Understanding our growing environmental vocabulary in England: Connecting Green Infrastructure, Natural Capital, Ecosystem Services and Net Gain(s) within the English Planning System.

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1 Introduction

The terms natural capital, ecosystem services, green infrastructure and net gain now form an integral part of a complex and ever-growing environmental vocabulary in England. They all feature in key national guidance and strategies (e.g. HM Government 25 Year

Environment Plan; MHCLG (2019) National Planning Policy Framework), but lack definitional clarity and integrated guidance[1]. Consequently, we see ad hoc and uncritical use in policy and practice. Furthermore, the environmental vocabulary differs significantly in Wales, Scotland and Northern Ireland, hindering more integrated approaches to environmental planning across the UK. This becomes significant as we develop our national environmental governance frameworks post-Brexit.

Understanding this vocabulary and optimising its potential application in policy and practice poses significant challenges for stakeholders including the public. First, there is the need to understand each term individually. Second, we then need to apply them in policy and practice, set within the constraints and opportunities of existing governance frameworks. Third, we need to understand how these individual terms relate to each other to aid mainstreaming the environment in policy and decision-making processes in economic and social policy and practice arenas. This is not straightforward as the terms were introduced at different times for different purposes and thus were never explicitly designed to work together.

So, the purpose of this briefing note is to understand how green infrastructure, natural capital, ecosystem services and net gain can contribute collectively to what a good environment looks like; specifically, how this technocratic, expert-led language can be better mainstreamed into a common framework for both policy and practice so that (urban) land management and development delivers more and better environmental and social benefits.

The note is structured in the following way. First, we provide a non-technical introduction to each term set within its historical roots, rationale and intended purpose. Second, we identify a set of common principles linking them together. Third, we develop a conceptual diagram with a supporting narrative showing the linkages and interrelationships and finally augment this with respect to the influence of the planning system.

2 Background and definition of terms

2.1 Natural Capital

Definition

"…the elements of nature that directly or indirectly produce value to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions. Natural capital is a broad term that includes many different components of the living and non-living natural environment, as well as the processes and functions that link these components and sustain life" Natural Capital Committee (2013)[2]

[1] In July 2019 updated national Planning Practice Guidance was issued for the environment but did not provide integrated guidance https://www.gov.uk/guidance/natural-environment [accessed 13 August 2019]

[2] Natural Capital Committee (2013) State of Natural Capital report https://www.gov.uk/government/publications/natural-capital-committees-first-state-of-natural-capital-report [accessed 13 August 2019]

Background

The term 'natural capital' was coined by E.F. Schumacher in the 1970s, to highlight the value of nature and to position it as a parallel concept to financial and manufactured capital. The concept of "stocks" is critical to understanding natural capital: healthy stocks of natural assets must be maintained in order to protect the flow of all goods and services to humans. This helps support notions of investment and deficit: over-consumption of natural resources depletes both the quality and quantity of natural capital stocks; and investment in the restoration of ecosystems can help to replenish those stocks (provided that the damage is not irreversible).

The language of the financial sector is now commonly applied to the process of measuring natural capital via 'natural capital accounting' (NCA), and there are now many tools that seek to capture natural capital value[3]. NCA estimates the value of nature in a set of accounts at different spatial scales (country, region, city, habitat or feature). There are typically two main elements to a set of natural capital accounts: i) measurements of the stocks, as the area and condition of different habitats or ecosystems (e.g. forests, freshwater, farmland), and ii) measurement of the flows of benefits, typically estimated as the net present value of the future stream of financial benefits attributable to the various ecosystem services that flow from the natural capital stocks (e.g. carbon storage, timber production, recreation, etc.).

