Operationalising 'absolute sustainability' in relation to natural capital

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Abstract:
Natural capital (NC) has the potential to be a vital component in delivering local and national sustainability of resource use. But NC risks being used as yet another measure of *relative* sustainability and resource efficiency gains; we argue that it needs to be considered in the context of '*absolute sustainability*' as defined by the Planetary Boundaries framework devised by Rockström *et al.* (2009) and Steffen *et al.* (2015). Measures of NC need to be related to absolute sustainability budgets and boundaries that we cannot afford to cross, such as the 'safe' global carbon budget, and to similar 'tipping point' thresholds at more local scales. This approach also draws attention not only to the stock of NC, but to flows, capabilities and resilience in NC, and to dynamic linkages between ecosystems over time.

Introduction
There has been considerable interest in, and elaboration of, the concept of Natural Capital (NC) in policymaking circles in the UK in recent years. The Natural Capital Committee and its outputs (Maskell et al, 2014; Eftec, 2015; Natural Capital Cttee, 2015) have raised awareness of the techniques and challenges involved in assessing the state of NC, accounting for its use, and including its valuation in economic policy processes. The NC concept has the potential to be a vital element in assessing local, regional and national sustainability of resource use. However, we argue that this potential depends on NC indicators and activities being coupled to recognition and measurement of *dynamics in the global stock, interaction and flow of ecological systems.*

The reason for this is simple: *increases in NC at a local scale cannot be assumed to preclude decay in ecological resilience of systems at greater scales and over time.* Suppose we plant a new woodland, with the aim of this being a net gain in local NC. It sounds like a clear win. But things are not so simple when we take a systems view of NC. What if the trees we picked are especially vulnerable to climate change? Or, what if our local gain in NC encourages invasive species that then produce net damage thanks to adverse effects elsewhere in our bio-region? Then we might discover that the gain in local NC is diminished. Worse, we might find that our woodland is not capable of surviving at all, perhaps because of new diseases related to climate disruption. And so we might find that the net gain in NC is only *temporary*, indeed *illusory*, because we haven't related our NC investment to bigger scales and dynamics of environmental change. We argue below that the usefulness of NC as a management concept and tool will be enhanced significantly by ensuring that its implementation is clearly framed by the fundamental challenges that arise from the nature of sustainable development in the wider and finite Earth system.

A highly influential approach to specifying sustainable development and diagnosing unsustainability in resource use is the *Planetary Boundaries (PBs) framework* devised by Rockström *et al.* (2009) and elaborated by Steffen *et al.* (2015). This approach to sustainability is summarised below. In brief, the PBs approach gives a framework for *absolute sustainability,* that is set by nine global or bio-regional parameters that indicate thresholds of resource use and system disturbance that cannot be crossed without high risk of ecological, economic and social disruption or even collapse.

'Absolute Sustainability': the Planetary Boundaries framework

The PBs framework is one of the most significant recent attempts to recognise ecological constraints on what we can do with Earth's resources. It offers a systematic approach to defining a "safe operating space for humanity", a zone of wellbeing and resilience in relation to a set of ecological conditions. The key idea is that by keeping human activities from breaching the PBs, we can maintain the Earth more or less in the conditions that have enabled humanity to evolve over the millennia since the Ice Age. The PBs framework is an exciting approach to specifying,

measuring and possibly prioritising the ecological constraints within which we can flourish. It opens up possible ways to conceptualise and operationalise what we call 'absolute ecological sustainability'.

In Figure 1 the current status of the PBs are shown in relation to the 'safe operating space' (SOS) for humanity (the zone bounded by a blue line) and to the zones of risk of dangerous disruption or 'tipping points' (signalled by orange and red shading). For example, the climate change boundary is set by the scientific consensus that anything over a 2°C average temperature rise forced by our greenhouse gas emissions takes us into a danger zone; and we are half-way there. The climate PB allows us to specify a total 'carbon budget' that we can't exceed if we are to keep out of the danger zone. This is an 'absolute sustainability' yardstick: we could achieve many local gains in relative carbon efficiency and *still* breach the planetary climate boundary.

Similarly, we can document massive breaches in the PB for the nitrogen cycle, and potentially can set an absolute 'budget' for use of nitrates. Other PBs are much less straightforward to measure and assess. For example, it is clear that biodiversity loss is massively greater than 'normal' on evolutionary scales, but we struggle to find indicators of biospheric integrity that can help pin down what counts as the sustainable boundary for genetic, habitat and ecosystem diversity. It is also clear that while some of the PBs are truly global in scope - such as the mixing of greenhouse gases in the atmosphere and oceans - some can only be measured meaningfully at local or regional scales. For example, freshwater resources vary enormously in availability from place to place and the 'boundaries' for water use can only be set in particular watersheds. All the same, it is clear that there are absolute boundaries at such local scales that need to be respected - otherwise watercourses can dry up, lose capacity to support fish stocks, etc.

