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Water–boundaries and borders – the great intangibles in water quality management:

Can new technologies enable more effective compliance?

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The Problem

Water, energy and food – global concerns about limited access to these three fundamentals for life are compounded by growing concerns about their future availability and sustainability:

- Continued population growth will exert significant pressure on the level and complexity of water resource use and allocation trade-offs which must also act to minimise ecosystem degradation.
- *"if 'business as usual' water management practices continue for another two decades, large parts of the world will face a serious and structural threat to economic growth, human well-being and national security"* – World Economic Forum, 2011
- If we accept that the world's ecosystems are capital assets essential for continued life on earth, then we must find ways to improve how we manage those assets for the future against persistent calls for growth.

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Three Key Discussion Points

- The World's ecosystems as Natural Capital Assets
- The case for a performance-based framework for WQM
- The role of new and innovative technologies in WQM

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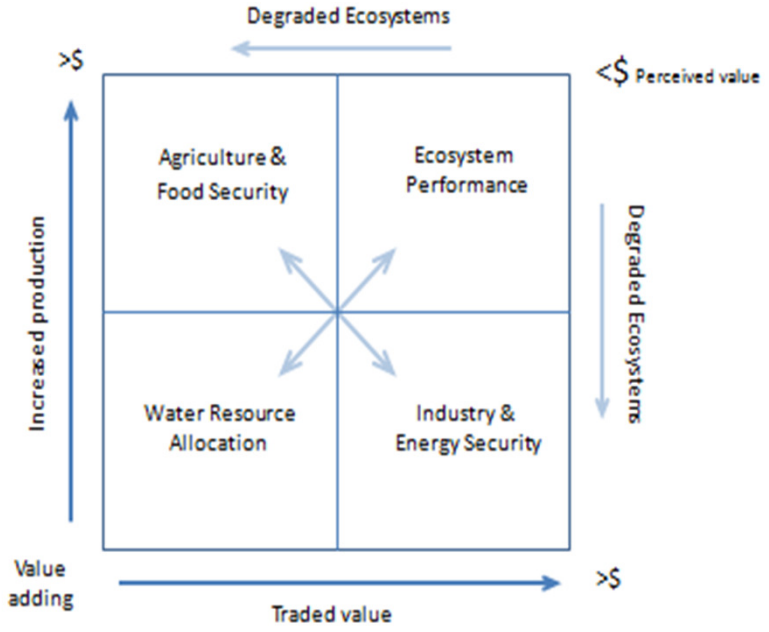
Ecosystems as Natural Capital Assets

- Ecosystems yield a flow of vital services, including:
  - the production of goods (i.e. water, food, fibre, and timber)
  - life support processes (e.g. soil formation, pollination, water treatment, climate regulation, genetics); and
  - life-fulfilling conditions (i.e. aesthetics, spiritual fulfilment).
- Ecosystems as capital assets are poorly understood, rarely monitored, and many are in rapid degenerative decline with extensive loss of service capability.
  - An expanding population and changing climates are adversely affecting ecosystem resilience.
- Therefore, the pursuit of "growth" and its perceived benefits must be considered in the context of its cost relative to the limitations of the world's natural capital assets to continue to provide the raw materials and (eco)services necessary to maintain and deliver the aspirations and goals of the worlds' populaton for better lifestyles.

The ‘Value’ of Water as an Asset

- The relationship between ecoservices, e.g. provision and access to water resources, is that declines in resource health and availability also reveal critical points and interdependencies in the supply of a combination of services that may also be in decline.
- The management, storage, use and reclamation of water forms the basis for life on earth, environmental health and energy and food security.
- Changes in water distribution, quality, and availability associated with short-to-medium term regional climate variability also creates challenges for future water, energy and food security.



Determining the underlying ‘Value’ of resource allocation in a water limited environment. *Adopted from (Coles 2013)*

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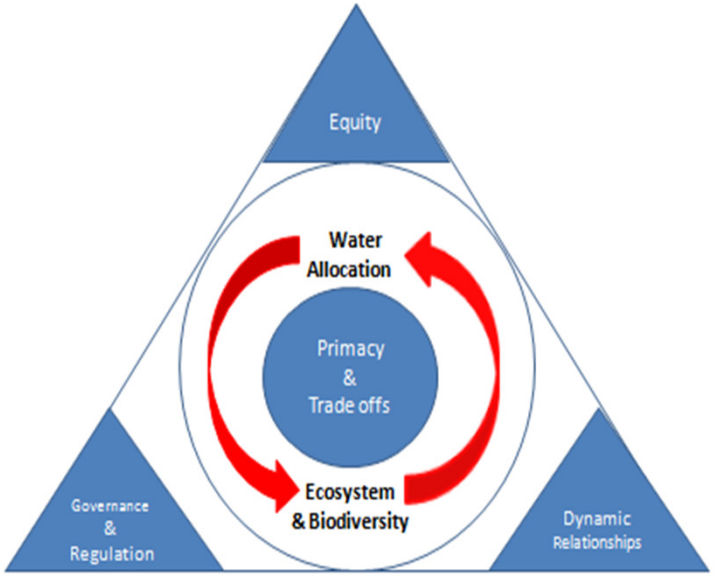
Protecting our Water Resources

- In order to meet present and future market demands compliant with water quality agreements, understanding of the drivers and actors of water quality and river health is required to determine equity in terms of water allocation and trade offs.
- Protecting the world's freshwater resources, therefore, requires diagnosing threats over a broad range of scales, from global to local, which translates into an understanding of ecosystem function, fragility and resilience.