The concept of natural capital has become increasingly prevalent in policy in the UK, and NCA is at last featuring in cost-benefit-analyses such as recent updates to HM Treasury Green Book [4]. NCA helps policy and decision makers to understand the value of the natural capital stocks of a particular resource, e.g. parks, notwithstanding its limitations and uncertainties. In particular, it does not fully capture all the cultural ecosystem services and the intrinsic value of ecosystems (their value in their own right, regardless of benefits to humans)[5]. While adoption of natural capital within UK policy is an advancement, it is worth noting that there are very few examples of NCA being used to inform decision-making within individual development projects. The UK's natural capital accounts are retrospective, documenting what has happened in the past with the intention to inform future policy decisions, rather than NCA being used to inform investment, design, construction and operation of specific development projects.

2.2 Ecosystem Services (ES)

Definition

"the benefits people obtain from ecosystems" (Millennium Ecosystem Assessment, 2005: V)

Ecosystem services are often considered as part of a 'cascade' model that links five partially overlapping concepts:

- the physical components of the ecosystem (structure), such as trees or bees,

[3]e.g. Natural Capital planning tool http://ncptool.com/ [accessed 13 August 2019]

[4] HM Treasury Green Book update 2019 https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent [accessed 13 August 2019]

[5]Spash, C. (2008) How much is that ecosystem in the window? The one with the biodiverse trail. Environ. Values 17 (2), 259-284.

- the functioning of and interaction between those components (process or function), such as photosynthesis,
- the delivery of a service to people, such as carbon storage or pollination,
- the resulting contribution to human welfare from the ecosystem (benefit, such as food crops or a stable climate)
- the value of the benefit, in monetary or non-monetary terms.

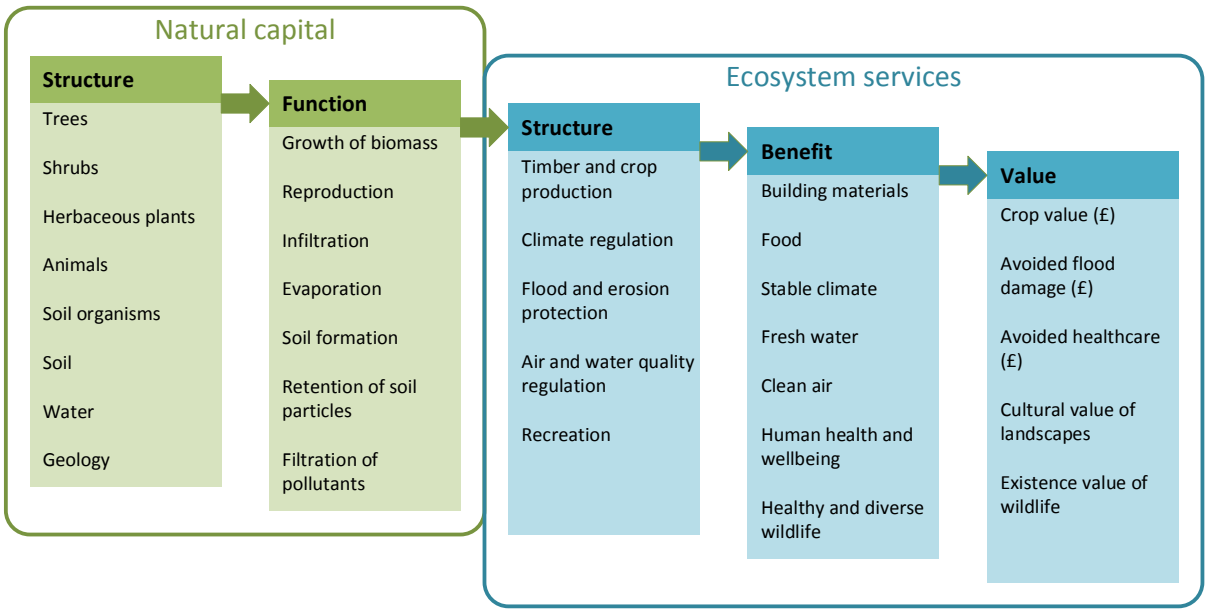

Figure 1 The ecosystem service cascade model[6] (note supporting services as identified under the MEA 2003 are now characterised within the 'function' category). Note Timber and crop production: Provisioning Services: Climate regulation Air and Water quality : Flood and erosion protection : Regulating Services: Recreation : Cultural services) It is also important to see how the concept of natural capital with its focus on stocks (structure and function) has been conceptually linked to flows (service, benefit and value) of ecosystem services.

