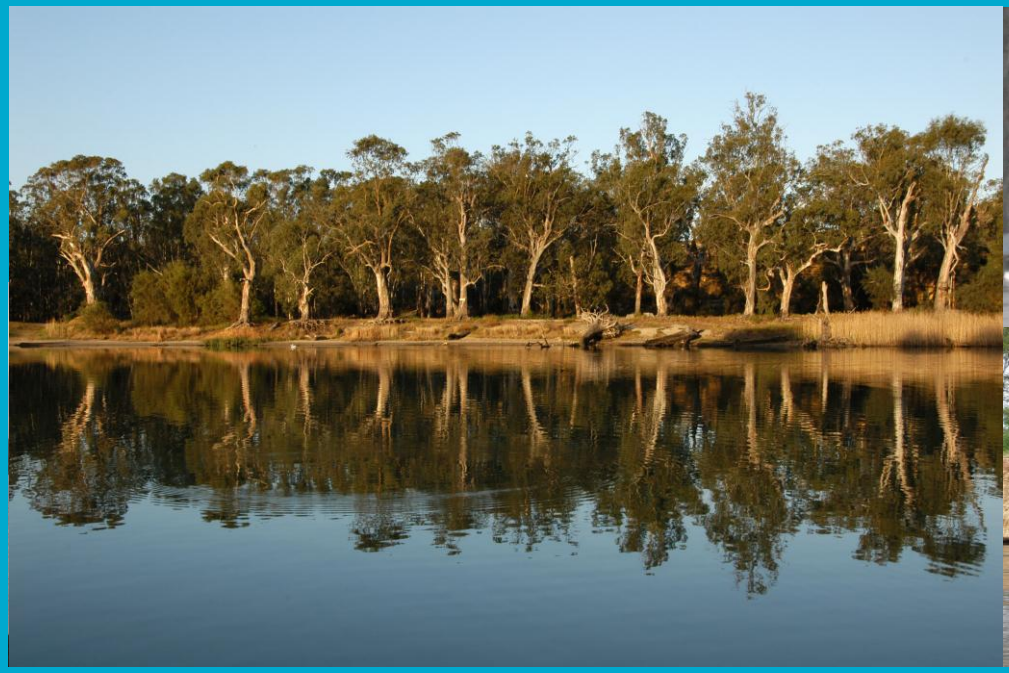
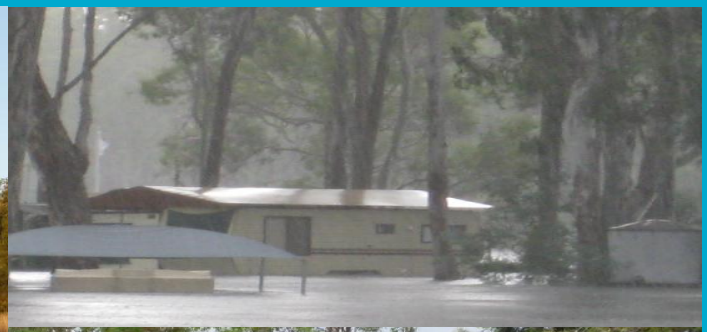




What typology for quantifying trans-boundary water cooperation benefits?

Jeff Connor

UN Transboundary Water Cooperation Benefit Quantification Expert Scoping Workshop, June 6-7, 2013

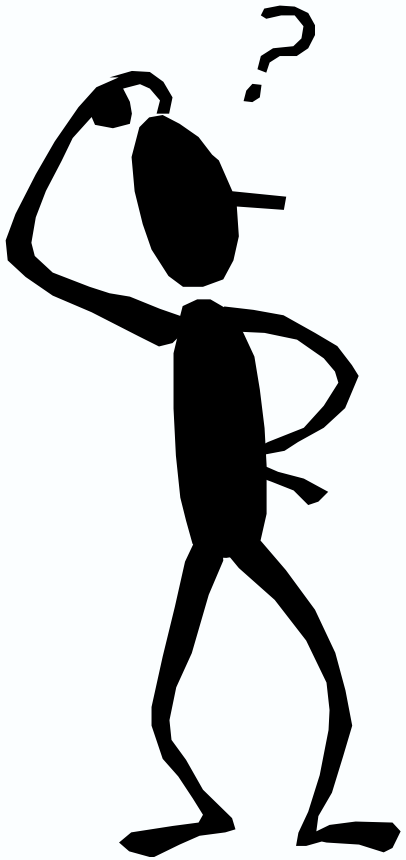
WATER FOR A HEALTHY COUNTRY AND DIVISION OF ECOSYSTEM SCIENCES
www.csiro.au

Why a transboundary water cooperation (TWC) benefits typology?

Understand, catalogue & communicate

(to cooperaters and experts):

- **Potential TWC action opportunities**
- **Impacts (intended and not) across the water cycle**
- **Valuation opportunities & challenges**



Challenges in typology development (& TWC benefit quantification)

- Individual and coordinated (institutional) actions
- consumptive; non-consumptive; rival & non-rival; use & non-use values
- Synergies and tradeoffs from multiple benefits & costs in:
  - water: sourcing, storage, conveyance, use, treatment, and disposal
  - complex temporal and spatial dimensions

Relevant typologies (TWC actions & impacts)