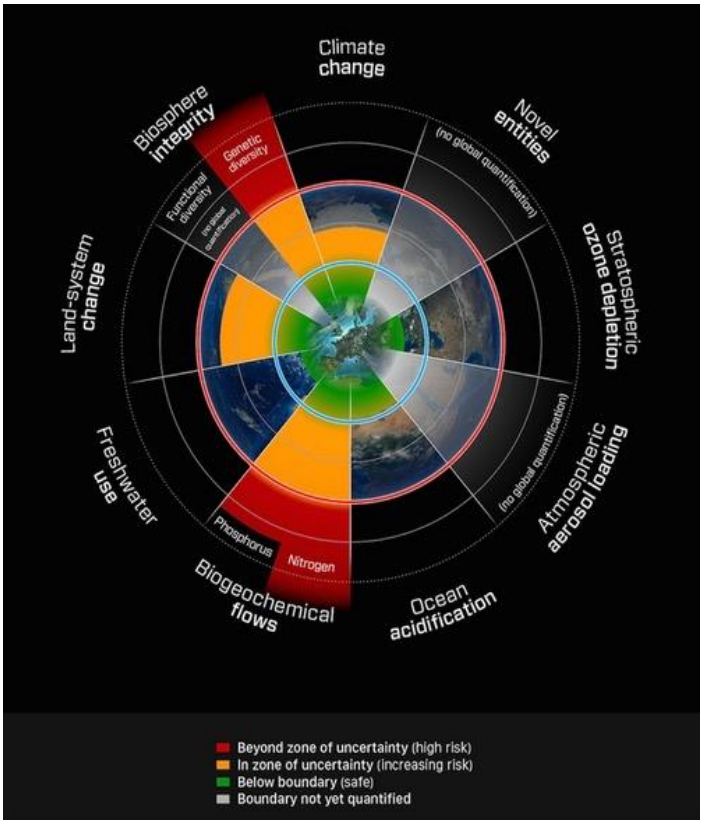

Figure 1: Planetary Boundaries, revised framework (Steffen, 2015) Source: Stockholm Resilience

However complex these challenges of measurement are, it is evident that NC can be and has been reduced, weakened or eliminated by local and global breaches in PBs. To go back to our example of a new woodland: simply measuring the extent of new stock that it represents, and counting it as a net gain, might give a very misleading picture if we leave PBs out of our assessment. How *resilient* is the new wood? How will its services be affected by changes in PBs? Might it actually be in the *wrong place* if we aim for very long-term resilience in the face of climate disruption and other changes in PB conditions?

Implications of the PB framework for Natural Capital approaches

So far, most attempts to account for sustainable development have taken the form of local, national and corporate measurements of progress *relative to a previous state of production and consumption*. For example, these might include measures of improvements in resource efficiency or in restoration of ecosystem function and quality. The former might include measures such as increases in energy efficiency or reductions in pollutants emitted by vehicles. The latter might include measures of reforestation or of reductions in river pollution. The critical point about such measures is that we can readily imagine, and indeed find evidence of, many kinds of relative

improvement in NC that nonetheless are inadequate at local or larger scales (all the way to the global) given the need to avoid breaching the PBs. In other words, measured gains in the quantity and quality of NC in isolation might be simply instances of improvements in *relative sustainability*, offering no information about whether they are taking us closer to *absolute sustainability*. In order to make NC an essential tool in policymaking and reporting for sustainable development, it has to be capable of helping answer the question: "*how does investment in local natural capital relate to pressures on global ecosystems and our distance from a safe 'absolute sustainability' boundary?".* This can be taken further to consider how investments in NC might relate to the *interactions* between PB variables, such as the feedbacks between climate forcing and land use changes?

Taking action on the PB concept brings some major implications for our measurement and support for NC. In particular, we have to ask the question: in adding to NC, are we simply making *relative* gains that could be diminished or lost because of breaches in *absolute* sustainability boundaries? This is equivalent to the situation of a business making many environmentally friendly efficiency gains but nonetheless increasing its absolute impact on the Earth, because the efficiency improvements enable more unsustainable production. This kind of 'rebound' effect is pervasive: suppose we plant more woods, achieving a net gain in local NC, but use the wealth generated to purchase carbon-intensive goods whose impact takes us closer to breaching the climate PB?

Some gains in local NC won't be *durable* given likely changes in PBs, and perhaps especially in climate, given its complex feedback effects on all the other PB variables. There may be some local apparent increases in NC that don't contribute to taking us on to pathways back into the 'SOS'. It is thus essential that we identify ways in which net increases in NC result in sufficiently *complex and resilient* stocks that can cope with extended periods in the risky zones between the SOS and an absolute PB. This dimension to selecting and measuring NC initiatives will need to account for the complex dynamics at work in ecosystems and their combination with impacts on PBs. For example, just as a doubling a forest area doesn't mean a doubling of ecosystem services from that woodland, so losing half of it doesn't necessarily mean a halving of the flow of services: the local NC structures and global dynamics must be taken into account if we are to grasp the link between NC stocks and PBs.

Conclusion and next steps

Measuring and accounting for NC is hard already, without bringing the PBs and concepts of 'absolute sustainability' into a highly complex equation. However, it remains the case that relative efficiency gains and extensions in NC cannot be enough to keep us, at global scale, within absolute ecological limits for development, such as the worldwide 'carbon budget' that must be respected if we are to avoid forced warming of 2^{o}C or more. Since this is so, a comprehensive NC accounting framework should include a 'distance to target' measurement of how far local and regional gains in NC relate to absolute boundaries, whether these are global (as with greenhouse gas emissions) or local/regional (as with freshwater quality).

What might be the next steps? At CES, University of Surrey, we have been working with Unilever and other partners on research and development to 'operationalise' the PBs. Others are tackling this huge task too. We hope that emerging tools might include measures of 'absolute sustainability' that can be applied to supply chains, life cycle analysis and NC accounting. One valuable first step is to draw up a baseline set of questions and provisional indicators concerning PBs for application to NC assessments. This would align well with similar efforts to come up with targets for corporate reporting and action on sustainability that are based on best available ecological science (see for example http://sciencebasedtargets.org). Natural capital is a powerful concept that needs to be understood and deployed against the background of the absolute limits that must be respected to achieve truly sustainable development that the PB framework is beginning to clarify.