Background

The concept of ecosystem services emerged in the 1990s as a way to improve the effectiveness of biodiversity protection policies. At its core is a reframing of the role of the environment from its established role as a constraint on land use change to an asset delivering multiple benefits to society, thereby supporting an emerging sustainable economic narrative. Thus, healthy and well-managed ecosystems provide ecosystem services that make direct and indirect contributions to human well-being. The concept of flows is important here as there are beneficiaries and providers of ecosystem services, which lead to the development of new market opportunities. Ecological economics facilitated this transformation and led to a concentrated effort to establish the value(s) of nature for use in policy and decision making. By identifying the beneficiaries and suppliers of valued ecosystem services, 'payment for ecosystem services' schemes were created. An ecosystem services framework captures these services in a conceptual way.

The Convention of Biological Diversity 1991 established 12 core principles for the management of the environment, termed the "ecosystem approach", within which Principle

[6]Figure adapted from M.B. Potschin, R.H. Haines-Young (2011) Ecosystem services: exploring a geographical perspective. Prog. Phys. Geogr., 35 (5), 575-594

5 states "*conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target*". This is also reinforced in the internationally agreed Biodiversity targets[7].

However, the significance and perceived usefulness of the ecosystem approach, as an operational concept, has declined significantly over time in favour of the use and application of the ecosystem services concept through dedicated mapping, assessment and valuation tools[8]. This was most apparent with global and national ecosystem assessments, including the UK NEA[9], which highlighted the ongoing decline in many ecosystem services. Despite this, the planning system in England only delivered relatively weak policy guidance to recognise the value of ecosystem services in the NPPF (CLG 2012: paragraph 109). However, this did lead to an improved evidence base from ecosystem mapping and modelling in some local plans where ecological expertise was in evidence. Nevertheless, the use of ecosystem service assessments to inform the investment, design, construction and operation of individual development projects is extremely rare.

2.3 Green Infrastructure (GI)

Definition

"Green infrastructure is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services, such as water purification, air quality, space for recreation, and climate mitigation and adaptation. This network of green (land) and blue (water) spaces can improve environmental conditions and therefore citizens' health and quality of life. It also supports a green economy, creates job opportunities and enhances biodiversity"[10].

Background

The term 'Green infrastructure' was first used in the US in 1994[11], emphasising that planning to protect and restore natural systems was just as important as planning for 'grey' infrastructure[12]. Its roots lie in the study of ecological networks, though it has also been driven, primarily in the US, by the benefits of developing more natural ways to manage stormwater runoff. In the UK, professionals working in landscape architecture, landscape ecology, green space management, green belt and Garden City planning and water management started using the term in the early 2000s, although many different interpretations, approaches and principles have arisen, leading to multiple definitions in the literature.

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[7] At time of writing this is the Aichi Biodiversity Targets https://www.cbd.int/sp/targets/ within Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services [accessed 13 August 2019]

[8] See Scott et al. (2014) http://uknea.unep-wcmc.org/NEWFollowonPhase/Whatdoesthefollowonphaseinclude/WorkPackage910/tabid/152/Default.aspx [accessed 13 August 2019]

[9] UK National Ecosystem Assessment http://uknea.unep-wcmc.org/ [accessed 13 August 2019]

[10] Source: http://ec.europa.eu/environment/nature/ecosystems/index_en.htm [accessed 13 August 2019]

[11] Firehock (2010) A Short History of the Term Green Infrastructure and Selected Literature, http://www.gicinc.org/PDFs/GI%20History.pdf [accessed 13 August 2019]

