Estimating supply functions for agri-environmental schemes: Water quality and the Great Barrier Reef

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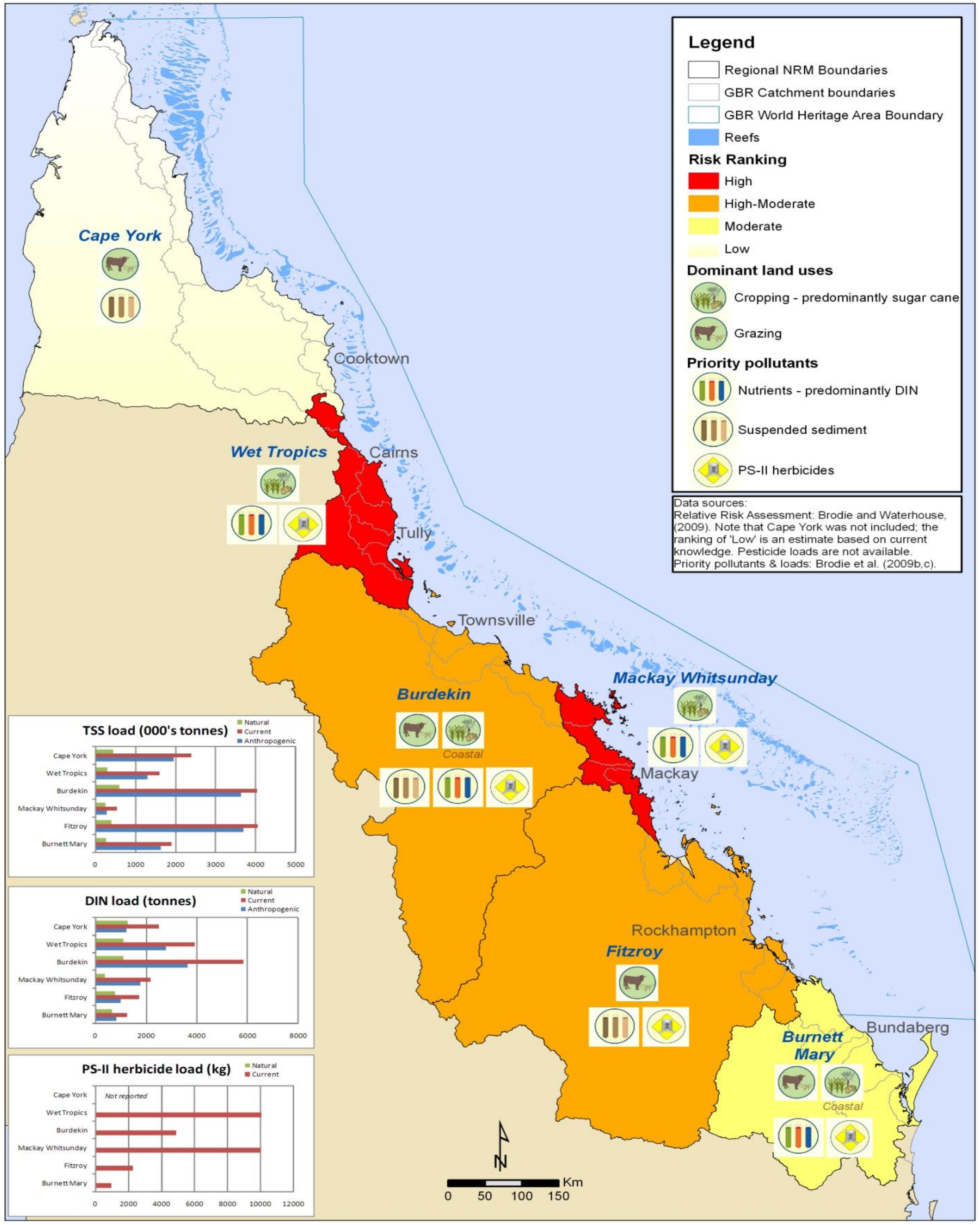
Background

- The Great Barrier Reef (GBR) impacted by sediments (SS), nutrients (N) and pesticides (PSII)
  - Mostly from agriculture
- The Aust. and Qld Govts fund water quality improvements
  - Includes Reef Rescue program (2008 – 2013) for $200 M
  - Being replaced by Reef Trust (2015 – 20) (Aust. Govt.) as well as additional Qld programs



