Policy brief

Natural Capital Accounting & Ecosystem Service Valuation

A look at how these tools can support better land management for the decarbonisation agenda

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Key insights

- Protecting, restoring, and managing lands in Queensland is essential to achieving the state's ambitious decarbonisation goals.
- Ecosystems are valuable carbon stocks and sinks that provide multiple other ecological and human benefits. Regenerating and revegetating land provides further opportunity for decarbonisation.
- Ensuring carbon reduction policies have environmental integrity requires robust accounting of environmental stocks, flows, functions, services, and benefits.
- Natural capital accounting (NCA) and ecosystem service valuation (ESV) trace the stocks and flows of natural resources in ecosystems and calculates both an ecological and monetary value.
- Used appropriately, ESV and NCA can support decarbonisation decision-making by ensuring the multiple benefits of ecosystems are recognised, spatially identified, managed, and valued.
- Land managers can use ESV and NCA to assess and demonstrate the ecological and economic value and benefit of their decarbonisation and nature-positive land management practices.
- NCA and ESV are evolving rapidly. The Decarb Hub can provide policymakers with current knowledge to ensure these tools are used effectively.

Queensland Decarbonisation Hub

The **Queensland Decarbonisation Hub** is funded by the Queensland Government and partnered with Queensland's leading universities.

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Why is this important?

Protecting Queensland's ecosystems and the carbon they contain is a quick win for supporting Queensland's ambitious decarbonisation agenda while supporting environmental integrity. However, land-based carbon stocks and sinks such as forests, wetlands, other vegetation and soils are under increasing and multiple threats including rapid urbanisation, resource extraction, invasive species, and the impacts of climate change (heat, drought, flood, and fire). The combined urgency to combat both rising carbon emissions and ecosystem degradation is an opportunity for the Queensland Government and landholders to address multiple social and environmental issues through maintaining and restoring environmental integrity.

For decarbonisation policies and strategies directed at land use to be effective and resilient, they must manage human disturbance while balancing economic livelihoods to ensure and protect environmental integrity. Environmental integrity is essential for ensuring the resilience of ecosystem-based carbon stocks, building public and industry confidence in carbon and biodiversity finance (see Carbon farming & nature repair markets policy brief) and enabling robust planning and decision-making criteria.

Ultimately, environmental integrity needs to effectively recognise, value and maintain natural ecosystems as close to their natural state within policymaking. To this end, natural capital accounting (NCA) and ecosystem service valuation (ESV) are two processes that enable a more systematic and rigorous assessment of the benefits of conservation and regeneration in land use decision-making. These tools are rapidly evolving and becoming more widespread, and it is essential for policy makers to understand their use, methodology and limitations.

This policy brief outlines the basis of NCA and ESV, how they can be used appropriately to support decision-making, and how they are being used in Queensland.

Background

Climate-related disasters, such as floods, fires, droughts, and more extreme weather are a costly reality for Australia.[1] The IPCC AR6 report made it clear that every tonne of carbon matters,[1] and with CO_2 concentrations in the atmosphere climbing rapidly past 425 ppm,[2] achieving Queensland's ambitious decarbonisation target is more important than ever.

Queensland is world-renowned for its natural environment, boasting pristine beaches, ancient remnant forests, wetland ecosystems and rural bushland. These ecosystems sustain unique and threatened communities, landscapes and plants and animals. These places depend upon environmental integrity, which can be defined as a set of people–environment interactions that foster resilience in both human and ecological communities, and is directly related to 'ecologically sustainable development' defined in the Queensland Nature Conservation Act 1992 and the Environmental Protection and Biodiversity Act 1999.

These natural ecosystems and their environmental integrity will play an ever-increasing role in decarbonisation, supporting climate mitigation through carbon storage, avoiding emissions, sequestration, climate regulation, and supporting the wellbeing of regional areas. However, these ecosystems face a range of threats.

Currently land sector carbon stocks and sinks are under threat due to urbanisation, extractive industries, as well as the impacts of climate change (heat, drought, flood, and fire). Overall, the Australia State of the Environment 2021 assessment found that the state and trend of the environment is poor and deteriorating.[3] Queensland, is still seeing the loss of biodiversity and increasing fragility of its ecosystems despite environmental legislation, policies and programs.[4] For example, in the two years from 2018 to 2020, Queensland lost over 900,000 hectares of remnant woody vegetation of high ecological value according to the Statewide Landcover and Tree Study (SLATS).[5]

Maintaining and increasing carbon stocks through land management and high integrity carbon mitigation policies over the long term will be essential for Queensland to meet state and national targets, and contribute to international commitments, for emissions reductions. Managing natural assets in this context effectively needs them to be mapped, evaluated, and classified. It is essential to capture the most up to date information on the condition, extent, quality, representation, contiguity, uniqueness, and scarcity of ecosystems. This information then needs to be effectively fed into policy and decision-making to support decisions about benefits and trade-offs.