[12] Grey infrastructure covers built fabric of cities using concrete and steel and other non living material to create roads, drains, dams, dykes,

What unites these definitions is the idea that green infrastructure planning adds value as a managed multifunctional network of green and blue features, which can operate at multiple scales. This network is purposefully designed to deliver multiple benefits across different sectors, thus contributing more than a collection of individual green infrastructure assets/features. GI works best as an integrative concept, including individual elements/features, such as green roofs as well as linked networks, and incorporating existing natural features such as woodlands in planned interventions. If backed up by the necessary scientific evidence,[13] and incorporated at the start of a development, it has the potential to tackle specific challenges, for example through creating connected green corridors for wildlife and people at the landscape scale; designing and locating GI to provide air pollution barriers between roads and schools or incorporating measures to tackling the climate emergency declarations now widespread across local authorities and agencies across the UK.

2.4 Net Gain(s)

Definition

Biodiversity Net Gain *"is development that leaves biodiversity in a better state than before. It is also an approach where developers work with local governments, wildlife groups, land owners and other stakeholders in order to support their priorities for nature conservation"*[14].

Environmental Net Gain: "*In short, this means improving all aspects of environmental quality through a scheme or project. Achieving environmental net gain means achieving biodiversity net gain first, and going further to achieve net increases in the capacity of affected natural capital to deliver ecosystem services"*[15]

Net gains are targets involving a set of processes for delivering gains natural capital/ecosystem services and green infrastructure as previously defined. In Defra's 2018 net gain consultation[16] outlines a potential three tier framework for environmental net gains (Figure 2). The first tier is biodiversity net gain; the second tier also includes natural capital net gains and the third tier also includes action to reduce the wider pressures on natural capital, such as increased energy and resource efficiency to reduce pollution).

[13] See http://www.tdag.org.uk/species-selection-for-green-infrastructure.html [accessed 13 August 2019]
[14] CIEEM, CIRIA and IEMA (2019) Biodiversity Net Gain Good practice principles for development. https://www.cieem.net/data/files/Publications/Biodiversity_Net_Gain_Principles.pdf
[15] Defra (2019) Net Gain: Summary of responses and government response, Glossary p91 Defra: London
[16] Defra (2018) Net Gain Consultation Proposals. Department of Environment, Food and Rural Affairs, UK. https://consult.defra.gov.uk/land-use/net-gain/