The problem of interest

- Very difficult to evaluate the cost-effectiveness of funding
- Cost-effectiveness important:
  - Evaluate the performance of past investments
  - Guide the allocation of future investments
- Limited information available
- But data and modelling are improving

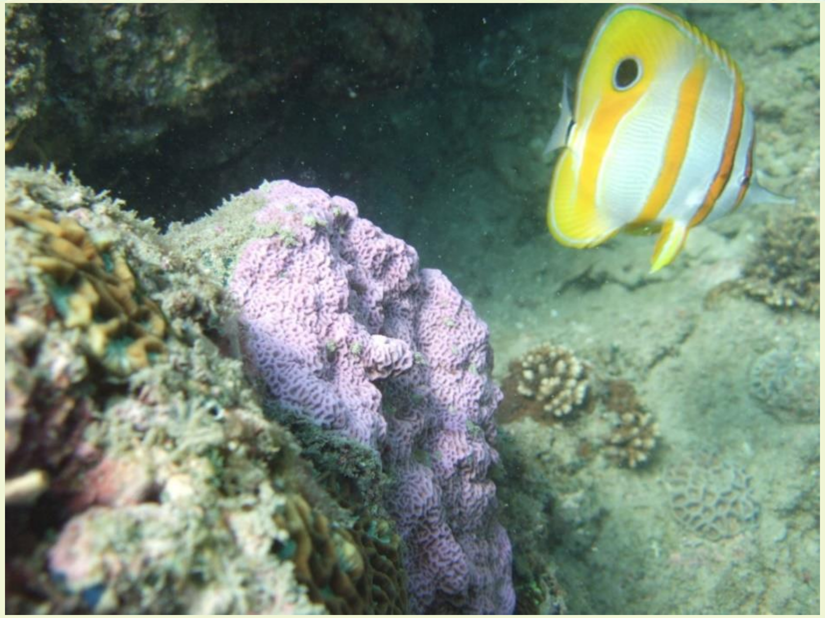
Flood plume in Far North Queensland

The focus of this paper

- Identify the factors that differentiate measures of cost-effectiveness
- Collate appropriate studies reporting costs and outcomes of funding programs
- Calculate cost-effectiveness
- Reconcile differences in values

Factors that differentiate measures of cost-effectiveness

- Variations in the types of benefits
- Variations in the types of costs
- Mechanisms to select programs/projects
- Differences in the scale at which benefits and costs are assessed
- Challenges in modelling or measuring both environmental and cost variables.
  - Missing or limited information