Natural Capital Accounts and Ecosystem Service Valuation provide a way to link ecosystem condition and extent to policy and decision-making. These tools provide a systematic, verifiable, and rigorous way to recognise, demonstrate and capture the value of ecosystems.

Natural Capital Accounting

Natural Capital Accounting (NCA) is a way to translate the stored benefits of the environment into conventional accounting mechanisms. Considering nature and ecosystems as 'natural capital' uses economic framings of nature and ecosystems.[6,7] The purpose of this is to give nature 'visibility' in the economics and finance of human activity and industry.

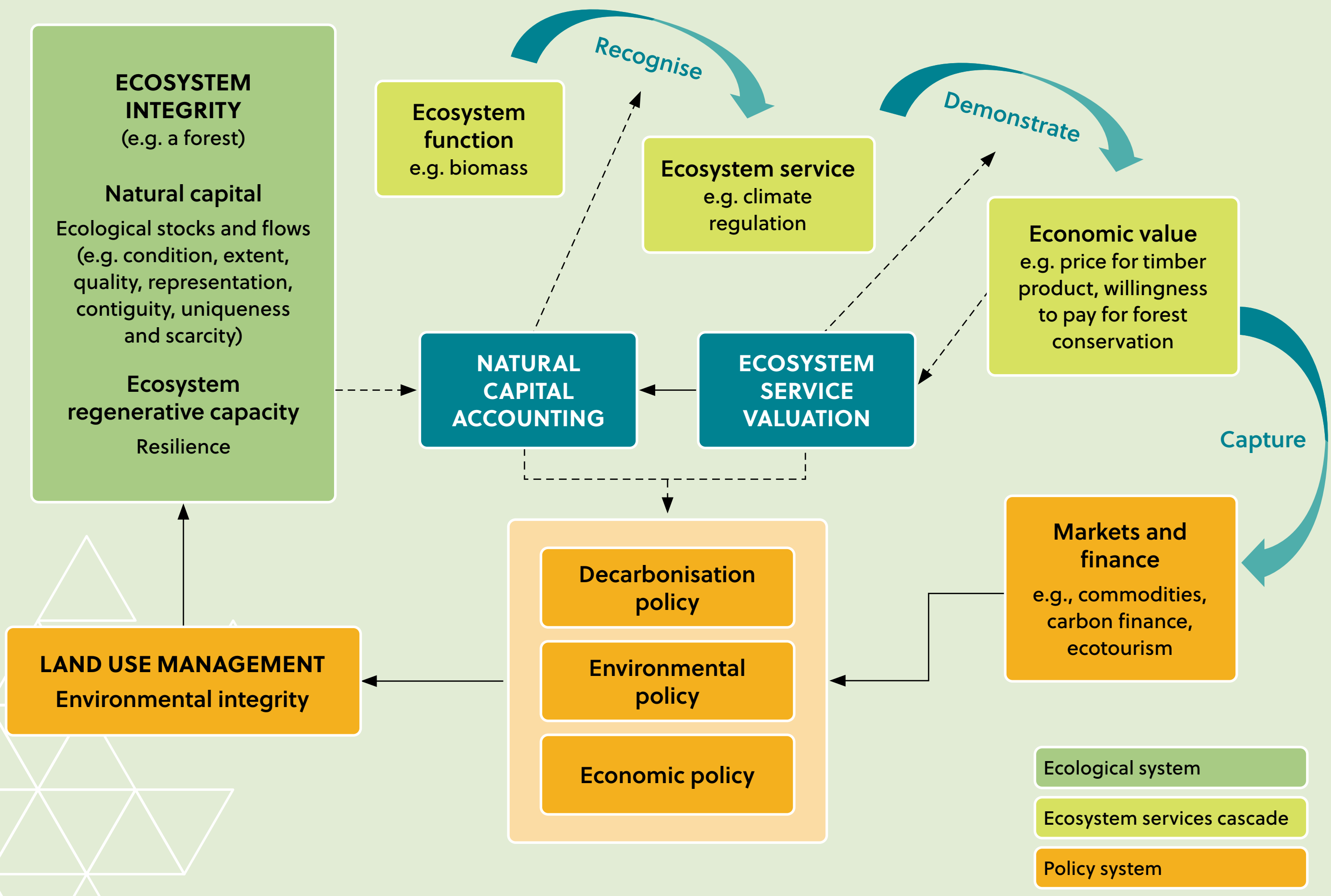
Natural capital encompasses the stock of renewable and non-renewable resources, including trees, soils, air, water, and flora and fauna.6 NCA records the stocks and flows of ecosystems, equivalent to the stocks and flows of goods and services. There are several NCA systems being developed, with the United Nation's System of Environmental Economic Accounting - Ecosystem Accounting (SEEA EA) being a key international benchmark.[8] NCAs can include both:

1. Physical accounts: the extent and condition of an ecosystem, e.g. how much forest there is (extent), and how close is to its natural undisturbed state (condition)
2. Monetary accounts: the flow and use of ecosystem services – the benefits the ecosystems provide to humans.

The data verifying the physical account is essential for understanding stocks and flows of resources. The monetary account can be useful for allowing comparisons to other accounts, such as GDP, and is based on valuing ecosystem services.

NCA, and the related ecosystem service valuation (ESV), enable ecosystem stocks and flows, and the related ecosystem function to be 'translated' into ecosystem services and their economic values to support policy (**Figure 1**). As functions and services are recognised and demonstrated they are then able to inform policy and land use management.

Figure 1: Ecosystem Service Cascade and role of Natural Capital Accounting and Ecosystem Service Valuation.



Ecosystem Functions and Services

> "Ecosystem services are the benefits provided to humans through the transformations of resources (or environmental assets, including land, water, vegetation and atmosphere) into a flow of essential goods and services e.g. clean air, water, and food."
> — Costanza et al. 1997.[9]

Ecosystem functions are the entire set of biological and physiological processes that are essential to support life and have intrinsic value, while ecosystem services are a subset of those functions that directly benefit humans. Ecosystem services are a useful concept for valuing the benefits or services that ecosystems provide to humans. Unlike other services, however, many ecosystem services are non-fungible, meaning they are irreplaceable and cannot be substituted by other economic services. There are a number of similar classification systems for ecosystem services that have been developed for slightly different purposes, including CICES,[10] TEEB[11] and the MEA.[12]

Examples of ecosystem services, using a simplified classification, is shown in **Table 1**. The role of Ecosystem Services in delivering ecological sustainability is already recognised in the Queensland State Planning Policy 2017 explicitly in the theme Planning for the Environment and Heritage.

Table 1. A commonly used classification of ecosystem services, adapted from Buckwell et al.[13]

Provisioning Services	Regulating Services	Cultural Services
Food	Air quality regulation	Aesthetic
Water supply	Climate regulation	Cognitive
Raw materials and energy	Moderation of disturbance	Inspiration
Genetic materials	Water flow regulation	Spiritual
Ornamental resources	Waste treatment	Recreation
Medicinal resources	Erosion Preventionprevention	
	Soil fertility maintenance	
	Pollination	
	Biological control	

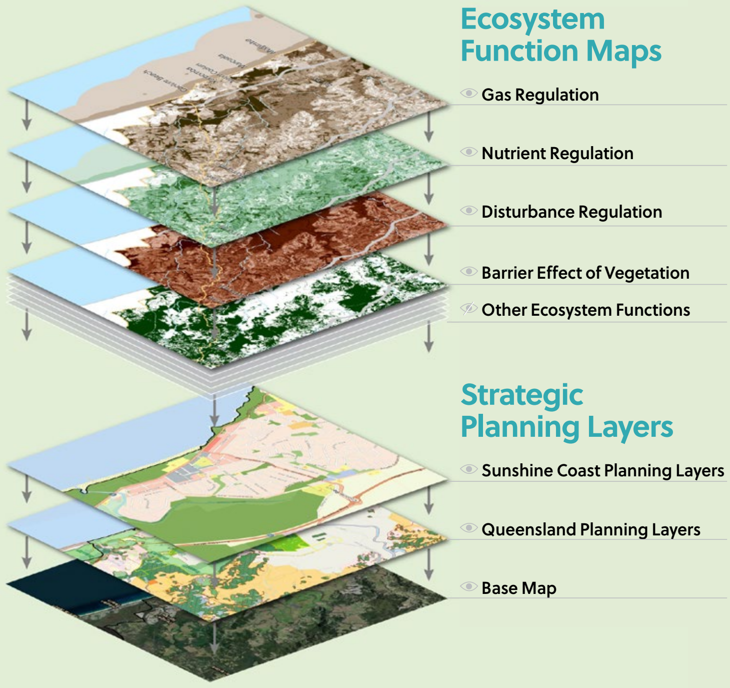
Case study

Sunshine Coast Ecosystem Function Mapping and Reporting Tool

Environmental valuation estimates are more accurate and stable when focused on a limited set of ecosystem services at smaller scales. Aggregating total ecosystem service values for complex systems at landscape scales is inherently challenging, even with best-practice methods. A practical alternative is to conduct spatial assessments of underlying ecosystem functions to identify hotspots and evaluate trade-offs from land-use decisions without relying on monetary valuation.

