



System of
Environmental
Economic
Accounting



Pilot ecosystem services accounts: KwaZulu-Natal

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Conservation, Partnerships & Ecotourism



Overview

- Ecosystem service flows in physical & monetary terms, summarised by biome
 - As many ES as possible s.t. time & data
 - Use value only
- Asset value of biomes
 - Based on sum of projected value flows
- Whole province down to coastline (excludes marine)
- Spatial resolution = 1 ha
- 2005 and 2011

Provisioning services	Wild resources
	Reared animal production
	Cultivation
	[Water supply]
Cultural services	Nature-based tourism
	Local recreation (non-resident)
	Local amenity (property)
Regulating services	Global climate regulation
	Local climate regulation
	Air quality amelioration
	Pollination
	Critical habitat (e.g. nursery)
	Coastal flood protection
	Flood attenuation
	Flow regulation
	Sediment retention
	Water quality amelioration

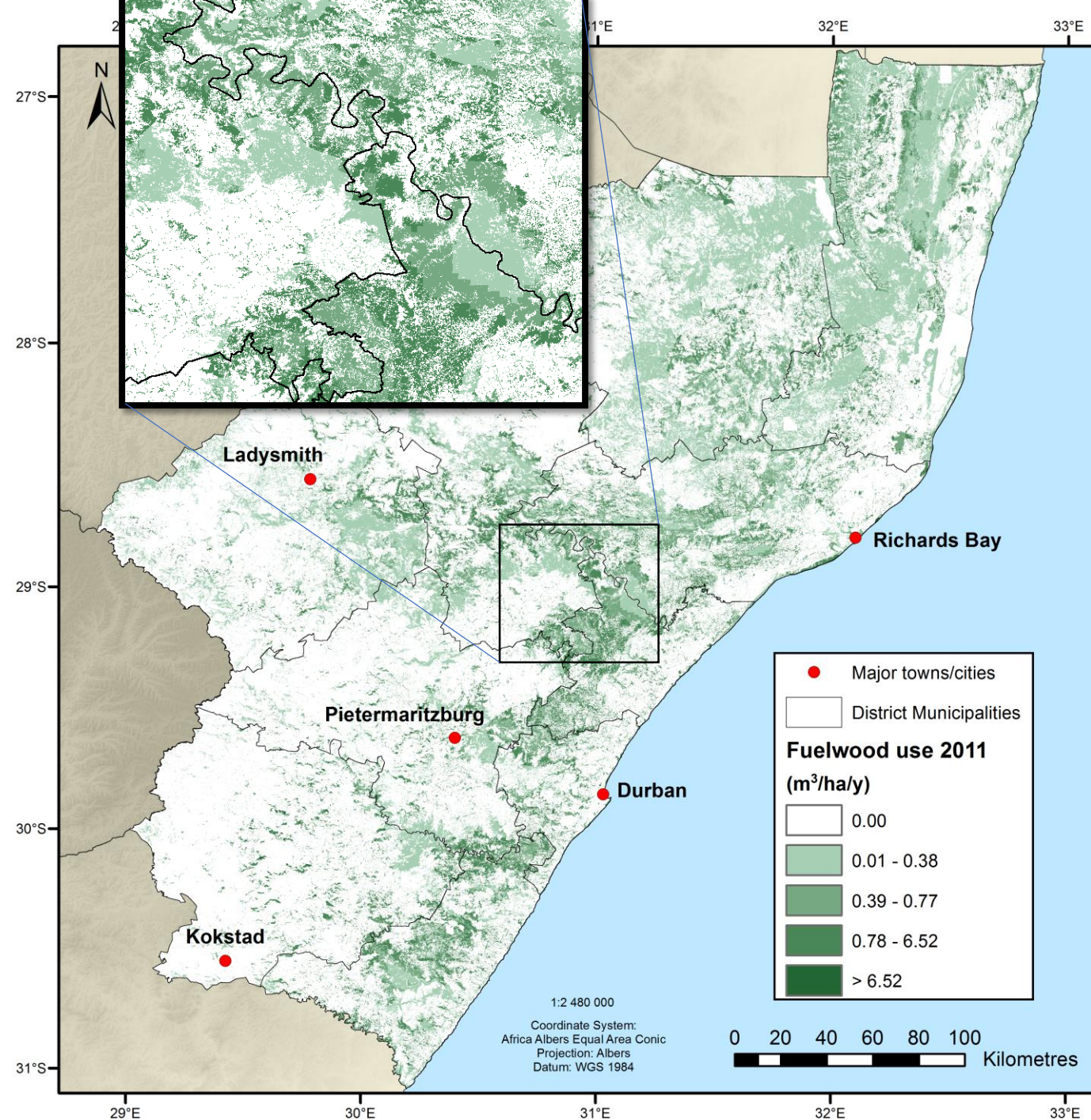


Valuation framework

Broad category	Broad rationale for valuation approach
Provisioning services	<ul style="list-style-type: none">• Used purposely, through joint contribution of natural and man-made capital and labour.• Valued in terms of resource rent (residual value)
Cultural services (use value only)	
Regulating services	<ul style="list-style-type: none">• Used inadvertently. If lost, could result in damages, but replaceable by engineering solutions.• Valued in terms of avoided costs

Provisioning services: Wild resources

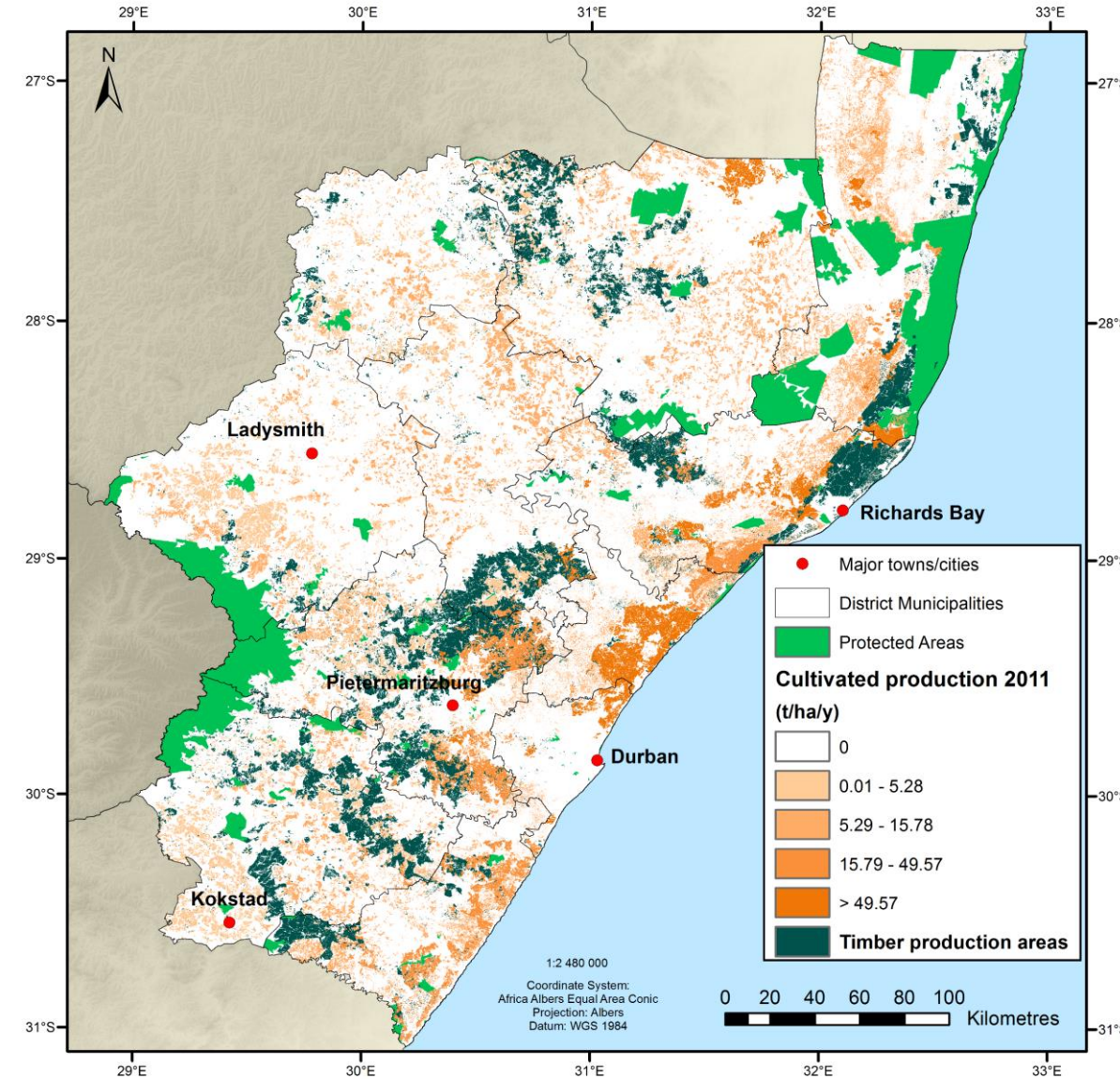
- **10** groups of resources
- **Availability** mapped in physical units/ha
- **Demand** based on survey and census data, mapped to residential areas
- **Use** estimated using a GIS-based model
- **Value** based on market prices