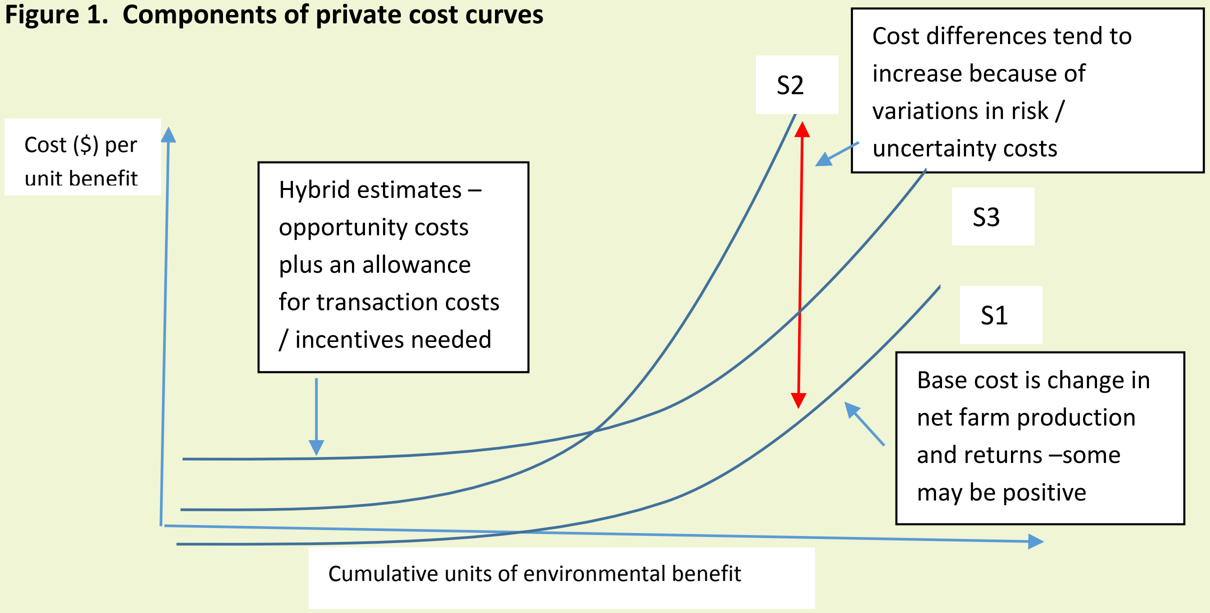
Variations in the types of benefits

- Different pollutants involved
  - Total suspended solids (TSS)
  - Nutrients
    - Dissolved inorganic nitrogen (DIN)
    - Particulate nitrogen (PN)
    - Dissolved inorganic phosphorus (DIP)
    - Particulate phosphorus (PP)
  - PSII herbicides (PSII)
- Point where changes estimated
  - End of paddock
  - End of catchment

Variation in the types of costs

- Private costs
  - Private operating costs
    - Changes in gross margins
  - Capital costs
  - Impacts of risk and uncertainty
  - Transaction costs
    - Sometimes estimated as administration costs
- Public costs
  - Administration costs
  - Program costs

Figure 1. Components of private cost curves



S1 = Private operating costs (estimated from bio-economic models); but under-estimates true incentives needed

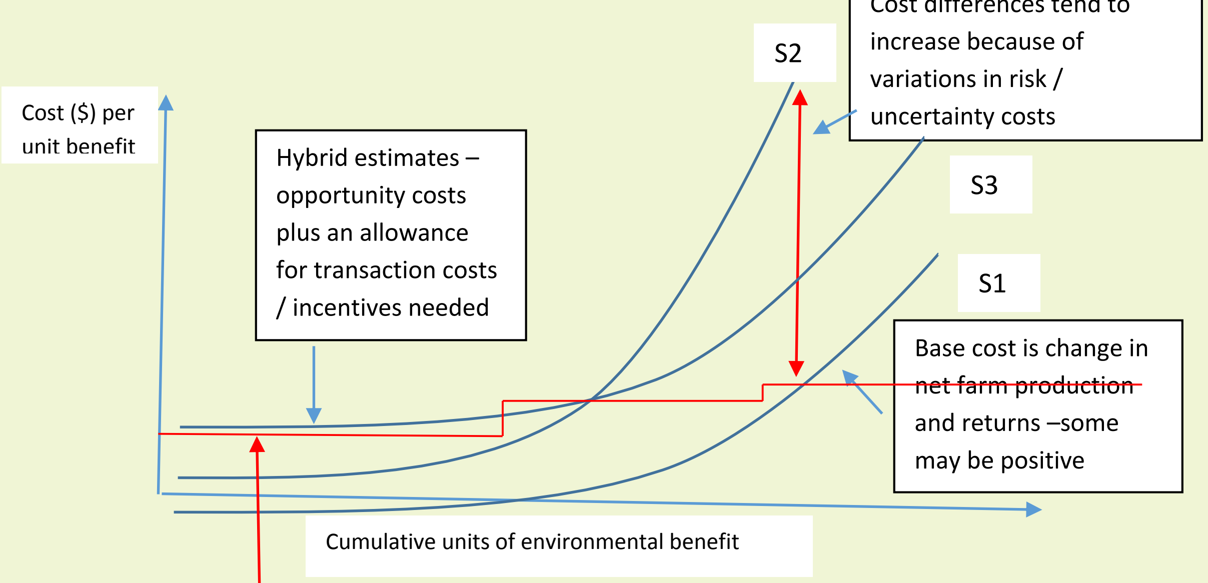
S2 = full private costs (oper. + risk + transaction); but is difficult to assess accurately

S3 = S1 plus allowance for transactions or incentives – easy to apply but overestimates costs in initial parts of supply curve and underestimates in latter part of supply curve

Mechanisms to select projects

- Most funds to improve agric. management have been grants
  - Focused on inputs (e.g. purchase machinery), not outputs (reduced pollution) or outcomes (healthy reef)
    - Often does not estimate benefits (reduced pollution)
  - Payments tend to be fixed rates
    - Does not reveal true costs or price discriminate
- Some smaller water quality auctions