- TWC**:** quantity, quality, watershed, & integration **actions**

- Impacting **Ecosystem service**

  provisioning, regulating, cultural, supporting (habitat) service impacts

- across **integrated water resource management cycle:**

  sourcing, storing, conveying,

  using, disposing of water

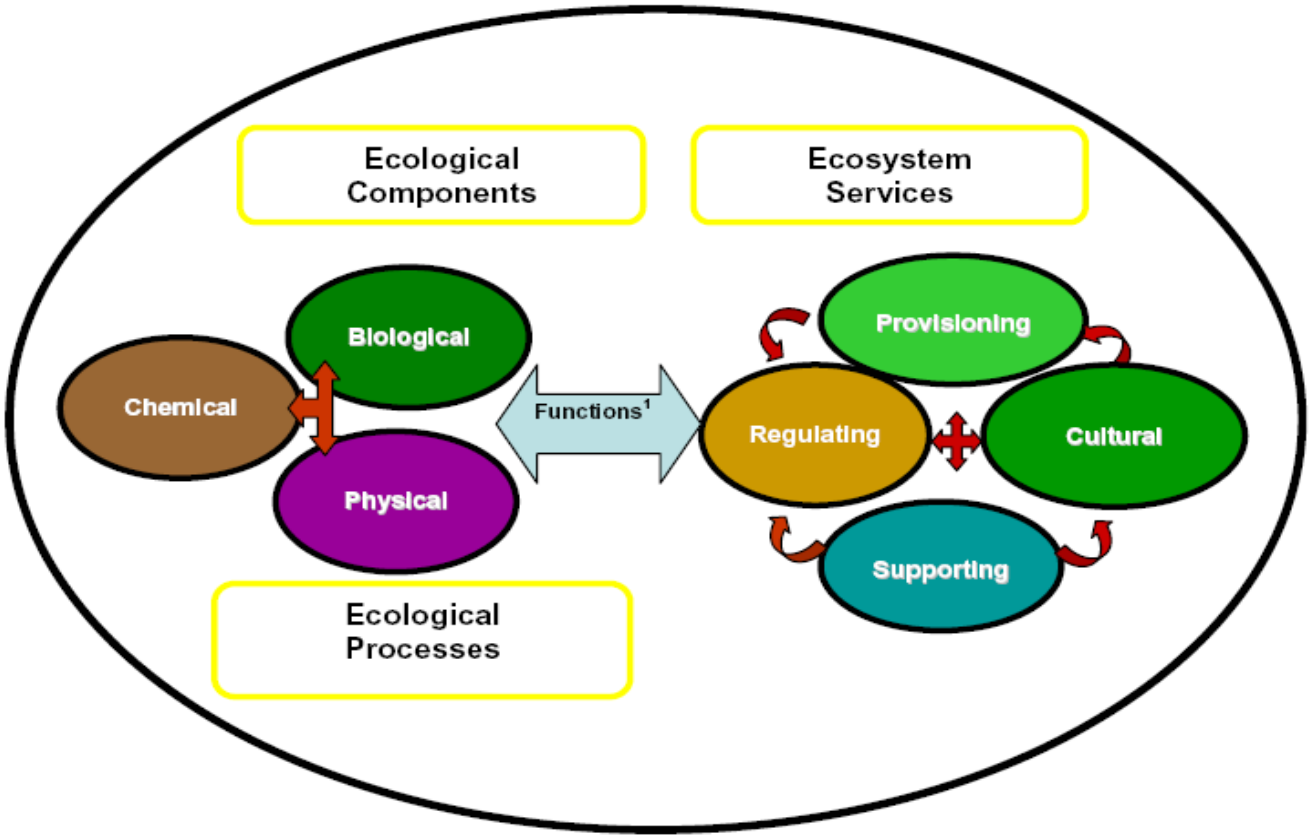
- Total economic value
- Sustainable livelihoods
- Blue and green water

Ecosystem services

The benefits people obtain from ecosystems.

- provisioning services such as food from irrigation water;
- regulating services such as regulation of floods, drought, land degradation, water quality, and disease;
- supporting (habitat) services e.g water temperature, flow, innundation;
- cultural services such as recreational, spiritual, religious, and other nonmaterial benefits".

Ecosystem functions produce services that we value



[1] The degree to which Ecological Components and Processes provide Ecosystem Services depends on the functional properties of the ecosystem (*e.g.* biomass production, nutrient cycling, food-chain dynamics and other properties of species and abiotic components)

Source: De Groot et al

ES Example: Cataloguing Potential Gas/Mining Development Impacts

Inventory possibly impacted ecosystem functions
provisioning, regulation, cultural, supporting services

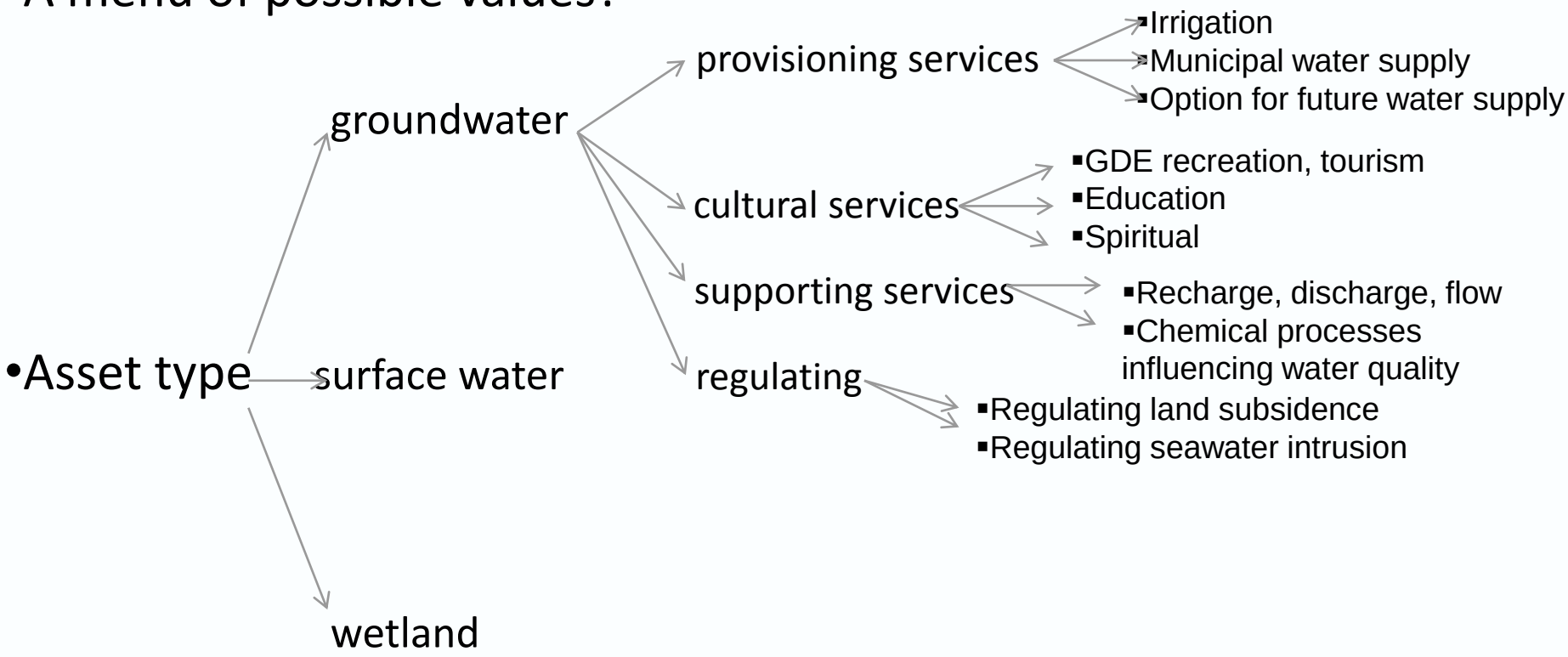
Develop lists from lit review of potential ESS by:

- water body type – surface, ground, wetland
- ESS type – provisioning, regulating, cultural, supporting

- Assess (screen) vulnerability of functions / values to mining/gas development
- Value potential loss ($ and other) of ESS at risk from development

Cataloguing possible mining development impacts on water ES

- A menu of possible values?