Drivers and actors that impact on water allocation and ecosystem performance that link "primacy" with trades offs, in a policy and science framework. *Adopted from (Coles 2013)*

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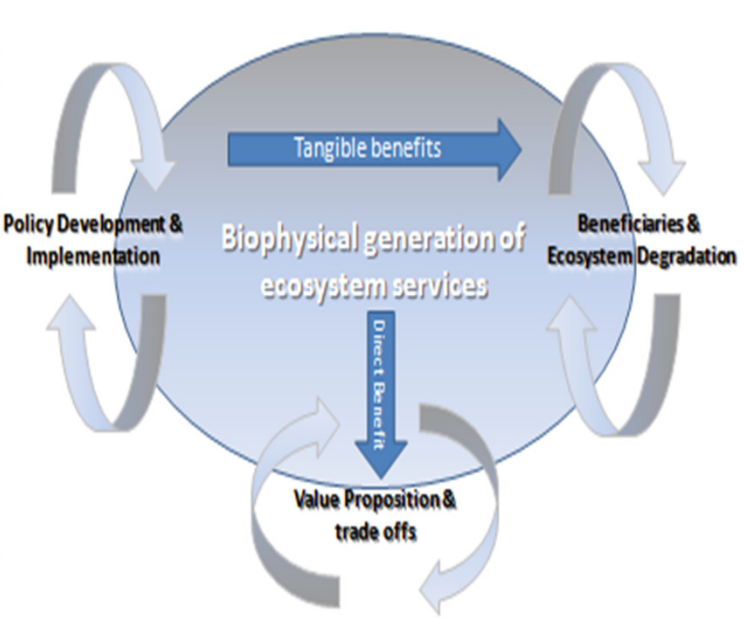
WQM Performance-based Framework

- An adequate and flexible eco-accreditation framework supported by a robust real time monitoring and reporting system is required to ensure water and land managers are utilising natural resources sustainably (and are being independently assessed).
- Creating such a framework requires appropriate data, a relevant regulatory system, and performance-based evidentiary governance framework.
- This will require determining and setting appropriate metrics for measuring and reporting ecosystem health and thus, setting appropriate performance targets and indicators.



Ecoservices Framework: Where services provided by the biophysical environment are valued and traded to beneficiaries, through policy, governance and market instruments. *Adopted from (Coles 2013).*

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New and Innovative Technologies

- Development, implementation, and compliance with transboundary water quality agreements, whether they be across basin, across water bodies or across national or international boundaries, remains constrained by our ability to monitor their effectiveness in [or near] real time.
  - For example, the effects of diffuse pollutants and their distribution within water bodies and transboundary rivers systems are difficult to capture and determine the exact point and timing of their release into that water system.
- What is needed, therefore, is the development and implementation of innovative technologies that provide integrated real-time monitoring systems and reporting networks with intelligent assessment frameworks that are able to determine the synergies within an altered "natural" landscape or urban environment, and that will provide the necessary levers to deliver the most balanced and sustainable outcome in a given locality.

There is a strong precedent…

- New and innovative sensor and communication technologies are being used in meteorological monitoring and reporting networks with significant effect on our ability to record and analysis synoptic data, and detect, track and respond to severe weather events on local, regional, national and international scales.
- For example, an automatic weather station (AWS) connected to either a dedicated or shared communication network (such as mobile, wireless or satellite network) enables us to capture and report in near real-time synoptic data within the immediate installed locality.
- This data not only enables us to monitor in near real-time the environmental conditions (in meteorological terms) at the microscale, but as part of an integrated AWS network also enables us to monitor in near real-time the prevailing conditions at the mesoscale and synoptic scale. This capability also enables us to 'ground-truth' weather radar and satellite data to detect and track 'abnormal' meteorological events, with obvious benefits to those communities at risk.
- Similarly, river height and sea level gauges employing innovative technology and integrated communications networks enable us to better monitor river and coastal conditions so we are better able to detect and track flood situations and abnormal sea conditions, such as storm surges and tsunamis.

In effect, all these networks are not only an integral part of an integrated data gathering system, but also an early warning system and a 'situation' management system.

Conclusion

- The need for improved water quality monitoring and governance compliance is not in dispute; however how we achieve this, in a timely and cost effective manner is yet to be determined.
- As for any accountable enterprise, an appropriate operational performance monitoring and reporting framework needs to be developed and implemented, without which short, medium and long-term goals, policies and directions cannot be set with confidence.
- The development of innovative sensor and network technologies to better monitor the local to global responses to impacts on ecosystems in this time of rapid change and increased demands is imperative.
- While significant effort in developing innovative sensor and network technologies is forthcoming, a sustained research effort is also required to derive an appropriate set of ecosystem performance measures, metrics and indicators that are suitable for use as health targets and indicators of change within catchments, and enable us to clearly identify and monitor shifts in ecosystem resilience. This is essential for us to be able to assess ecosystem performance and achieve sustainable outcomes at multiple levels.

Take away message

Changes in natural resource management approaches and system functional design bring not only environmental benefits, but are perceived as an increasingly viable, financially sound alternative.

By employing, a real time integrated and targeted monitoring system, in an operational performance-based framework, which allows for the assessment of both the catchment functions and modifications to those functions or (eco) services by the various stakeholders, real improvements in water quality management are possible.

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Thank You

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