Figure 1. Components of private cost curves

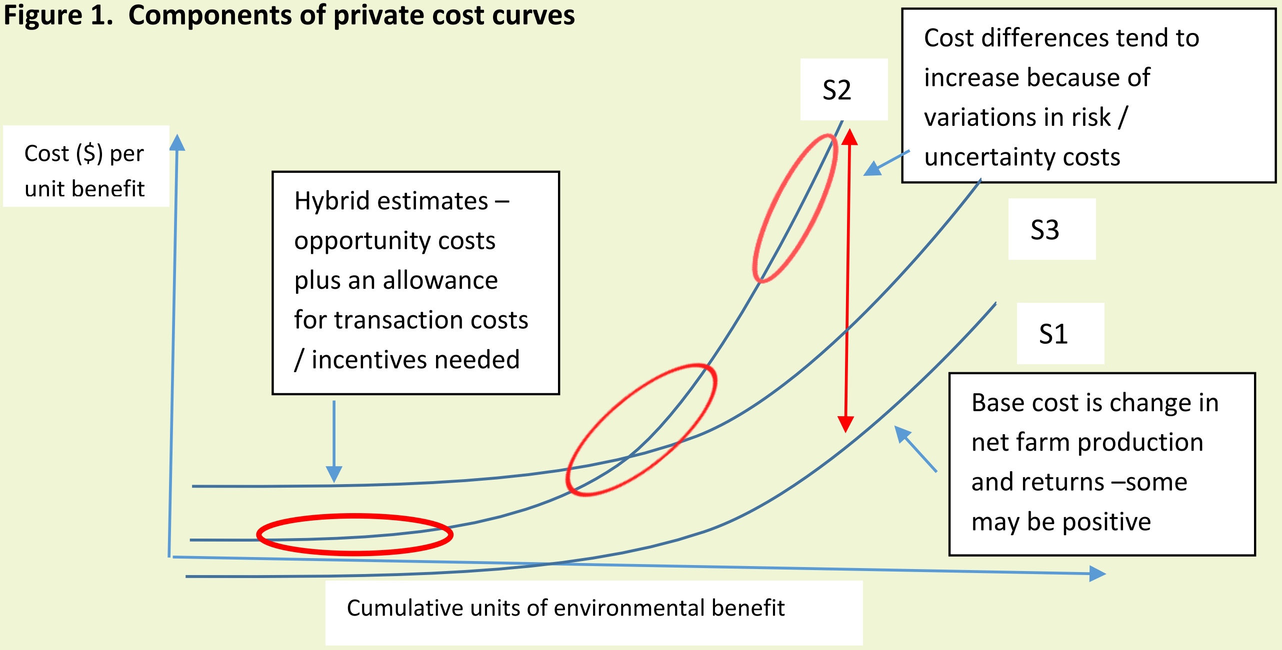


Fixed rate grants typically provide uniform payment for different activities - based loosely on input costs and sometimes on gross margin change for average enterprise

Differences in scale

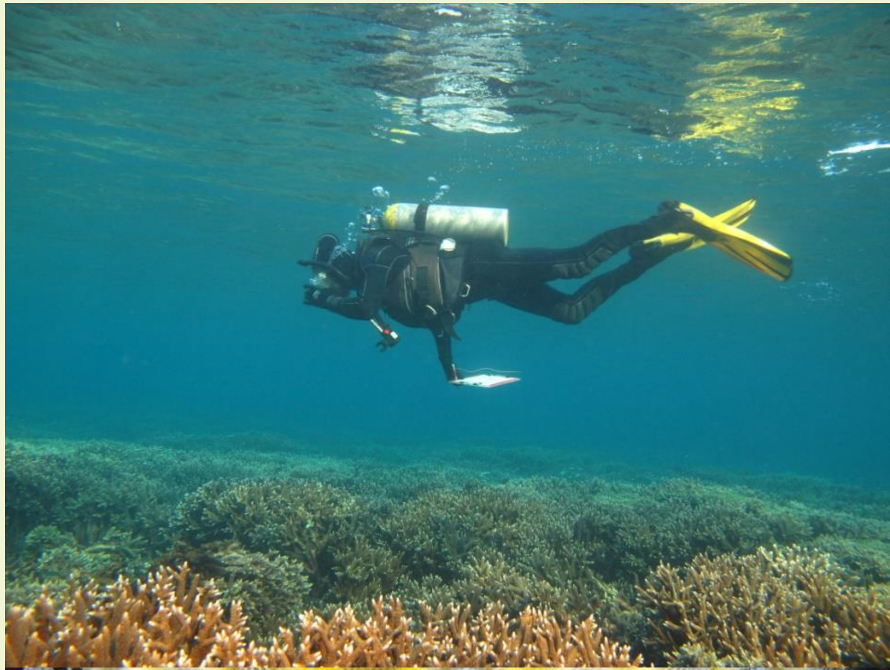
- Scale issues are typically ignored in grant programs
- Assumption is that costs of change are relatively uniform, all that is missing is encouragement and adoption
- But both average and marginal costs vary along the supply curve