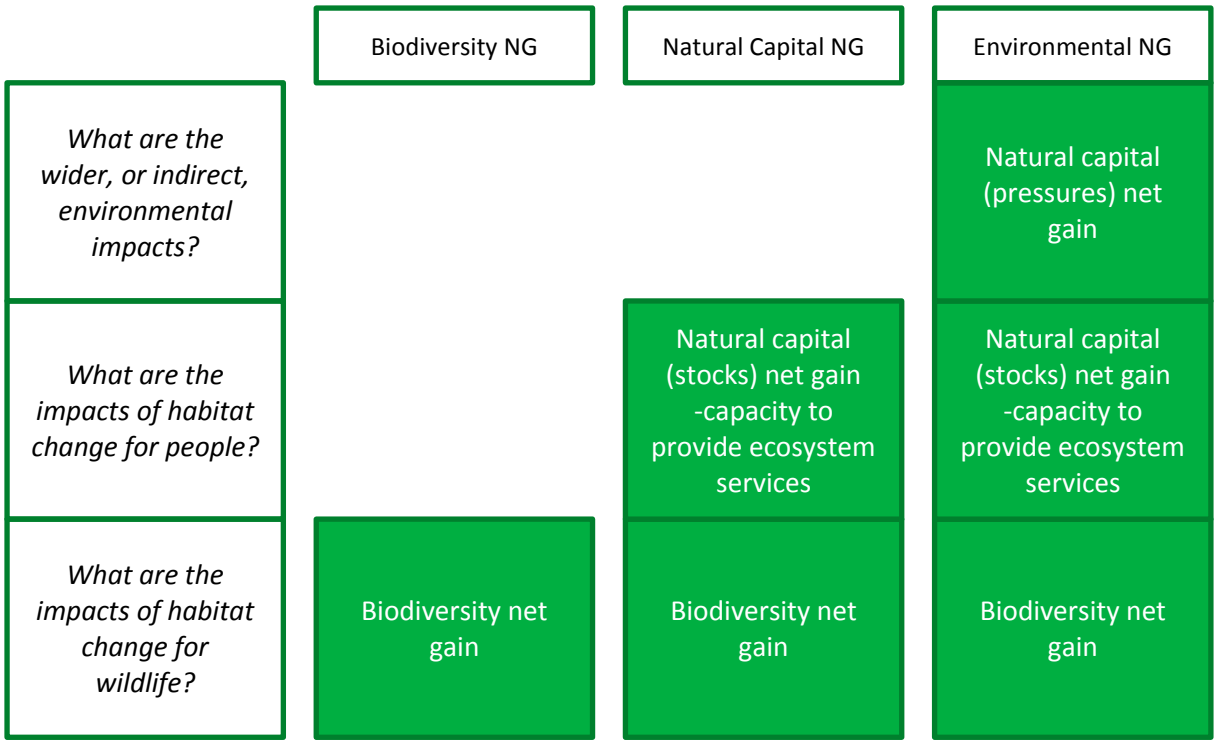

Figure 2 Relationships between biodiversity net gain, natural capital net gain and environmental net gain[16]

The term 'net environmental gain' was first formally introduced by the UK government in its 25 Year Environment Plan (2018), in which the government stated, "*we will ensure that we support development and the environment by embedding the principle that new development should result in net environmental gain*". However, there was no definition for what net environmental gains should be produced. Our understanding is that a POST brief is being produced on net environmental gain, but currently there is still no universally agreed definition although the response to a recent consultation led by Defra (2019) advances a definition in the glossary (see footnote 15). We are suggest that any definition should recognise the concept of net **gains** (plural) to avoid the risk of a single measure being used to crudely and fallaciously summarise the different ecosystem services and other environmental indicators involved. Thus net gains are required across key ecosystem services acknowledging that trade-offs are necessary.

Our interpretation of net gains is, therefore, **where development leaves the environment in a better state than before in line with the environmental priorities identified in strategic national and local plans, international environmental targets, and the views of wider publics.**

This is important in helping ensure that strategic national and local environmental priorities are secured in developments, especially to avoid perverse outcomes where an overall net gain figure masks the loss of particular ecosystem services.

Background

Biodiversity Net Gain(s) is an established concept to the UK first encountered in the NPPF (2012) and the 25 Year Environment Plan. It has evolved from a global initiative to address failures of legislation to fully protect the environment from economic development by ensuring that development projects do not lead to a net loss in biodiversity. Where

adopted, development projects provide evidence, using an agreed methodology, that there has been no net loss (and ideally a net gain) of biodiversity.

At the core of this approach are the UK's good practice principles for biodiversity net gain (CIEEM, CIRIA, IEMA, 2016) based on the international principles developed by the Business and Biodiversity Offsets Programme (BBOP). These ten principles include following the "mitigation hierarchy" of first avoiding biodiversity loss as far as possible, and then minimising, restoring, and lastly compensating the loss. Within this hierarchy, compensation is allowed only as a measure of last resort giving rise to the concept of biodiversity offsetting or habitat banking. The principles also include avoiding losses of irreplaceable habitats: if such habitats are lost, they cannot be offset elsewhere and so biodiversity net gain cannot be claimed for the project as a whole. Having secured biodiversity net gain, projects should then aim to optimise the wider environmental benefits for a sustainable society and economy. Finally, Biodiversity Net Gain should be undertaken in accordance with good practice for people, which calls for developments to ensure that people's wellbeing is at least as good as a result of Biodiversity Net Gain as it was than before (Bull et al., 2018)[17]. Biodiversity Net Gain was initially a voluntary approach adopted by certain local authorities and commissioning agencies. Now the government has announced that it will become mandatory in England for certain types of development approved under the Town and Country Planning regime (HM Treasury Spring Statement 2019).