Modifying ESS Language for Public Communication of potential Water Benefit Impacts of Gas/Mining Development

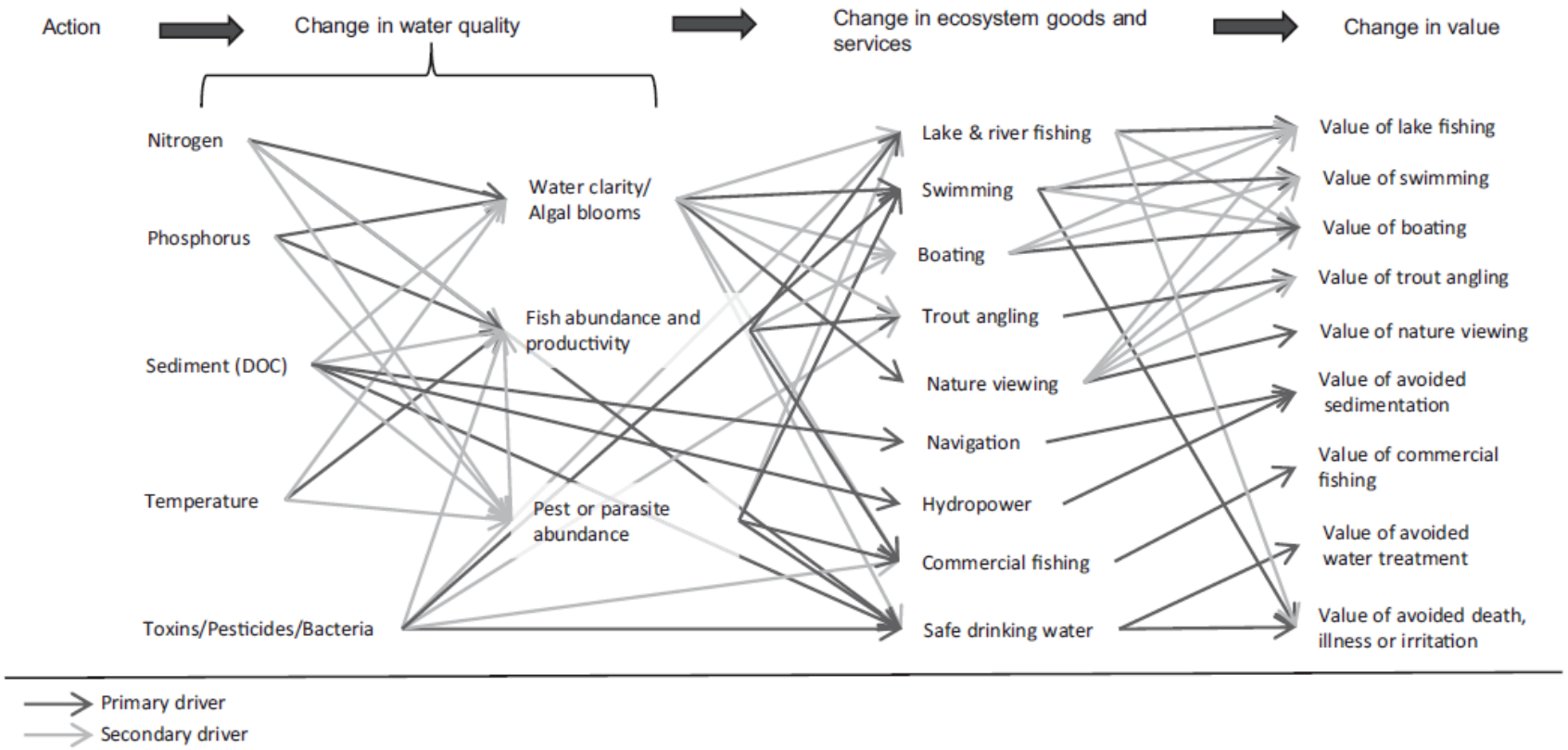
Economic value	Consumptive - Municipal ; industrial ; Mining - Stock and domestic; Irrigation; Forestry
	Non-consumptive - Fisheries and aquaculture - Recreation and Tourism (includes cultural) - Food and Fibre (e.g. floodplain grazier)
	Environmental Maintenance - Carbon sequestration - Pollution control (bioremediation, sediment, nutrient, salinity) - Erosion protection - Natural hazards (eg. Land subsidence control) - Amenity (Recreation, regional economic growth) - Market perception of environmental credentials (reputation, brand etc)

Cultural values –better not monetised?

Heritage	Importance of eceosystem to personal or collective history and cultural identity: • Historic sites, features and artefacts • Designated cultural landscapes • Cultural traditions and knowledge
Amenity	Importance of nature for cognitive development, mental relaxation, artistic inspiration, aesthetic enjoyment and recreational benefits, and may include: • Aesthetic quality of landscape • Recreational features and use • Artistic features and use
Therapeutic	The provision of therapeutic effects mental and physical well-being: • Capacity of systems to provide 'health services' • Restorative and regenerative effects on peoples performance • Socio-economic benefits from reduced health costs and conditions
Spiritual	sacred, spiritual and religious significance
Existence	Importance people attach to nature for ethical reasons (intrinsic values) and inter-generational equity (bequest value).

Applying ES to water quality action > Ecosystem impact > value change

Fig. 1. Framework for linking actions to values for water quality-related ecosystem services.