Figure 1. Components of private cost curves



Challenges in measurement

- Difficult to measure both costs and benefits
  - Costs not revealed in grant programs
  - Benefits very difficult to model, particularly at individual farm level
  - Modelling improved from a low base
  - Easier to model changes at end-of-paddock, but better to measure changes at end-of-catchment
  - Estimates not available in a timely way
- Outcome is that costs and benefits are poorly considered in project assessment



Factors that explain major differences in estimates of cost-effectiveness

Key factors

- Variations in cost components
- Point at where improvements are modelled

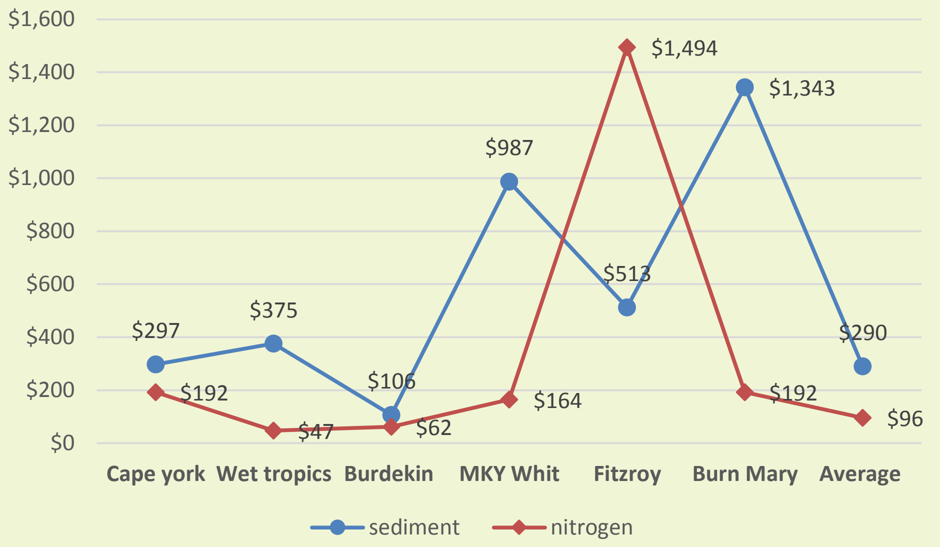
Other reasons

- Measurement / modelling not accurate
- Scale of improvement varies
- Selection of activities and projects varies

