making (de Laet, 2000). Arguably, the challenge of promoting environmental sustainability is most critical in those contexts that consistently prioritise patently unsustainable development, yet our case studies show the difficulties of expecting environmental assessment alone to shift these priorities.

To address this, advocates of ecosystem services approaches might promote collaborative modes of assessment: actively engaging stakeholders as a way of improving knowledge inputs and achieving greater buy-in to the results. Our meta-analysis highlights dilemmas in expecting such engagement to lead to decisions which shift dominant norms. In the EF and GI case studies deliberate steps were taken to enroll a wide set of actors in supporting the new assessment approaches. In each case a degree of senior or official support for the concepts was achieved, with it being inscribed into formal, high-level policy documents: they had attained some form of obligatory passage point status. However, as we saw with the EF in Cardiff, trying to enroll and keep on board proeconomic development actors can entail representing the potential use of an assessment technique in modest, negotiable terms—as simply an aide to decision making (see also Russel and Turnpenny, 2009; Shackley and Darier, 1998), or part of the environmental 'baseline'—which softens any confrontation with fundamental decisions about the trajectory of growth. Alternatively, the concept in question can remain nebulously multifunctional, as with GI in Ireland: a useful status for holding together a discourse coalition, but which deflects any tensions between growth and environmental protection into the implementation stage. In each case the 'success' of attaining widespread stakeholder buy-in has led to the methodologies being relatively unchallenged in themselves (they remain 'positive modalities'), but this is bought by modesty or ambiguity of consequences for decision making.

[6] York footprinting officer, personal communication, 8 May 2007.

Berkshire's efforts to construct an environmental capital-based framework for evaluating their draft minerals plan was much less collaborative, and failed to survive the public inquiry process—in itself, it was a negative modality. But, arguably, it at least directed attention to more fundamental questions about 'need', 'growth', the role of markets, and environmental values, which ultimately contributed—as part of wider learning and political processes—to significant shifts in minerals planning policy. If we are to understand how new modes of environmental knowledge production and utilisation come to exert real leverage over business as usual, then there is a need to look beyond the initial coalitions of the willing that voluntarily subscribe to new approaches, to trace the temporally extended, multilevel processes by which such knowledges exert leverage and foster learning, and in which conflict sometimes plays a constructive role (Cowell and Owens, 2006).

5 Conclusions

The environmental history of the UK planning system since the 1970s is characterised by restlessness about the appropriate methodological and procedural frameworks by which to connect environmental knowledge to planning processes. Our analysis looked at environmental capital frameworks, the EF, and GI; but equally we could have examined 'environmental space', 'quality-of-life capital', 'environmental capacity studies', or a whole suite of environmental indicators (see also Baker et al, 2013). Ecosystem services approaches are but the latest candidate in this story. This constant methodological reformulation could be regarded as much a sign of the enduring weakness of environmental objectives, vis-à-vis the economy, as evidence of methodological learning. Moreover, if we are to theorise effectively about the relationship between environmental knowledge and decision making, we must resist the temptation to believe that 'new' methodologies alone recast the scope for knowledge utilisation.

An overarching theme of this paper is that analysts of evaluation should spread their attention from 'internal' properties of the techniques concerned to consider how these properties intersect with the external venues and contexts in which techniques are used. Patterns of environmental knowledge utilisation in planning may often be political, but they are not wholly arbitrary or idiographic: there is scope to analyse how particular political, economic, and environmental conditions shape the extent to which new assessment procedures exert leverage over business as usual. We used concepts from science and technology studies to show how cementing the status of new assessment techniques, and linking them to action, depends on a complex and sometimes precarious assemblage of knowledge content, metaphor, policy resources, and institutional setting, which can affect how far key actors "consent to the adequacy of the social abstractions", like evaluations, "as bearers of value" (Robertson, 2012, page 396). In tracing how legitimacy was assembled for new assessment techniques, we identified the important role of intermediaries or policy entrepreneurs, as well as the problem framings that assessment techniques embodied (or could be used to mobilise).

Our meta-analysis has an ambivalent message for the belief that adopting open, collaborative modes of knowledge creation will lead to 'more effective' utilisation, in the normative sense of giving more priority to the environment. In some places this may happen, but enrolling actors with divergent policy agendas can also lead to new assessment methodologies being confined to modest, informational uses, exerting little immediate leverage over business as usual. Conversely, asserting that a particular methodology must be accepted, or that the knowledge generated has nonnegotiable consequences for existing policies, invites negative modalities—resistance and rejection. However, it would be unwise to judge new assessment techniques in a short-term, linear fashion in terms of their impacts on immediate decisions, or on whether all stakeholders are persuaded. The design and application of assessment techniques need also to be viewed as part of wider critiques of the

sustainability of prevailing development trajectories, often spanning multiple arenas and tiers of government, which contribute to longer term processes of policy learning and change.

What, then, of 'the expedience hypothesis'—the argument that by representing environmental values in economic terms they will be given greater weight by decision makers? Our analyses do little to bear this out. Although planning has pervasive utilitarian presumptions, and is susceptible to dominance by economic interests, it has in practice allowed a variety of ethical justifications for environmental protection to bear on decisions, with little tradition—in the UK at least—of routinely demanding the monetary valuation of environmental costs and benefits (Baker et al, 2013; and elsewhere, see Hockley, 2014; Wilkinson et al, 2013). Although environmental capital, EF, and GI all in different ways mobilise an economistic, instrumental language of value, our case studies showed little evidence that this language in itself automatically translated into wider support for proenvironment decisions. Certainly, the instrumentality of 'infrastructure' helped form a discourse coalition around GI in Ireland. However, where novel assessment approaches lead to conclusions that challenge economic priorities, the fact that environmental values might come clothed in economistic language of 'capital' or 'services' offers little protection against them being criticised or set aside. It seems unwise, therefore, that many advocates of ecosystem services approaches continue to attribute innate persuasive powers to economistic measures of value (see, eg, Braat and de Groot, 2012).

In considering future research on the take-up of ecosystem services approaches, policy researchers ought to give particular attention to planning, insofar as the differentiated local contexts in which much planning work takes place give opportunities for theorising across case studies. Indeed, there are important opportunities for researchers to apply our findings to the insinuation of ecosystem services approaches within the English planning system. The system here has changed significantly since the election of the 2010 Coalition government, with overwhelming priority being given to addressing economic crisis (Cowell, 2014). One could see economic discourses of environmental value as more palatable in this situation, and it is notable that the UK National Ecosystem Assessment generally avoids explicit reference to 'environmental limits', emphasising instead the 'benefits' of ecosystems, efficiency, and conventional utilitarian ethics of balancing competing goals. This palatability may explain why there is now some formal support for the use of ecosystem services approaches in UK planning, with national planning policy stating that "the planning system should contribute to and enhance the natural and local environment", for which one mechanism is "recognising the wider benefits of ecosystem services" (DCLG, 2012, paragraph 109). Though this reference creates a new policy resource, to be drawn upon by those seeking to justify using ecosystem services approaches, to 'recognise' is a highly flexible injunction—scarcely an obligatory passage point for planning activities. Where there is such a 'space of negotiation' (Murdoch, 1998) around ecosystem services approaches, take-up is likely to be highly uneven. Places which already feel highly dependent on, or attach great value to, the benefits provided by the natural environment may be early adopters of ecosystem services approaches (Wilkinson et al, 2013). The challenge is to understand whether and how ecosystem services approaches insinuate themselves into planning contexts where facilitating conventional economic growth is the dominant objective.

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