Source: Keeler et al., 2012

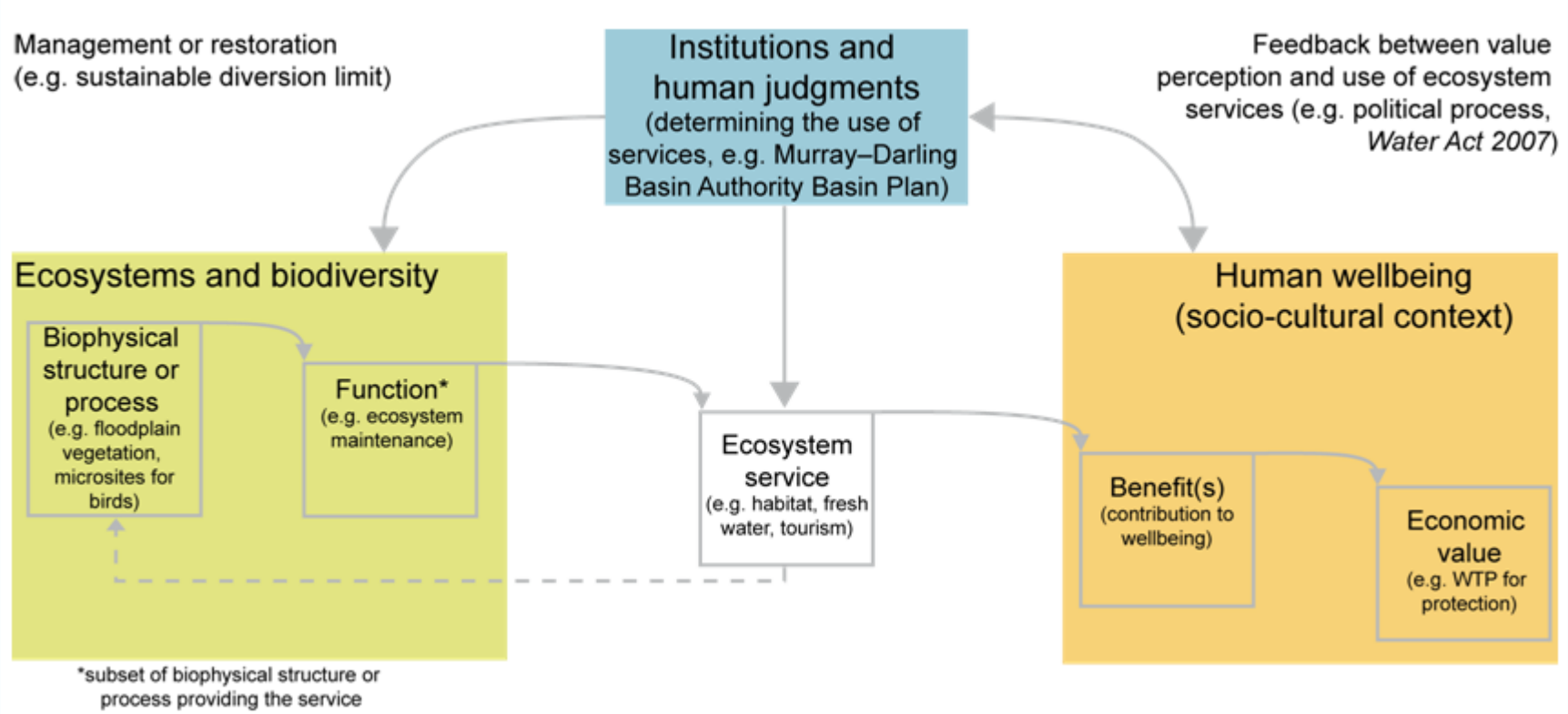
Combining ES and Water cycle concept to Inventory impacts across the water cycle

Example: comparing ES impact across water cycle of urban water supply investments

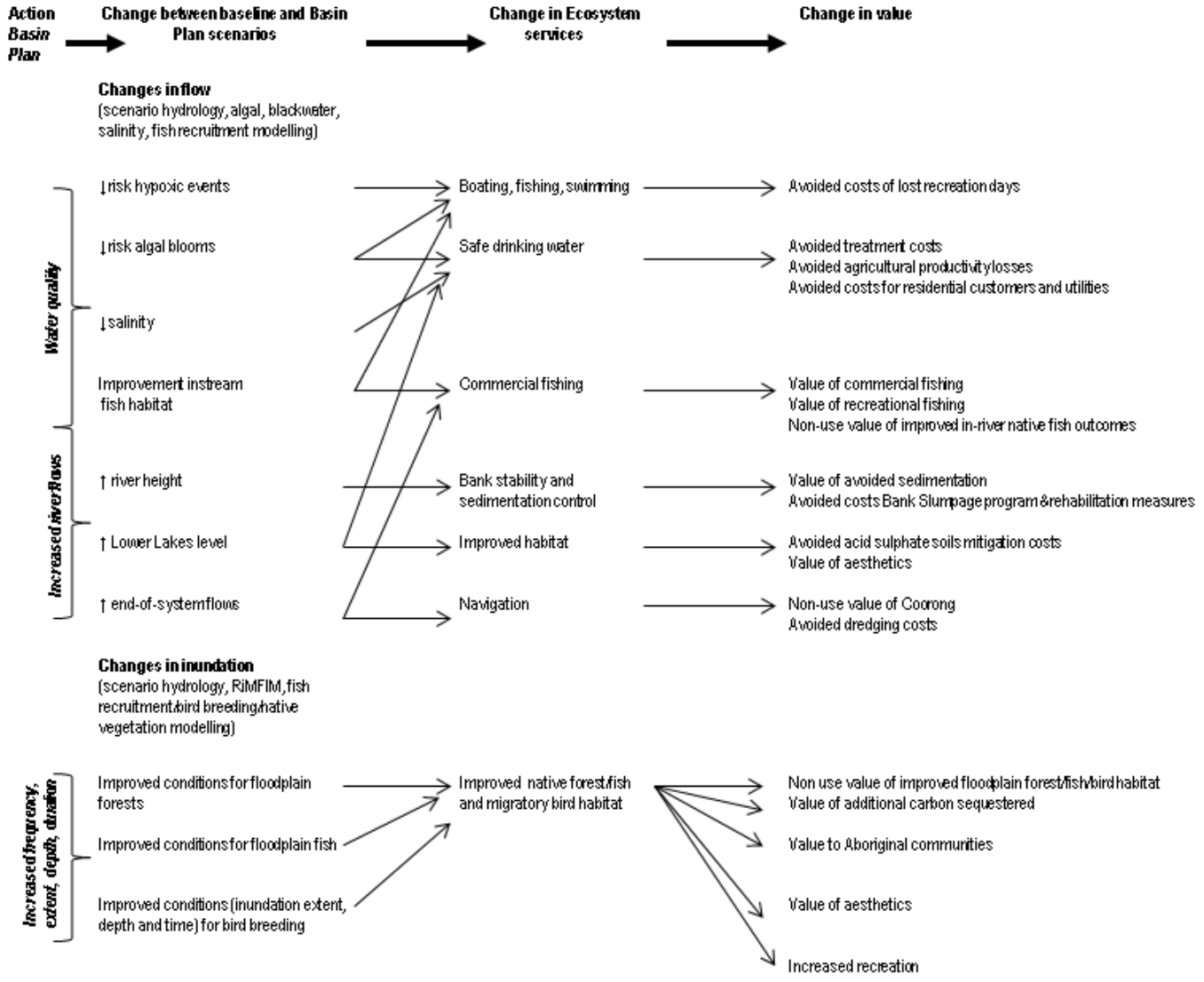
Water supply investments	Water cycle stage					
	Extraction	**Storage**	**Conveyance**	**Treatment**	**Use**	**Disposal**
Surface water	*Provision freshwater, food and fibre and, fish production*	*Flood & erosion regulation, recreational amenity, habitat support, support for cultural spiritual values*	*Climate and air quality regulation, habitat support, aesthetics-disamenity value*	*Water quality regulation, estuarine amenity, & habitat support*	*Amenity space, cultural & education, and research values, provision food and fibre production*	*Provision fish production, coastal amenity, & habitat support*
Stormwater	*flood regulation*	*Flood & erosion regulation, recreational amenity, habitat support*	*Climate and air quality regulation, habitat support, aesthetics-disamenity value*	*Water quality regulation, estuarine amenity, & habitat support, provision fish production, Climate and air quality regulation, support nutrient and soil cycling*	*Amenity space, cultural & education, and research values, Provision freshwater,*	*Provision fish production, coastal amenity, & habitat support, Erosion regulation, support nutrient and soil cycling*