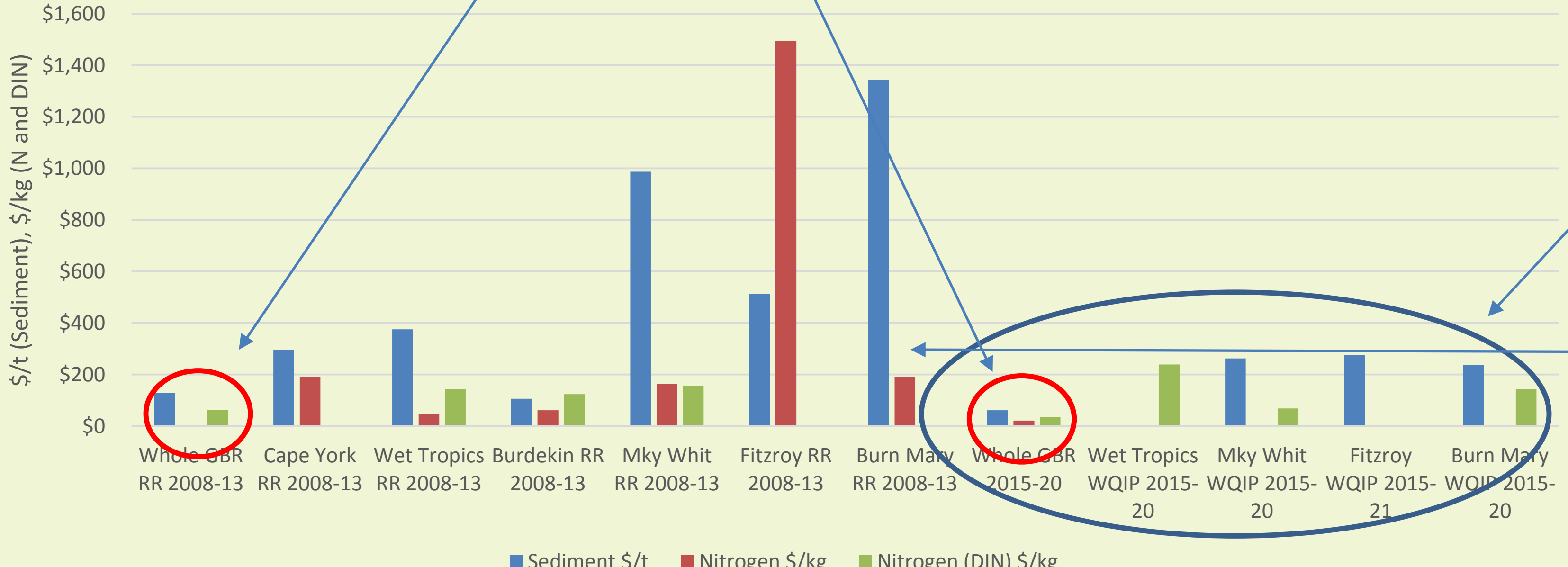
		Predictions of emissions	
		On –farm	**End-of-catchment**
Costs of action	**Operating costs (Curve S1)**	Bio-economic models (various)	Bio-economic models (various)
	Operating + risk & transaction/admin. Costs (Curve S2)	Water quality tenders (various)	
	Operating costs + allowance for admin/incentives (Curve S3)	Local Assessment (Terrain)	Reef Rescue grants WQIP (various)