In England, the revised NPPF now requires Local Authorities to identify opportunities for Biodiversity Net Gain in their Local Plan and individual planning applications using approved metrics.

The relationship between Biodiversity Net Gain and wider environmental net gains is important (Figure 2). There is an emerging consensus that Biodiversity Net Gain should, in most situations, be the pre-requisite, because healthy, diverse and resilient ecosystems are crucial to deliver ecosystem services currently and in the future and provide a key part of the Natural Capital. Provided that Biodiversity Net Gain is secured, plans can then be adapted to deliver wider Environmental Net Gains. In many development situations it will not be possible to deliver net gains in all ecosystem services; often there will be large losses in food production, for example, if development is on farmland. Nevertheless, by assessing net gains and losses these trade-offs can be made transparent, helping to inform societal decisions about the most effective use of land and investment. However, there is a tension between a biodiversity gain approach versus a broad assessment of changes in ecosystem services.

[17]Bull et al. (2018) https://www.cieem.net/data/files/Publications/Biodiversity_Net_Gain_Principles.pdf [accessed 13 August 2019]

3 Fitting the environmental pieces together

From the preceding definitions and narrative, we can start to fit these different pieces together. The starting point is to identify common principles which provide conceptual bridges to help better connect them within human-society interactions.

1. The environment provides a finite stock of multifunctional assets (natural capital).
2. The environment delivers individual and multiple benefits to people through the exploitation of natural capital stocks through different flows of ecosystem services.
3. The environment generates different ecosystem services, which different people benefit from for different reasons. Thus, policy and decision making often require trade-offs to be made with consequent winners and losers from any resource management decisions.
4. Green infrastructure provides a way of managing natural capital stocks and ecosystem service flows as both a planning approach and delivery mechanism within a connected network delivering multiple benefits
5. The overriding purpose of the planning system is to deliver sustainable development and environmental net gains.

These principles are now used to build a conceptual framework (Figure 3).