ES applied to cataloguing and valuing MDB environmental water reallocation benefits

Background: Recent Murray Darling Basin Initiative reallocated about 20% of current diversion to environment; CSIRO evaluated benefit with ES framework



MDB: action > Ecosystem impact > value change



Adapted from Keeler et al., 2012

Scenarios

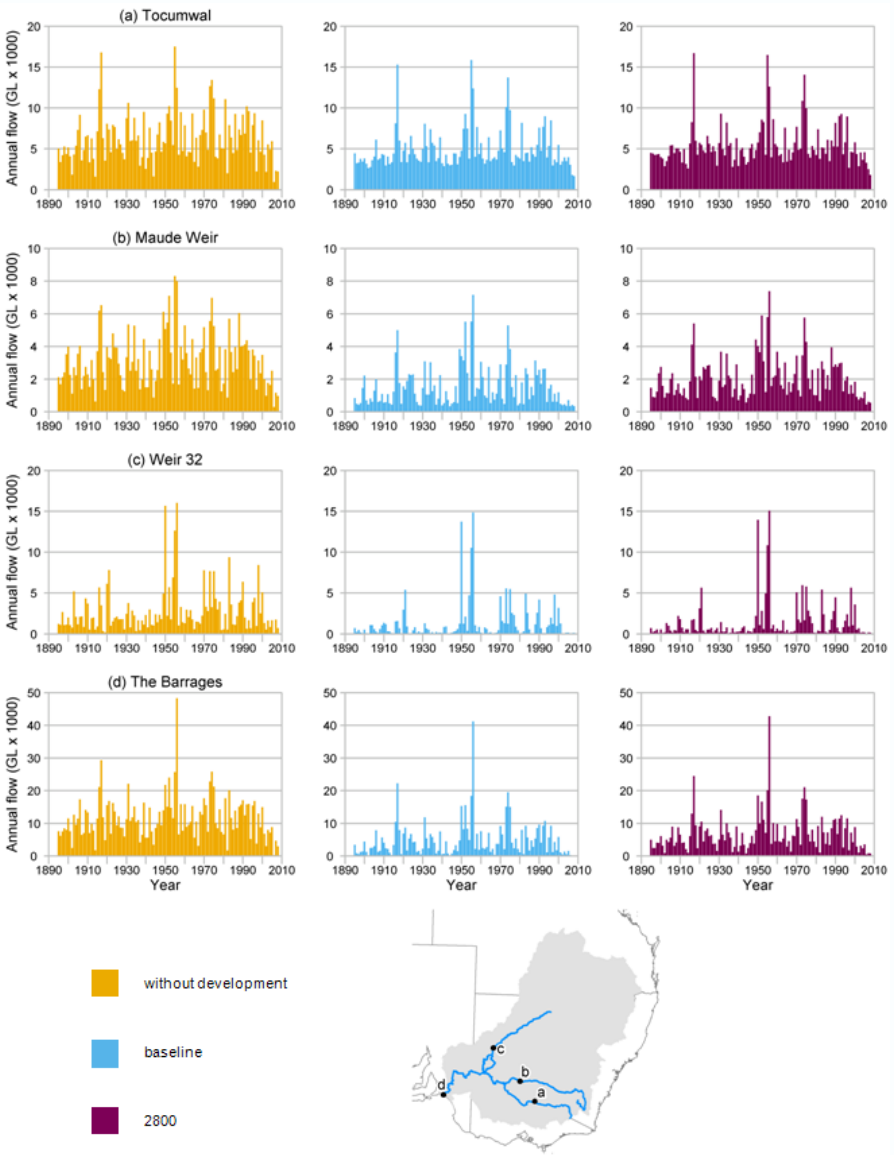
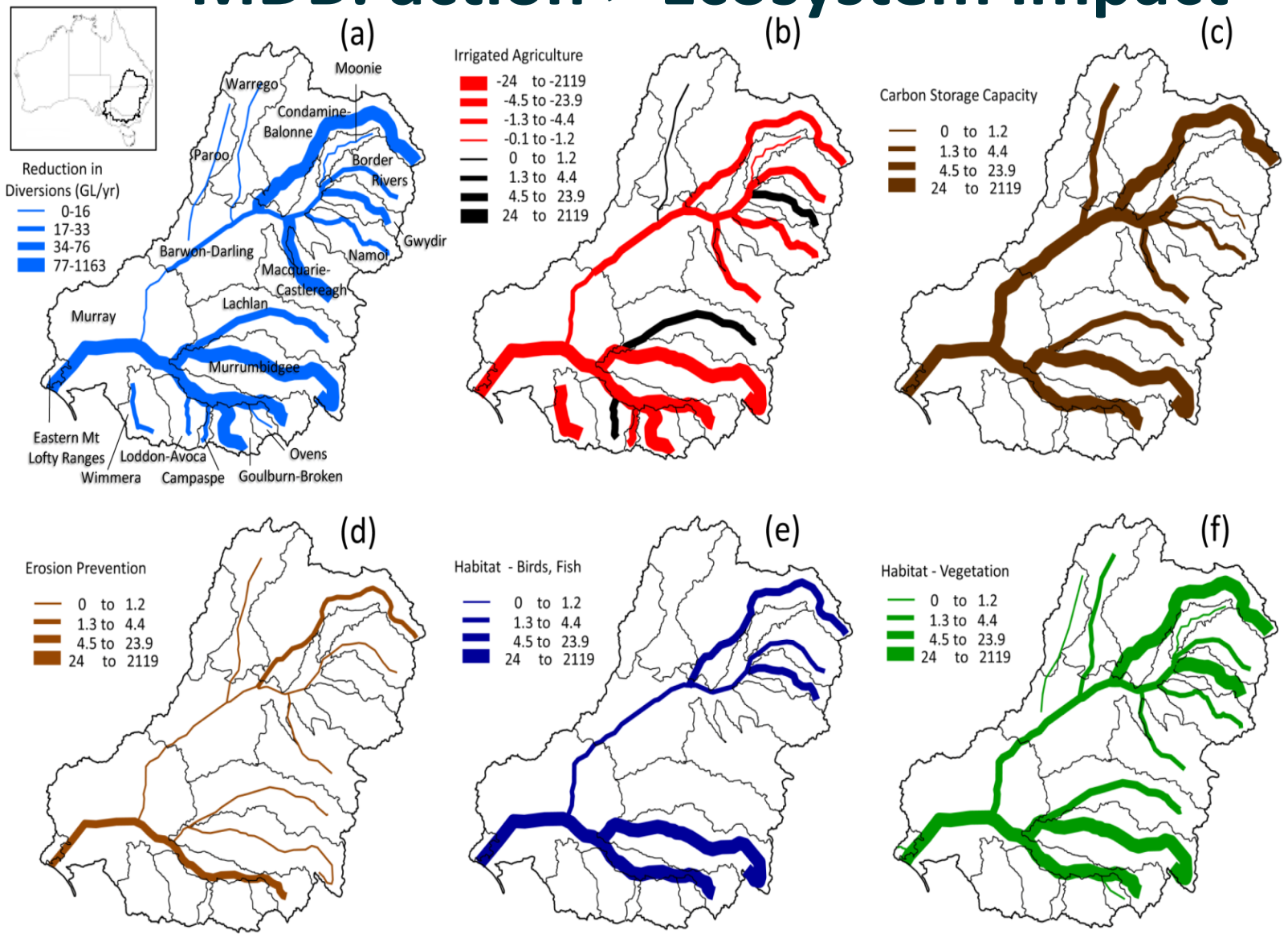