The Ecosystem Function Mapping and Assessment Tool, developed through the Valuing the Sunshine Coast's Natural Assets project by the University of the Sunshine Coast and Sunshine Coast Council, exemplifies this approach. This open-access GIS-based tool generates high-resolution maps of 19 ecosystem functions at scales ranging from individual lots to the entire Sunshine Coast region.

By overlaying state and regional planning and conservation layers with ecosystem function maps, the tool supports land-use management decisions. It identifies ecosystem hotspots, assesses trade-offs, and explores land-use scenarios, providing critical insights relevant to decarbonisation efforts.[17]



University of the Sunshine Coast

Sunshine Coast Council

Ecosystem Services Valuation

Different types of ecosystem services require and use different methods of valuation.[19] Market-based methods of valuation use market prices as a guide to economic value. However, many ecosystem services are not represented directly in markets and so cannot be valued using market pricing. Many services such as clean air and clean water are in high demand but generally do not have a 'market value' so they must be assessed through non-market and proxy methods such as contingent valuation or damage cost avoided (**Table 2**).

Note that all methods of valuation have a range of uncertainty that must be considered when using NCA and ESV. Ecological resources are multidimensional and not fixed. They can be very long-term and also grow over time, having positive discounting rates. It is commonly thought that direct market valuations are more accurate or 'better' valuations, but this is not necessarily the case as market prices have a high degree of uncertainty.

Table 2: Types of Ecosystem Valuation Methods. Adapted from Buckwell and Morgan.[19]

Economic Valuation Methods		
Market based	Residual methods	Gross value of natural capital
	Replacement costs	Total cost of replacement due to loss
	Opportunity costs	Difference compared with best alternative option
	Damage cost avoided	Potential costs of avoided losses
Non-market based	Revealed preferences	
	Travel cost analysis	Travel preferences as a proxy for natural area value
	Hedonic pricing	Value attributed to specific benefit
	Stated Preferences	
	Contingent valuation	Value placed on hypothetical loss or gain of benefit; indicates willingness to pay (WTP) or willingness to accept (WTA)
	Choice experiment	Value placed on hypothetical loss for gain of multiple benefits; indicates WTP or willingness to accept WTA

Examples of Ecosystem Services Valuation

Example 1 – Economic Values of Moreton Bay and the Maroochy River

As examples of ESV, a 2002 study of the non-market ecosystem services values of Moreton Bay wetlands found that a 'willingness to pay' among the general public for 'non-use' benefits (i.e. the value that people assign to economic goods regardless of whether they use it, sometimes called a 'feel good' value) ranged from $11.41 to $19.42.[20] Healthy Land and Water estimated the total value of Maroochy River (without all the other assets and coastal and marine assets) is worth around $10.8 billion per year.

Example 2 – Economic Valuation of Increasing Queensland's Protected Areas

Research from The University of Queensland (2020) illustrates an economic evaluation approach related to increasing Queensland Protected Areas from 8.24% to 17% land area. The valuation of protected areas is calculated based on estimates of National Park Generated Spending (NPGS). This calculation has indicated that a 17% increase in National Park protected area could be related to an almost $38 billion dollar asset.[21]

Example 3 – WetlandInfo, Queensland Government

The Department of Science and Innovation has done significant work in examining the use of ESV in Queensland, in particular regarding the value of wetlands. They have produced a very useful overview of economic valuation and importantly the consideration and management of non-use values such as tourism, bequeathing to future generations and flood mitigation.

The Queensland Wetlands Program uses a whole-of-system values-based approach which recognises human-nature relations within a larger catchment scale of planning.[22] This is a complex process where ecosystem components and processes are mapped to beneficiaries of the services provided and values (importance, worth and significance) of an ecosystem are identified. Values include existence values (human based) and intrinsic (nature based). Wetland valuation has also been associated with blue carbon values, recognising the carbon sequestration in mangroves, tidal marches and seagrasses. The Program also provides an overview of economic valuation and importantly the consideration and management of non-use values such as tourism, bequeath to future generations and flood mitigation.