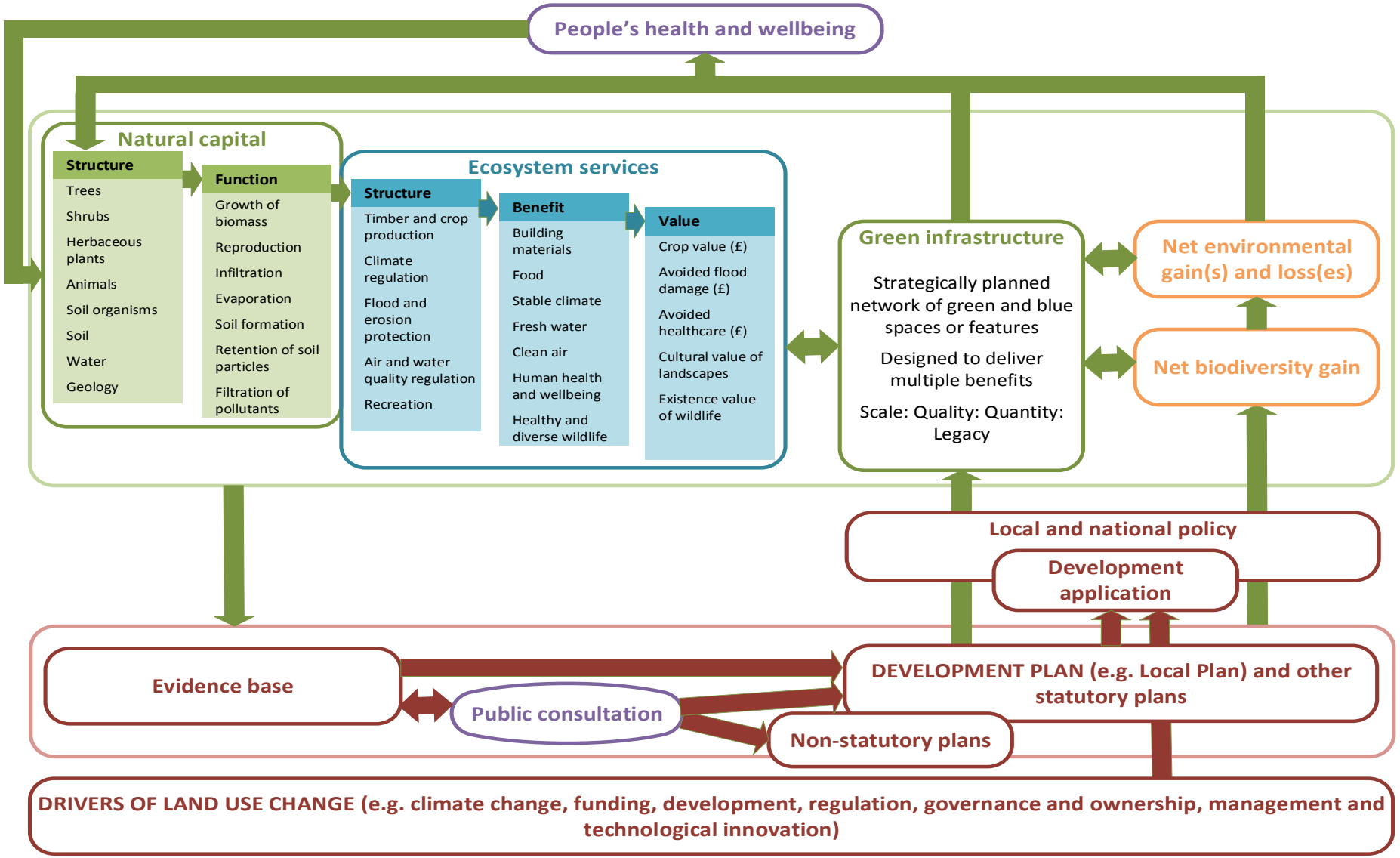

Figure 3 Conceptual framework detailing the relationship between natural capital, ecosystem services and green infrastructure in land use planning.

Figure 3 shows a simplified conceptual representation of how these terms interact collectively and can work together to create added value resulting in a good environment and enhanced public health and wellbeing.

At the heart of the figure within the GREEN BOX SYSTEM are the STOCKS of natural capital assets which produce FLOWS of individual ecosystem services that deliver specific BENEFITS which are VALUED differently by stakeholders and wider publics. These natural capital STOCKS and ecosystem service FLOWS form the core resource for GI. GI thus represents strategically planned NETWORKS that capture Natural Capital stocks and Ecosystem Services flows to deliver MULTIPLE BENEFITS with NET GAINS as a process and target to help deliver against this[18]. Cumulatively this process enhances peoples' HEALTH and WELL-BEING and also INVESTS back into particular natural capital assets.

We now complicate this by introducing DEVELOPMENT into the system via the red boxes in Figure 3. This now shows how the different environmental components interact in response.

- First, DRIVERS of land use change lead to new pressures for development and land management which are regulated and mediated primarily by the PLANNING SYSTEM.
- In the UK and England we have a PLAN-LED system according to the STATUTORY DEVELOPMENT PLAN (local or strategic plan) which provides the key decision making framework for development proposals.