Figure 2.1 Annual volumes under the without-development, baseline and 2800 scenarios at (a) Tocumwal, (b) Maude Weir, (c) Weir 32 and (d) the Barrages

MDB: action > Ecosystem impact



Ecosystem service	Ecological benefits and water quality benefits (Chapter 3 and Chapter 4)					Ecosystem services benefits (Chapter 5)				Economic benefits (Chapter 6)			
	Input	Scale	Method	Output	Section	Input	Scale	Method	Section	Input	Scale	Method	Section
Provisioning services													
Food and fibre						☐		Marginal change	5.5	☒		Production cost	6.3
Fresh water	☒		Assess flow scenarios	Acidification of Lower Lakes	4.3	☐		Marginal change	5.5	☒		Avoided cost Consumer surplus losses	6.4
	☒		Blackwater model	Cyanobacterial bloom formation	4.4								
	☒		RiM-FIM	Blackwater occurrence	4.5								
Regulating services													
Carbon sequestration						☐		Marginal change	5.5	☒		Carbon credit market	6.5
Wastewater treatment						☐		Marginal change	5.5				
Erosion prevention and maintenance of soil fertility						☐		Marginal change	5.5	☒		Avoided cost	6.6
Moderation of extreme events						☐		Marginal change	5.5	☒		Benefit transfer	6.7
Cultural services													
Spiritual and sense of place						☐		Marginal change	5.5				
Recreational and mental health						☐		Marginal change	5.5				
Aesthetic appreciation and cultural inspiration						☐		Marginal change	5.5	☒		Hedonic	6.8
Tourism						☐		Marginal change	5.5	☒		Travel cost: benefit transfer and calculations	6.9
Habitat services													
Habitat (nursery and genetic diversity)	☐		Literature review of long-term datasets	Long-term status and trends of condition	3.3	☐		Marginal change	5.5	☒		Benefit transfer from choice modelling Avoided cost	6.10
	☒		RiM-FIM DSS	Floodplain vegetation	3.5								
	☒		MFAT	Native fish	3.6								
	☒		MFAT DSS	Waterbird breeding	3.7								
	☒		Coorong Hydrodynamics Model Coorong Ecosystem States Model Coorong Mudflat Model	Coorong	3.8								

MDB: Ecosystem impact > value change

Applying ES as TWC benefit typology ?

Advantages

+ systematic cataloguing of full range of:

action > impact > value

+ provides valuation challenge insights (market, non-market values)

Challenges

-Provides no particular insight into possible range of TWC actions

-May require supplementation to systematically consider water cycle interdependencies

Recommendation: ES + TWC benefit typology

1. Inventory potential TWC actions
   - Consider: Quantity, quality, watershed, integration actions
   - For: sourcing, storing, conveying, using, treating, disposing
   - Consider physical actions & institutions / incentives

2. Inventory ES impacts on: provisioning, regulation, cultural, supporting services across water cycle

3. Inventory valuation possibilities - markets, production functions, reveal preferences, stated preferences

Inventory TWC actions

Alternative 1: SIWI following Sadoff and Grey (2002)

Actions for:	Action types	benefits
Water quantity	Supply infrastructure; demand management; improved system management & allocation institutions	Consumptive use benefits
Water quality	Treatment infrasturture; watershed actions; flowing management	Consumptive and in-situ use values
Water shed	Reforestation; land cover management; water retention, impervious surface management	Reduced water hazard vulnerability: Flood, storm, salinity; groundwater recharge
Integration	Define property rights, management, impact assessment, benefit sharing, side payment protocols	All of above +

Inventory TWC actions

Alternative 2: actions by water cycle geography

Actions for:	Action types
Sourcing (extracting)	Actions in catchments (land cover change) to influence water quantity & quality ; supply infrastructure
Storing	Storage & release quantity and timing
conveying	River flow management, pipes & pumps, riparian management
using	Diversion, use, property rights & policy, demand management and efficiency
disposing	Treatment infrastucture; use efficiency and demand management

Institutions to create TWC dynamic incentive 1: functional MDB Water Market

1990s reforms resulted in volumetrically defined, metered (surface & some ground) water rights independent of land, tradeable.