Policy informed by NCA and ESV

Land use management is going to play a vital role in decarbonisation policy. Natural capital accounting and ecosystem service valuation are mechanisms that support better land use decision-making by helping to integrate decarbonisation, environmental, and economic policy (Figure 1) and are especially important for supporting sustainable finance and environmental markets.[19]

Good land use management must evaluate trade-offs between any value gained through either resource extraction or land use change and the loss of value from changes in ecosystem services, which depend on ecosystem integrity.

Failure to pay adequate compensation for the erosion, destruction or extraction of a natural resource will occur when the value of the asset or resource that is extinguished is uncertain or not carefully understood. For example, protecting intact native forest will support more ecosystem services, with far greater value than timber alone, than replacing it with a plantation forest.[23,24] Better recognition and demonstration of ecosystem services will ensure they are correctly valued and accounted for in decision-making.

NCA and ESV are central tools for translating ecosystem integrity and its resulting ecosystem services into policy in the face of impacts or pressures from natural or human-made interactions or events (**Figure 1**).[11,18]

Economic values and the use of markets and finance to support ecosystem integrity will be central to decarbonisation policy. Some ecosystem service benefits can be captured to create income streams (conventionally these are extractive resources such as timber production). Increasingly, non-extractive capturing of ES, such as carbon storage functions, can result in an income stream, e.g. through carbon credits or other environmental markets. NCA and ESV add valuable information to support these environmental market mechanisms.

Firstly, they provide transparent and comparable information on the ecosystem services, and their value, of different ecosystems, building confidence and integrity in burgeoning environmental markets. Secondly, as they become more established and widely available, these methods will help land stewards demonstrate a more complete picture of the benefits of their land management practices. This will allow them to demonstrate co-benefits of decarbonisation land management – potentially resulting in higher value credits (credit bundling) or access other credits (credit stacking).

Crucially, NCA and ESV will highlight the importance of ensuring environmental integrity because natural capital and the accompanying ecosystem services stem from the extent and condition of ecosystems across a landscape.

Capacity for NCA and ESV in Queensland

Queensland is already developing and embedding the use of NCA and ESV. NCA is being increasingly used within research projects to inform policy. The NESP undertook an environmental-economic accounting for the Mitchell River in Far North Queensland using the SEEA-EA system to create a set of ecosystem accounts for the river. Furthermore, NCA is used widely for environmental markets, and as these develop both NCA and ESV will become increasingly important.

Natural Capital Accounting is already being used in the Land Restoration Fund and other environmental markets in Queensland. The Australian-developed Accounting for Nature has aligned its method to the widely-accepted, publicly available UN SEEA-EA standard and provides NCA services to landholders and others seeking to access the LRF and other environmental markets. The Queensland Government recently provided funding for Accounting for Nature to support the uptake of their environmental accounting standard.

Importantly, NCA and ESV are still being developed and are likely to undergo changes and improvements, especially as their use in environmental markets widens and they become more widely accepted. It is likely that the UN SEEA-EA process will become the 'gold standard' for NCA, but that a multitude of aligned and non-aligned accounting and valuation methods will be developed and marketed. Policymakers will need increased knowledge and capacity to understand and use both NCA and ESV appropriately and rigorously. The Queensland Decarbonisation Hub will develop resources to support improved and appropriate use of both NCA and ESV.

Finally, it is important to note that NCA rests on good information about the extent and condition of ecosystems. Here, good data such as the State of the Environment Report and the Statewide Landcover and Tree Study are essential and valuable contributions to understanding the value of Queensland's ecosystems.

Recommendations

1. Policymakers need to work with multiple stakeholders to ensure the environmental integrity of Queensland's decarbonisation projects.
2. Policymakers should align energy, economic and environmental policies to balance multiple demands and trade-offs to ensure that the land sector supports decarbonisation.
3. Policymakers should recognise that environmental integrity aims to preserve the values and resilience of nature, and that NCA and ESV can demonstrate these values and show that monetary exchanges or offsets are always a less desirable environmental outcome.
4. Policymakers and other stakeholders should ensure rigorous and appropriate use of the best available ESV and NCA systems and tools. ESV and NCA are developing rapidly, and proprietary methods are likely to multiply and compete, especially as environmental markets grow.
5. Policymakers should support the gathering and use of high integrity data on ecosystems. For example, SLATS data should be updated yearly, otherwise long term and impactful ecological decisions are based on outdated information.

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