  BUT
  - This plan is produced from an EVIDENCE BASE covering natural (natural capital and ecosystem services mapping), economic and social DATA, wider public consultation and other material considerations including national planning guidance and other non-statutory plans and strategies.
  - The approved development plan contains policy priorities for biodiversity, green infrastructure (including the identification of a green infrastructure network) and the environment with predesigned policies explicitly and implicitly for biodiversity net gain and environmental net gains on the development.
  - Natural capital, ecosystem services and green infrastructure are prioritised in decision making according to the strength of policy (ies) wording in the statutory development plan. Here attention needs to be placed on the functional coverage of policies across these terms, as well as the strength of policy wording when compared with other social and economic policy priorities[19].
  - Ideally a strong policy framework with good functional coverage and strong policy wording within the development plan will enable positive feedback

[18] The ability to deliver multiple benefits as part of a network distinguishes green infrastructure from green space and single green features.

[19] See Hislop and Scott (2019) https://mainstreaminggreeninfrastructure.com/project-page.php?green-infrastructure-planning-policy-assessment-tool for a tool that has been developed to assess the quality of GI policy.

loops leading to a robust GI framework, net gains, increased health and well-being in accordance with clearly identified priorities and needs.

- Consequently any proposed development is assessed and modified using these development plan policies and evidence of the collective impacts on net biodiversity/ environmental gains or losses as determined through the natural capital - ecosystem services - green infrastructure relationships previously described
- The priorities (Global, EU, National, Regional, Local) in the development plan policies may require TRADE OFFS to be made between gains and losses across different ecosystem services which consequently may impact on the integrity of the green infrastructure network.
- If ANY priorities are compromised significantly in any development then the proposal should be rejected and/or modified.
- Biodiversity Net Gain will shortly be mandatory for certain developments in England. This will strengthen any development plan policies and act as a significant requirement to be met before approval can be given. However wider Environmental Net Gains are only seen as desirable.
- Ultimately, any planning decision will necessarily involve trade-offs to be made across and within ECONOMIC, SOCIAL and environmental perspectives in line with perceived priorities, resulting in net gains and losses.
- Understanding the holistic result of these trade-offs for various development options, and how they affect people's wellbeing and the natural capital asset base with both winners and losers, is crucial in enabling a good development to be negotiated and approved.
- Thus, development may result in both negative and positive feedback loops to natural capital in light of the material considerations[20] that shape the final decision. However, there is a significant lag factor to these positive and negative impacts which will require significant MONITORING and ENFORCEMENT of claimed gains.

Comment

Currently with major declines across many ecosystem services and species reported worldwide (e.g. IPBES Report 2019[21]; Living Planet Report 2018[22] and in the UK[23]), it is clear that environmental losses are significantly accelerating and that further erosion to natural capital stocks is likely to lead to irreversible tipping points. The feedback loop shown in the

[20] Material consideration is a matter that should be taken into account in deciding a planning application or on an appeal against a planning decision. Material considerations can include (but are not limited to): Overlooking/loss of privacy, Loss of light or overshadowing, Parking, Highway safety, Traffic Noise, Effect on listed building and conservation area, Layout and density of building, Design, appearance and materials, Government policy, Disabled persons' access, Proposals in the Development Plan, Previous planning decisions (including appeal decisions), Nature conservation https://www.planningportal.co.uk/faqs/faq/4/what_are_material_considerations [accessed 13 August 2019]

[21] IPBES report 2019 https://www.ipbes.net/news/ipbes-global-assessment-summary-policymakers-pdf [accessed 13 August 2019]

[22] http://wwf.panda.org/knowledge_hub/all_publications/living_planet_report_2018/ [accessed 13 August 2019]

[23] https://www.rspb.org.uk/globalassets/downloads/documents/conservation-projects/state-of-nature/state-of-nature-uk-report-2016.pdf) [accessed 13 August 2019]

diagram embodies the need for social learning and improved evidence to help us reverse the decline in natural capital as soon as possible, and enable stronger and more robust policies to be designed. **Here the establishment of a strong green infrastructure network becomes an essential part of a planning-led solution.**