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Commentary : The Future of Changes in Global Ecosystem Services

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1. Introduction

Since the publication of "Changes in the global value of ecosystem services" in Global Environmental Change (GEC) (Costanza et al., 2014a), interest in the topic has exploded in both the research and policy communities. As of September 2021, SCOPUS lists over 38,000 articles on "ecosystem services." Of these, over 29,000 (76%) have been published since 2014. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), established in 2012, includes 137 countries under the auspices of four United Nations entities: UN Environment Programme, UNESCO, Food and Agriculture Organization, and UN Development Programme, indicating very broad international government support for and use of the concept.

But, as noted in the GEC article: "Probably the most important contribution of the widespread recognition of ecosystem services is that it reframes the relationship between humans and the rest of nature. A better understanding of the role of ecosystem services emphasizes our natural assets as critical components of inclusive wealth, well-being, and sustainability" (Costanza et al., 2014a) pp. 153).

One important (but certainly not the only) contributor to changing this framing has been efforts to estimate the relative magnitude of ecosystem services (ES) in units comparable to other contributions (i.e. monetary units). A significant reason for the interest in Costanza et al. (2014a) was its estimation of the changes from a previous 1997 global estimate (Costanza et al., 1997). To make this comparison possible, similar methods were used. But the new estimate employed more up-to-date, per hectare ES values and new global land use change data. Combining these updates, produced an estimate of $20 trillion/yr of lost ES between 1997 and 2011. In 2011, the estimated global ES value was $125 trillion/yr compared to a global Gross Domestic Product (GDP) of $75 trillion. Some of the $125 trillion ES value is included in GDP, but most ES are non-marketed regulating services such as storm and flood protection, climate regulation, and habitat for biodiversity, among others. For example, new estimates of the global value of coastal wetlands for storm protection alone are around $500 billion/yr (Costanza et al., 2021). We estimated that the ES included in GDP consisted of marketed provisioning services such as food, raw materials, and parts of recreation. These services accounted for about $27 trillion/yr, or 36% of GDP (Fig. 1). In the future, ES values can continue to decrease, or we can invest in ecosystem protection and restoration to reverse this trend (Kubiszewski et al., 2017).

Costanza et al. (2017b) summarized recent progress and future directions for research related to ES. The remaining challenges they identified include:

2. Trade-offs and valuation toward multiple goals, using multiple methods

Three types of values are necessary to understand ES and natural capital. These are based on the three sub-goals for sustainable wellbeing of humans and the rest of nature, first articulated by Daly (1992). These three sub-goals are: (1) sustainable scale – staying within planetary boundaries; (2) fair distribution – distributing resources and property rights fairly, within the current generation of humans, between this and future generations, and between humans and other species; and (3) efficient allocation – efficiently allocating resources as constrained and defined by 1 and 2 above. This includes both marketed and non-marketed resources, especially natural and social capital and ecosystem services. However, most ES valuations have been toward the economic efficiency goal (Costanza et al., 2017b; Gómez-Baggethun et al., 2010; Jacobs et al., 2016). Even within this goal there is much room for improvement. We need to balance and expand coverage (1) geographically, especially to the global south and (2) to ecosystems that are less thoroughly studied, including deserts, tundra, open oceans, and

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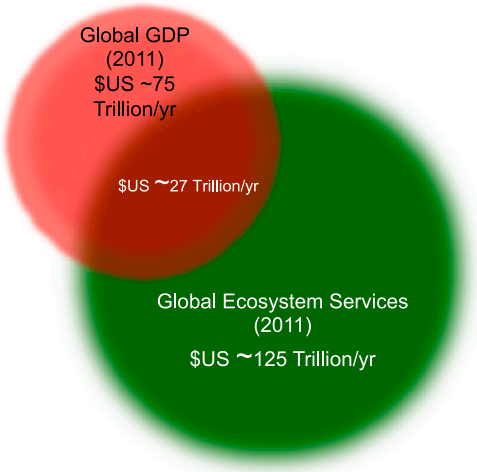

Fig. 1. Relative sizes of global GDP vs. global ecosystem services in 2011 and an estimate of the overlap. Values from Costanza et al. (2014). Ecosystem services directly included in GDP estimated as food, raw materials and ½ of recreation.

agro-ecosystems. We also need to expand valuation approaches to include all three of the goals mentioned above (Costanza, 2020). This means more deliberative, group valuation to address fairness and more integrated modelling of long-term interactions to address sustainability. Both deliberation and integrated modelling are more expensive and time-consuming than conventional, individual-based approaches, but our capabilities in both areas are rapidly improving, along with our capabilities for integrating them.

3. Integrated modelling

Integrated modelling is necessary to understand the dynamic, non-linear, and spatially explicit trade-offs in social-ecological systems in both the short- and the long-term (Bagstad et al., 2013; Turner et al., 2016). These models can be developed, and used, in active participatory processes involving the full range of stakeholders (Costanza and Ruth, 1998). In recent years, the feasibility of modelling complex systems using advances in computer systems, modelling software, and big-data has dramatically improved. However, building truly integrated models of the whole system to evaluate the dynamics and value of natural capital and ES is an ongoing challenge.

4. Accounting and assessment: Beyond GDP toward sustainable wellbeing

There is rapidly growing interest in alternatives to GDP as the primary national policy goal (Costanza et al., 2014b; Kubiszewski et al., 2013). These approaches need to adequately include the contributions of ES. For example, China has committed to estimating Gross Ecosystem Product (GEP) to incorporate the value of ES into their national accounting (Ouyang et al., 2020). The UN's System of Environmental and Economic Accounts (SEEA) recently published guidelines for ecosystem accounting. This is a step in the right direction, but SEEA is still based on a linear input-output model of current national accounts and an 'exchange value' approach to valuation tied to 'income' as opposed to a broader conception of wellbeing. The existing accounts do not capture the complexity of how economic processes are embedded in society and the rest of nature. A much more integrated, dynamic, non-linear approach connecting human systems with the rest of nature is needed to assess overall progress and wellbeing (Costanza et al., 2016). There is an urgent need to continue research and build a broad consensus about how to better measure sustainable wellbeing at multiple scales.

Above all, there is an urgent need to integrate ES and natural capital into economic policy. We need to recognize that we are 'addicted' to the current 'GDP growth at all costs' economic paradigm. We need 'societal therapy' based on developing a shared vision of the post-growth world in order to overcome this addiction (Costanza et al., 2017a). Ultimately, we need to change the basic economic paradigm to sustainable well-being, including the substantial contributions of natural capital, if we hope to achieve a future in which humanity and the rest of nature can flourish.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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