Provisioning services: Crops, livestock, wildlife

- Ecosystem inputs to production, net of intermediate services
- Output volumes used as proxy physical measure
- Agricultural census data (District) and annual provincial data, matched to cultivated land cover classes
- Subsistence production and net income/ha from literature (few)

Cultivated production (t/ha/year)



Cultural services:

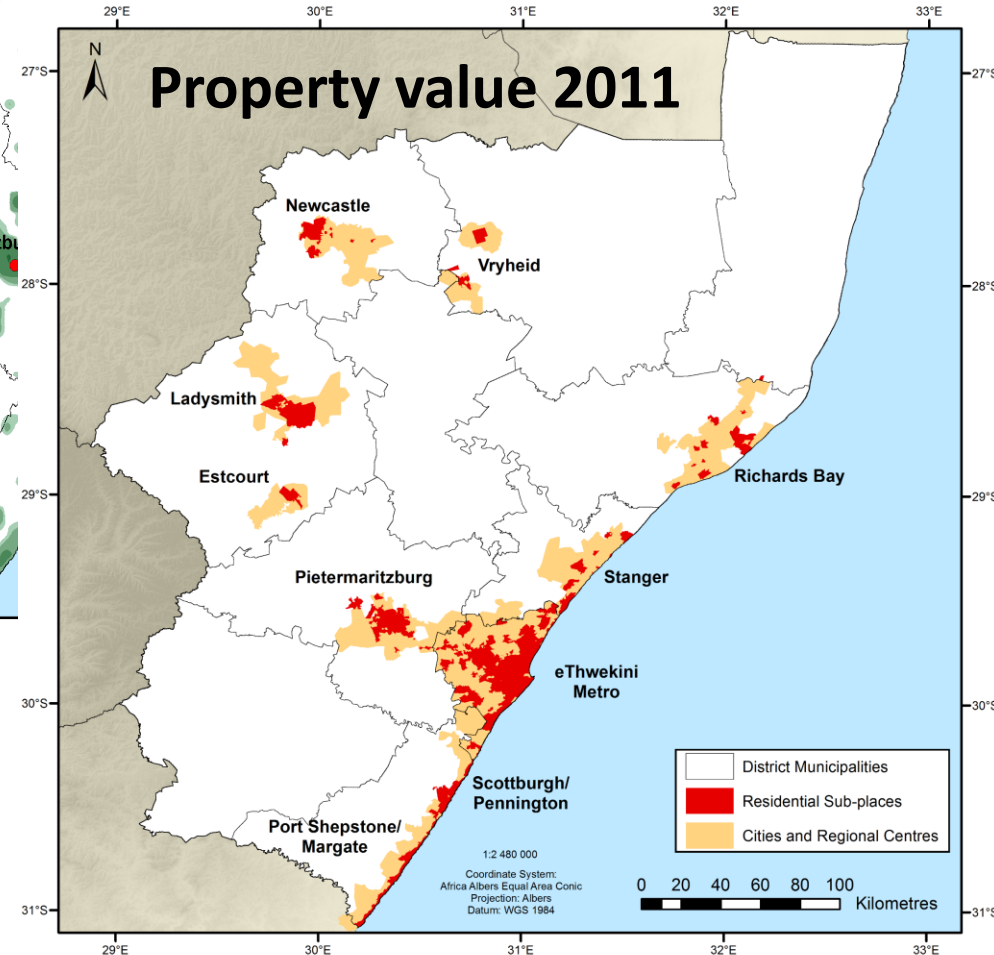
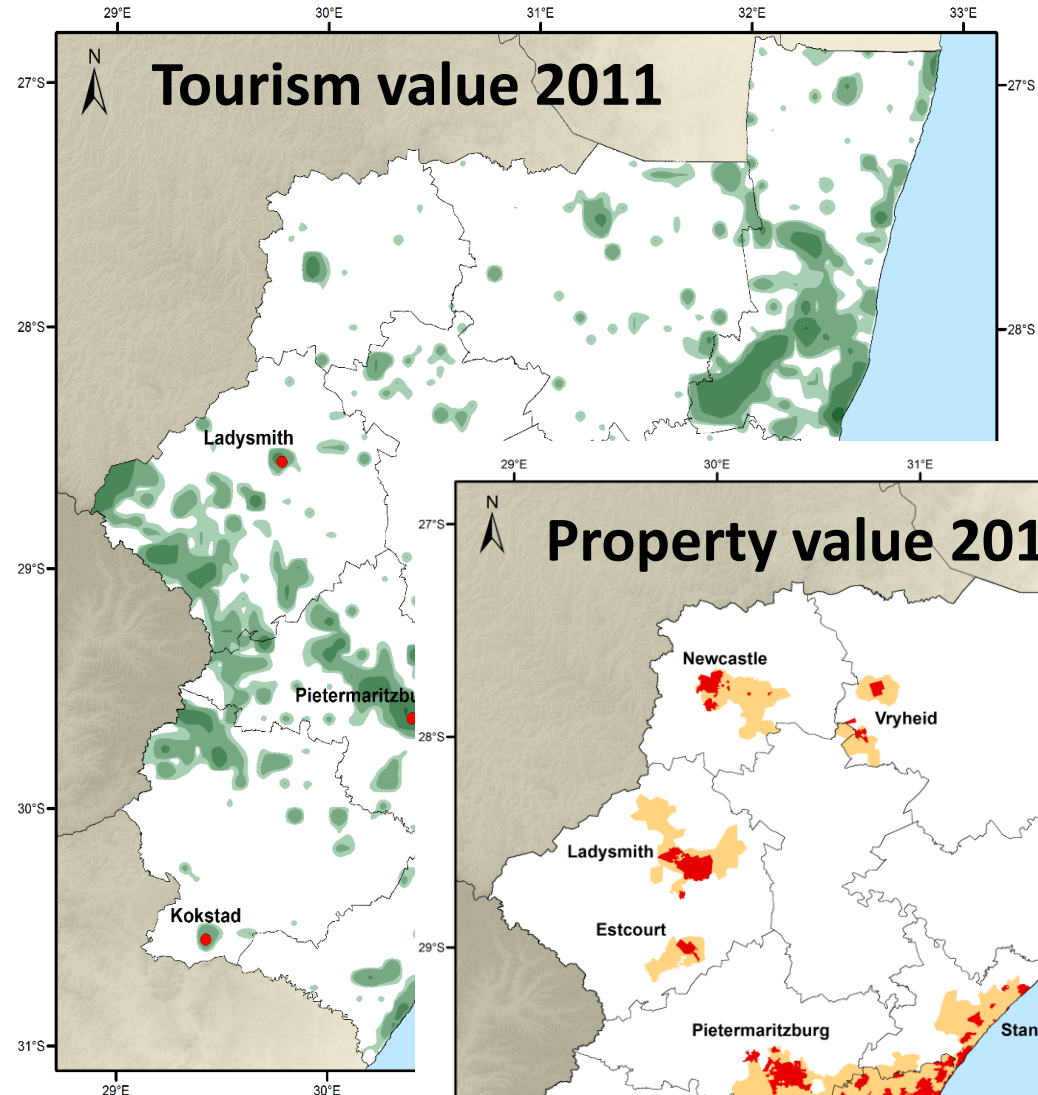
Tourism & recreation

