

News & views



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Figure 1 | Forest near the Las Cruces Biological Station, Costa Rica. In 1997, Costanza *et al.*¹ drew attention to the economic value of the services that ecosystems provide. This work contributed to a global movement connecting ecology and economics, which was emerging independently at that time. For example, Costa Rica began paying landowners in 1997 to reforest, including at this site. The payments for these ecosystem services provided many benefits, including in areas such as biodiversity, climate, water security and tourism.

In retrospect

25 years of valuing ecosystems in decisions

Gretchen C. Daily & Mary Ruckelshaus

The economic value that the world's ecosystems provide was first estimated in 1997, eliciting a wide range of reactions. How have such valuations advanced since then, and what are today's frontiers in using these values for decision-making?

A quarter of a century ago, Costanza *et al.*¹ put forward an estimate for the economic value of global ecosystem services – the benefits people obtain from ecosystems. The authors valued these at US\$33 trillion per year. Objections to

the exercise were raised on many grounds, from those involving technical matters to ethical concerns about pricing nature. And its utility was questioned, drawing comments² such as, “there is little that can usefully be done with a serious

underestimate of infinity.” Yet Costanza and colleagues' bigger aim went far beyond merely producing a number. They wanted to reframe the way people think about nature, especially in the context of economic decision-making. As they stated in the paper, “We must begin to give the natural capital stock that produces these services adequate weight in the decision-making process, otherwise ... human welfare may drastically suffer.”

The revelation of the sheer scale of nature's value, mostly outside the market system and unaccounted for in cost–benefit analyses, was eye-popping. By using familiar terms for their comparison – global gross national product was just \$18 trillion per year at the time – the authors made headlines.

This work by Costanza *et al.* was part of a much larger set of waves being set in motion. In 1992, scientists around the globe signed a ‘Warning to Humanity’ about the risk of collapse of Earth's life-support systems and the associated impending peril (see

go.nature.com/3pe9o0r). A drive to integrate ecology and economics was under way, and through it came detailed recognition of societal dependence on nature^{3,4}. The arc of this work grew, with the 1995 Global Biodiversity Assessment⁵ and the 2001 launch of the Millennium Ecosystem Assessment⁶, galvanizing researchers globally to assess the status and trends in ecosystems and their services to society as a foundation for policymaking.

These efforts highlighted key elements of what needed to change, and addressed how fast and why the alterations were necessary. But a burning question remained largely unanswered: how to move from knowledge to action. In the late 1990s, three contrasting places lit the way. Facing a decline in the quality of drinking water, New York City decided to invest between \$1 billion and \$1.5 billion in upstream improvements in wetlands, and in farming and forestry practices, harnessing an ecological approach to secure safe drinking water rather than building a water-filtration plant at a cost of between \$6 billion and \$8 billion⁷. With a record-high deforestation rate at the time, Costa Rica paid landholders to conserve and restore rainforest (Fig. 1) to gain a suite of benefits, including hydropower generation, enhanced scenic beauty and a contribution to global climate security⁸. In the wake of devastating flooding along the Yangtze River, China decided to pay more than 120 million farmers to restore forest and grassland on steep slopes as a way of reducing the risk of future floods⁹.

Each of these payments for ecosystem services (PES) is still in operation today, and their success has inspired replication worldwide. Latin America now has ‘water funds’ supporting at least 39 major cities (see go.nature.com/3mrvbcv), modelled after that serving New York City. And there are now more than 550 PES programmes operating in more than 60 countries around the globe, with an estimated expenditure of \$40 billion in annual transactions¹⁰.

As these PES programmes advanced, so did the transdisciplinary science, technology and partnerships supporting them¹¹. Open-source software makes the science accessible and actionable, revealing where, how much and to whom nature delivers benefits^{12,13}. When co-developing new solutions with decision-makers, this approach informs systematic, targeted investments in nature and its stewards, from cities to countries, and across landscapes and seascapes¹⁴. These capabilities hold great potential for further advances in policy, planning, finance and operations¹⁵.

Also under way is systems change: a transformation of mindsets and institutions – their policies, practices and norms – to address causes rather than symptoms. In November 2021, ten multilateral development

banks (financial institutions based in two or more countries and chartered to encourage economic development), which together contribute approximately \$222 billion annually in development-aid financing (see go.nature.com/3x0i56q), committed to “mainstream nature into our policies, analysis, assessments, advice, investments, and operations” by 2025 (see go.nature.com/3aobzdz). To support this, both the Inter-American Development Bank and the Asian Development Bank have established a Natural Capital Lab – a one-stop shop to drive innovation across the banks in terms of ‘nature-positive’ approaches and financing.

The Inter-American Development Bank is linking natural-capital assessments – data-rich maps of the extent and condition of a country’s ecosystems and quantification of benefits flowing to people – to multi-sector development planning, including energy, infrastructure, tourism and fishing. The integrated plans are supported by innovative loans, such as those for the protection and restoration of coral reefs, mangroves and seagrasses, with performance metrics and incentives rewarding improvements in ecosystems.

As demonstrated in the Bahamas and Belize, these approaches target high-priority locations to protect coastal communities from storms and sea-level rise, while boosting fishery, tourism and other livelihoods. In Belize, the new ecosystem-based spatial-development plan was used to set ambitious carbon-sequestration targets in coastal and marine ecosystems for the country’s nationally determined contribution under the Glasgow Climate Pact adopted

“The success of payments for ecosystem services has inspired replication worldwide.”

at the 2021 COP26 climate meeting (see go.nature.com/3z4piqy). Mangrove protection and restoration were prioritized because of their multiple benefits to local communities, in addition to the global climate benefit¹⁶.

We can see powerful pathways to scaling up success for systems change. In 2021, the United Nations approved a universal framework for global deployment, known as the System of Environmental–Economic Accounting (see https://seea.un.org and go.nature.com/38lc38h), and a new metric, derived from this accounting, called gross ecosystem product (GEP)¹⁷. Now being implemented across China and several other countries, GEP guides investments from beneficiaries to ecosystem stewards, and tracks progress towards green, inclusive pathways of development.

The many efforts to value ecosystem services

25 years ago helped to advance funding for nature beyond that provided by philanthropy. Today, the Global Environment Facility, a key source of public financing for nature, is initiating a record-setting investment cycle focused on nature-positive approaches for economic prosperity (see go.nature.com/3wSI80u). To achieve a future in which nature and people survive and thrive, the private sector must now help, with record ambition and speed, to drive the transition from biosphere degradation to regeneration.

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