

**Science & Environment**

# Environmental and natural resource security for the 21st century

**beyondbrics**

3 MINUTES AGO by: Juan Carlos Castilla-Rubio and Giulio Boccaletti

The nature of environmental and natural resource security has changed dramatically since the 1990s. Over the last two decades, the global economy, geared towards exploiting natural resources to serve an exponentially growing population of consumers, has far exceeded the carrying capacity of the planet. The depth of the transformation has been so profound that it has pushed Earth into a new geological epoch, the Anthropocene. Indeed, scientists have identified planetary boundaries that it would be unwise to transgress, and we seem to be in the process of crossing many of them right now.

Over the past few years, the world economy has also been quietly undergoing a further, high-speed transformation driven by the fusion of digital, material science and biological innovations of the Fourth Industrial Revolution. The World Economic Forum has highlighted this transformational pathway as the fundamental

shift that is driving the global economy today. How it will incorporate the value of ecosystems and the interconnectedness of human and natural processes will determine whether the global economy manages to reconcile itself with the planet's finite resources or whether we will simply accelerate its impacts.

At a recent meeting of the World Economic Forum's Global Future Councils in Dubai we discussed what it would mean for a country to be "future prepared" when it comes to environmental and natural resource security. Three dimensions will matter for leadership and 'preparedness capacity' in this regard.

The first is the management of the stock of natural capital. The idea of a natural capital account, alongside the more traditional economic national accounts, is far from new and is part of a push to encourage countries to monitor their wealth, not just their income. But significant challenges still remain in a "natural wealth management" strategy for a country. Natural capital is typically embedded in complex dynamic systems and in real options whose value increases with volatility, making the capital stock variable over time, complicating the valuation of future ecosystem services.

The sustainable management of this natural capital requires us to rethink its governance, yet

few environmental and natural resource ministries are set up to do so, particularly given the siloed nature of the portfolios they manage, divided by resource type and therefore unable to address increasingly complex interdependencies and volatility .

The themes of the Fourth Industrial Revolution are likely going to be critical. As argued in [a recent PNAS paper \(http://www.pnas.org/content/early/2016/09/13/1605516113.abstract\)](http://www.pnas.org/content/early/2016/09/13/1605516113.abstract), the Amazon is a tremendous source of biological and biomimetic assets. The planned [Amazon Third Way \(https://www.theguardian.com/the-gef-partner-zone/2016/dec/16/the-amazons-new-industrial-revolution?CMP=Share\\_iOSApp\\_Other\)](https://www.theguardian.com/the-gef-partner-zone/2016/dec/16/the-amazons-new-industrial-revolution?CMP=Share_iOSApp_Other) entrepreneurial revolution will learn from and then emulate Amazonian natural forms, processes and ecosystems to create more sustainable designs and innovations. This is bringing within reach a pathway where we aggressively research, develop, and scale up a new high-tech approach that sees the Amazon as a global public good of biological and biomimetic assets that can enable the creation of innovative high-value products, services and platforms for current and entirely new markets. There is significant innovation potential in learning from the Amazon through biomimicry-inspired nanoscience—reproducing complex biological systems on a nano-molecular scale, and developing new environmental friendly

processes and technologies for preventing and remedying pollution, new bioinspired textile structures, new revolutionary energy production and carbon sequestration technologies, new robotic applications, and new autonomous vehicle artificial intelligence algorithms, to mention a few.

New forms of governance are also going to be important to the management of natural wealth. For example, the adoption of institutionalised water markets could help reconcile the needs of communities and nature, adaptively managing complex hydrology in scarce basins. The value of the world's underlying water assets, one measure of embedded natural capital, is [estimated at more than \\$330bn \(https://global.nature.org/content/water-share-report\)](https://global.nature.org/content/water-share-report), which could end up providing an important testing ground for blockchain-enabled water rights markets, coding the governance rules enabling the right and obligation to sustain natural capital assets.

The second dimension of future preparedness relates to the management of risks originating from environmental and natural resource issues. In developing hydropower infrastructure on rivers, for example, countries can face vastly different environmental and social risks for the same total amount of installed hydropower capacity, depending on how they optimise the

[planning of river basins \(https://global.nature.org/content/power-of-rivers-report\)](https://global.nature.org/content/power-of-rivers-report) and therefore the siting of individual projects. This multivariate optimisation problem – which encompasses both traditional project risks as well as broader environmental and social concerns at the basin scale – will have a direct bearing on whether projects make sense or not and on the valuation of the projects themselves, their underwriting needs, and their long-run economics.

Risks of domestic or international disruption originating in environmental or natural resource problems can also be transmitted through trade, and the themes of the Fourth Industrial Revolution may be again important. Consider for example, the work of Space Time Analytics, a Brazilian start-up, which is working on a global water risk management platform that will be able to predict likely scarcity scenarios leveraging artificial intelligence technologies and nanosat data streams. The use of information such as this, incorporated in the management of supply chains, may prove essential to increase the resilience of global value chains in a world of greater hydrological uncertainty.

The third dimension of readiness is that of economic growth resulting from the productivity of the natural capital that the economy is able to deploy. Proponents of the green or circular

economy might argue that this is the challenge of our time – redefining growth from a resource intensive, linear process, to a resource productive, circular process. It is clear that the technology shifts of the Fourth Industrial Revolution might support such a transition – a case in point is Raízen Energia, the world’s largest sugarcane biofuel producer investing in advanced digital, biological and material science innovations to improve the bio-industrial system’s total resource productivity, and eliminate all waste outputs by developing new bio-products and bio-materials for current and new global markets.

But broader shifts in the governance and management of our landscapes will also have a role to play. For example, when considering the soy, wheat and corn cropland of the US, a recent report estimates that full adaptation of a [soil health system \(https://thought-leadership-production.s3.amazonaws.com/2016/11/01/17/51/52/8b1da9e7-9195-4261-ac4b-01d7eef22572/rethink-soil-executive-summary.pdf\)](https://thought-leadership-production.s3.amazonaws.com/2016/11/01/17/51/52/8b1da9e7-9195-4261-ac4b-01d7eef22572/rethink-soil-executive-summary.pdf), almost \$50bn of societal and on-farm benefits could be realized each year. Globally, the potential for a restoration economy to contribute to sequestering vast amounts of carbon is supported by countless examples, from owners of degraded forests planting native high-value mahogany trees, thus doubling the rate of carbon storage while restoring the economic and ecological integrity of

their forest, to farmlands on the Mississippi floodplains restoring landscapes, storing carbon and creating future revenue from low-impact timber harvest, and possibly carbon markets, through native commercial hardwoods.

As we come to terms with the consequences of a unsustainable global economy, both innovative policy and entrepreneurial responses leveraging the disruptive technologies of the Fourth Industrial Revolution may provide an opportunity for those countries able to prepare themselves to operate in a resource constrained world. Leaders in the 21st century will find themselves confronting environmental and natural resource security as a mainstream issue in the policy and in the corporate innovation agenda. Responsible leadership must mean recognizing this fact and developing a framework for managing its consequences, harnessing the opportunities that this security and innovation agenda offers to confront some of the profound social and economic challenges all countries face.

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