3 elements in water rights definition:

1) water access **entitlement** – 'a perpetual entitlement to a share of water from a specified consumptive pool

2) Annual **water allocations** a 'specific volume of water allocated to water access entitlements in a given season

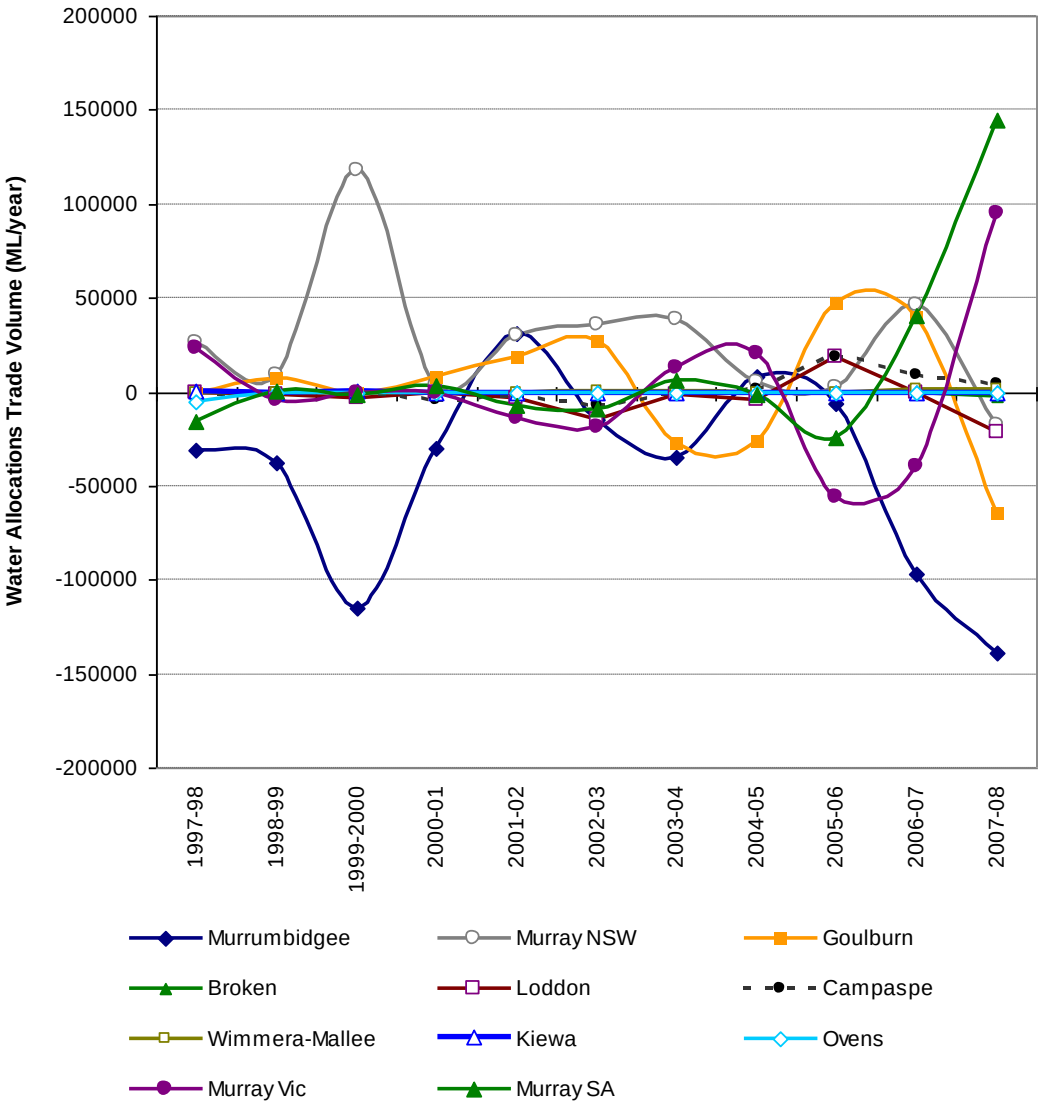
3) Water is a "crown right" – like a lease – renewed periodically (5 to 10 yearly) – with updating of overall "pool size" - so entitlement are effectively "devalued" when pool shrinks

The result of water rights reform

Efficiently functioning markets especially for annual lease of water allocations.

- Half of all water allocations traded in 2007-08 water
- From low value annual broad acre and pasture to high value horticultural and wine.
- Estimates of the benefits as high as $A 1 billion including regional multiplier impacts in the context of irrigated agricultural sector gross value of $A 5 billion.