Estimates of CE vary substantially

Reef Rescue program reveals large variations in average costs across regions



Estimates of CE at **whole GBR** much lower than at component level

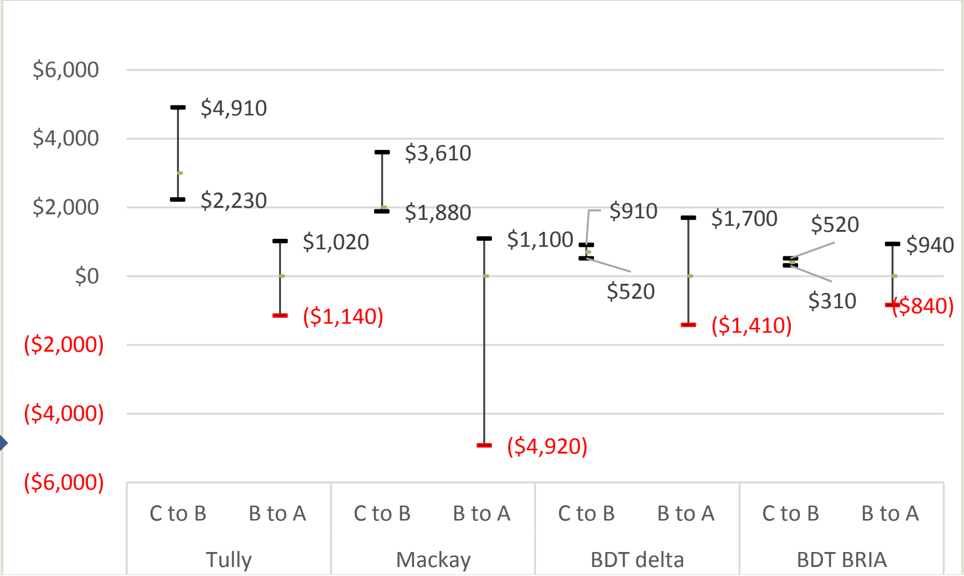


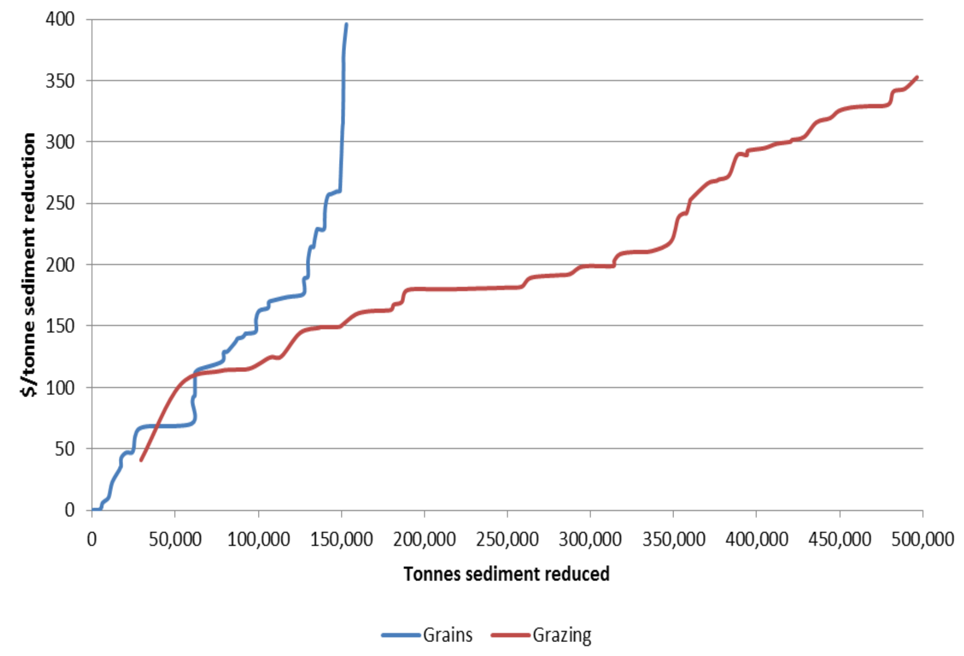
Predictions of future costs in **Water Quality Improvement Plans** are much lower than average **historic costs**

Estimates from Bio-economic modelling much lower

Show that costs are much lower (although cost components differ)

	Pollutant	Private cost	location	Reported results
Sugarcane				
Poggio et al. 2014	Pesticide End of paddock	AEB (10yr @6%)	Tully; Mackay; Burdekin (x2)	-$4,920/kg to +$4,910/kg pesticide reduction across C-B, C-A and B-A class practice change
Van Grieken et al. 2013	DIN End of catchment	NPV (gross margins + capital) (10 + 5 yr @ 7%)	Tully Mackay	-$22/kg (5yrs) to +$22/kg (10yrs) -$22/kg (5yrs) to +$22/kg (10yrs) NPV of practice (ABCD) change
Grazing				
Star et al. 2011, 2013, 2015a	Sediment End of paddock	NPV (20yr @6%)	Fitzroy Basin	$4/t to $421/t sediment reduction across 5 land types and 3 land condition classes
Star et al. 2015b	Sediment End of catchment	Capital + operating	Fitzroy WQIP	$19/t to $9,799/t across land types and land conditions in 93 sub-catchments; average cost to achieve 20% reduction is $277/t
Pannell et al. 2014	n/a	Capital + operating + non-financial	Burnett Mary WQIP	$10 - $160/ha/yr for practice (ABCD) change across different practices, land types & farm size (includes $25/ha for incentives to change practices)