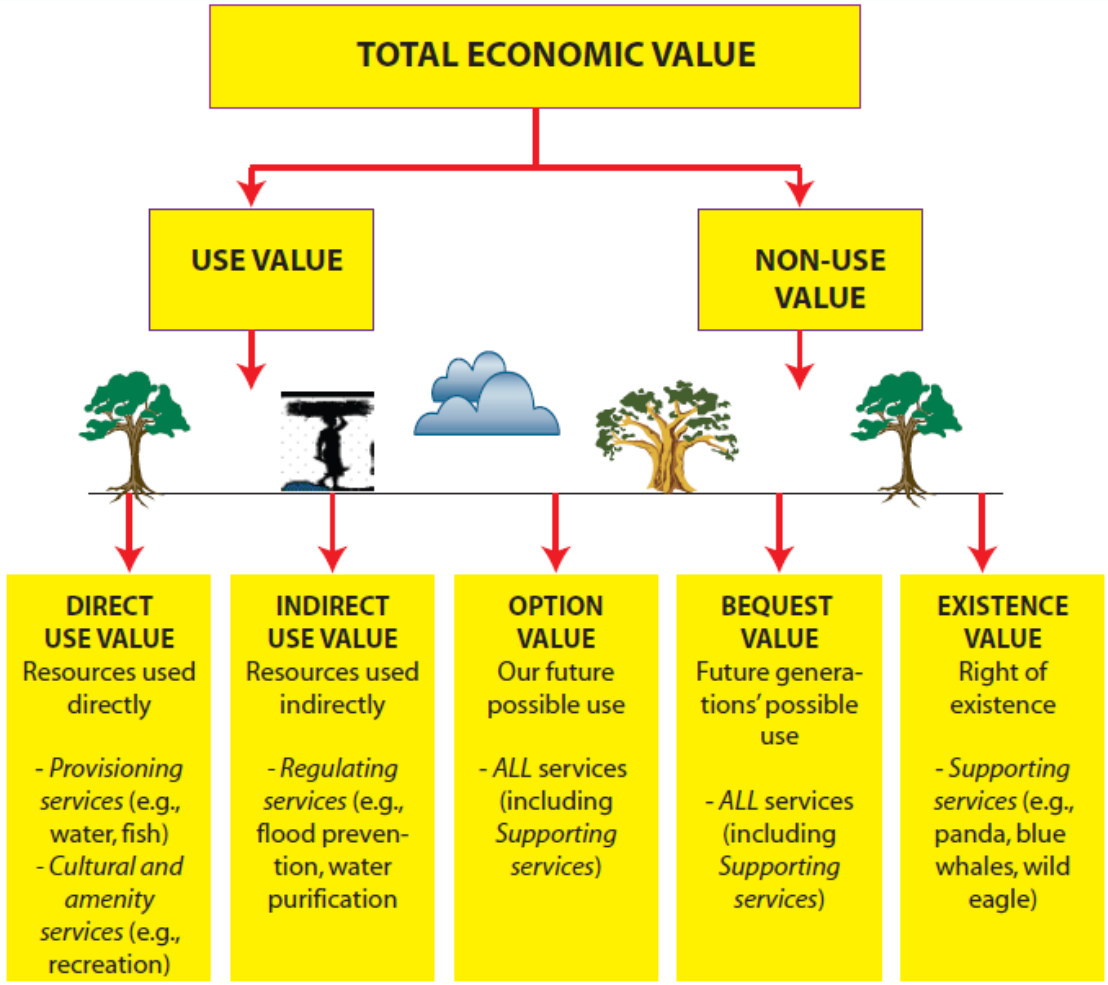
Trade patterns (Source: Kaczan et al., 2009)



Institutions to create dynamic TWC incentive 2: MDB salinity credit trading

- 1980's rising salinity
- 1990's MDB states impacted agree to:
- "cap" salinity contributions;
- Monitor salinity contributions with a "debit" accounting system
- Offset "debits" with agreed "credit" actions
- Efficient dynamics result
  - states built "salt interception" engineering in other states where this is most cost effective
  - Victoria creates "salinity impact" zone based irrigation development charges
  - Irrigation districts upgrade conveyance and irrigation infrastructure for salinity credits

from economic values of ecosystem cataloguing to valuing - ES frameworks maps to TEV



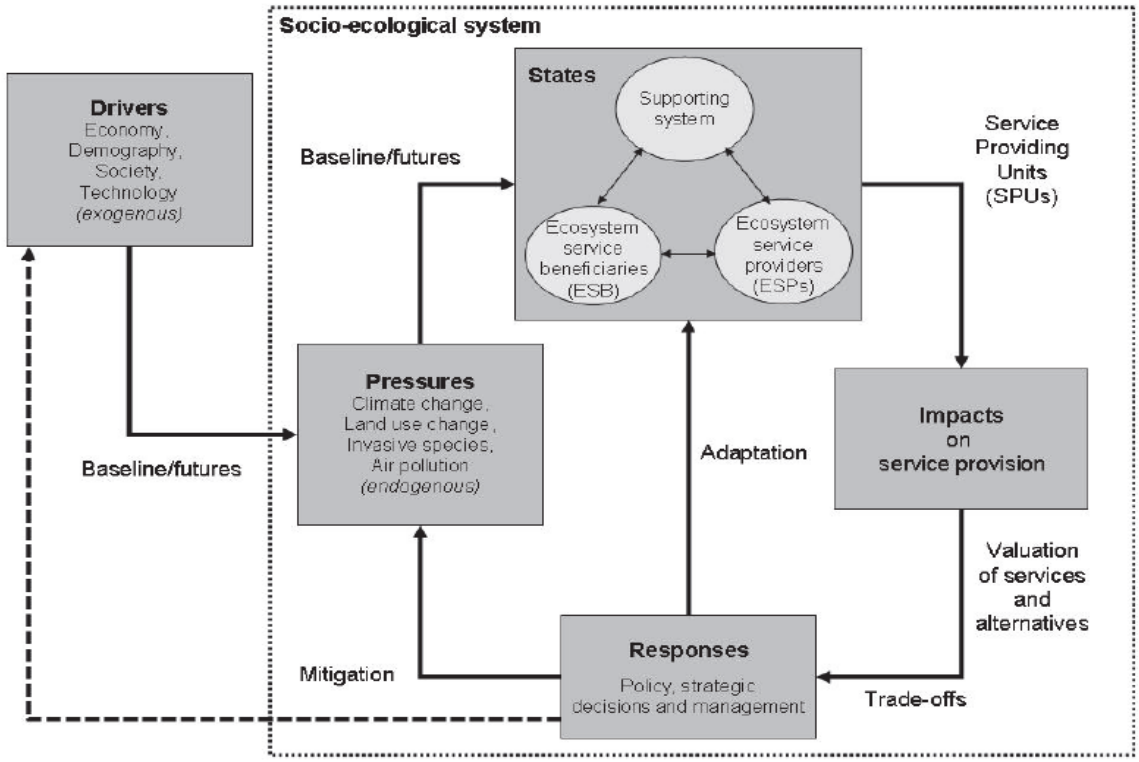
- Direct and non-direct use (non & consumptive use) values are best candidates for $ valuation

- Revealed preference, avoided costs, market production values most are most readily understood accepted by public

Source: De Groot et al

ESS Framework in Bigger Mining/Water Policy Context

Figure 5: A framework for linking direct and indirect drivers, pressures and responses in a coupled socio-ecological system for assessment of the effects of environmental change drivers on ecosystem services (after Rounsevell et al., submitted).



Key: ESB = Ecosystem Service Beneficiary; ESP = Ecosystem Service Provider; SPU = Service Providing Unit

Raffaelli, D. & C. Frid (eds.): Ecosystem Ecology: a new synthesis. BES Ecological Reviews Series, CUP, Cambridge [in press]

Thank you

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