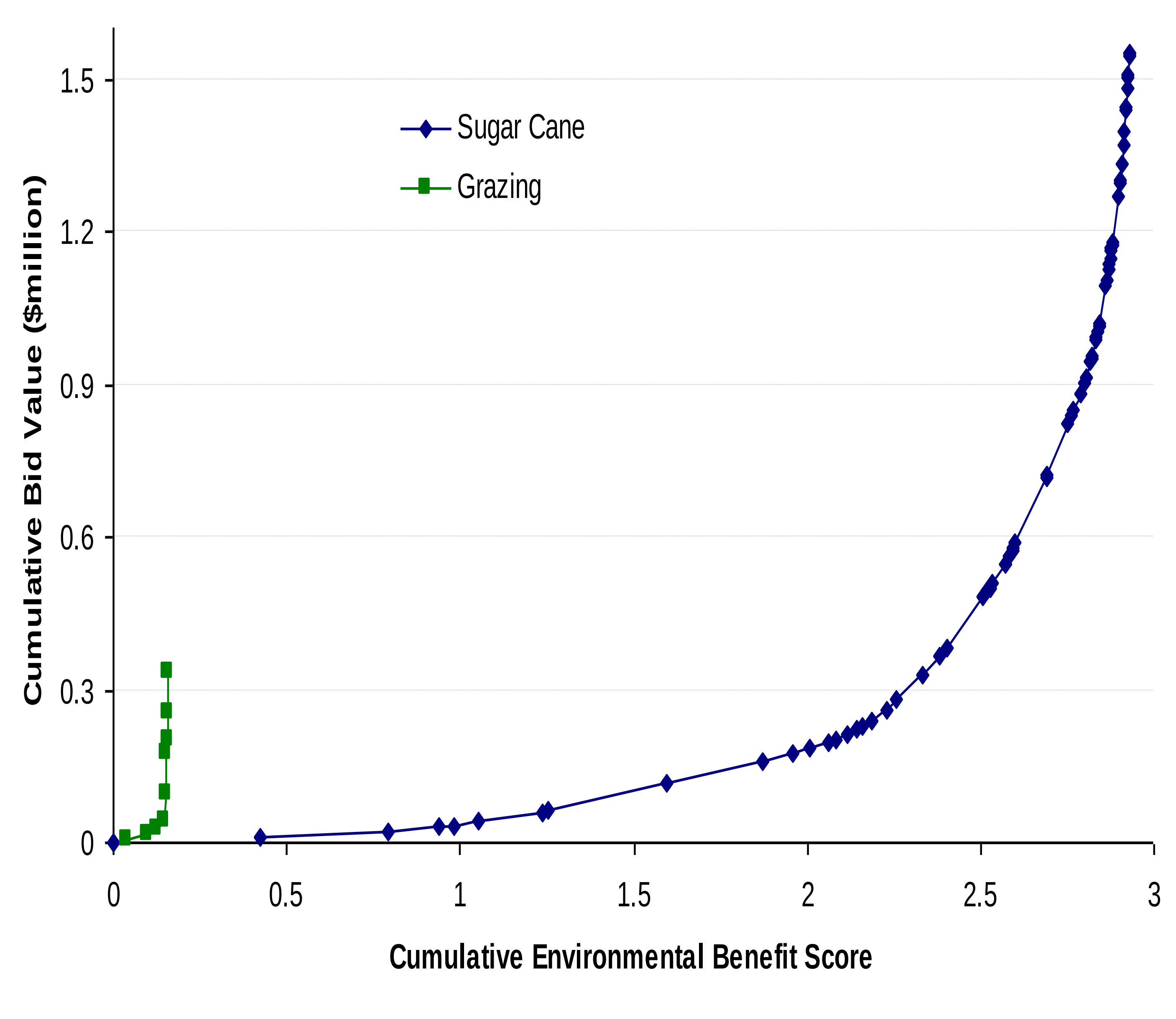




Shows that costs vary with scale of change

Estimates from Water quality tender are lower still

- Run in Burdekin in 2008
  - Comparison limited by end-of-paddock modelling and smaller scale
- Reveals large heterogeneity within regions
- Costs vary by allocation approach (Tender vs Reef Rescue average)
  - For Sediments, average grant costs ($536/t) > five times tenders ($105/t)
  - For Nitrogen, average grant costs ($359/kg) > 71 times tenders ($5/kg)
  - For Pesticides, average grant costs ($39,107/kg > 20 times tenders ($1,976)



Summary, with example of Sediment costs ($/t)

- Large heterogeneity within and between regions means large benefits available from targeting
  - Averages hide some very costly projects
- Predicted future costs lower than past grant costs
  - Better modelling and targeting ?
  - But still higher than achieved with auctions
- Predictions at whole GBR look too low
- Recommend:
  - Better selection methods
  - Prioritise by cost effectiveness
  - Use benchmarks to flag limits to funding