- **Tourism value**

- Attraction-based tourism value derived from Tourism Satellite Accounts, SA Tourism reports
- Spatialised using density of geotagged photos
 - Panoramio, Flickr

- **Property premium**

- Hedonic study of ~16,000 eThekweni (Durban) properties
- Value function transfer to KZN's 10 main towns



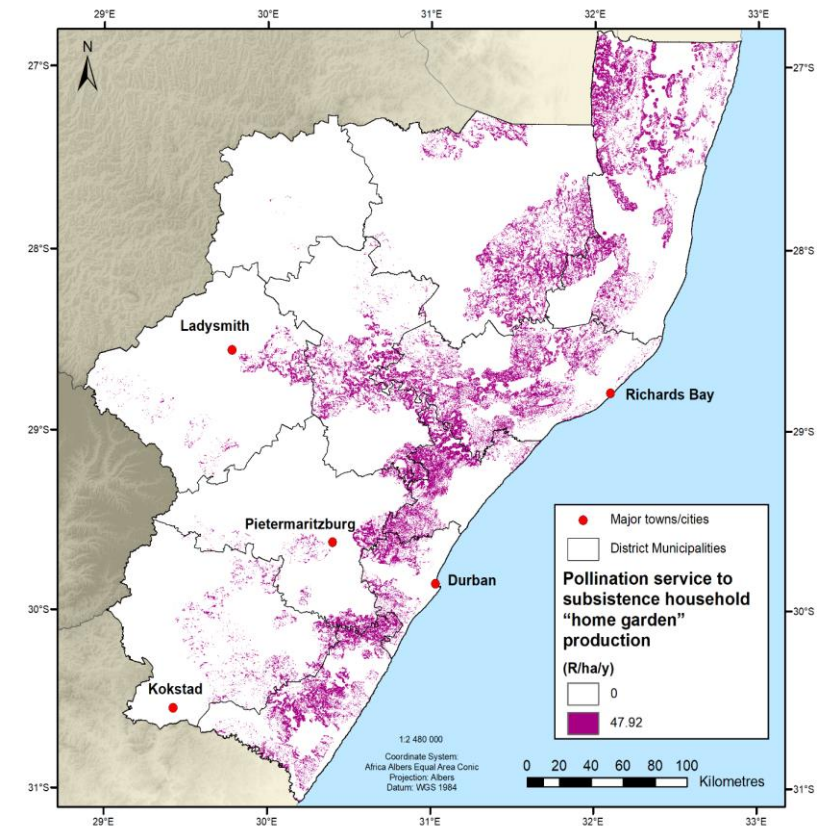
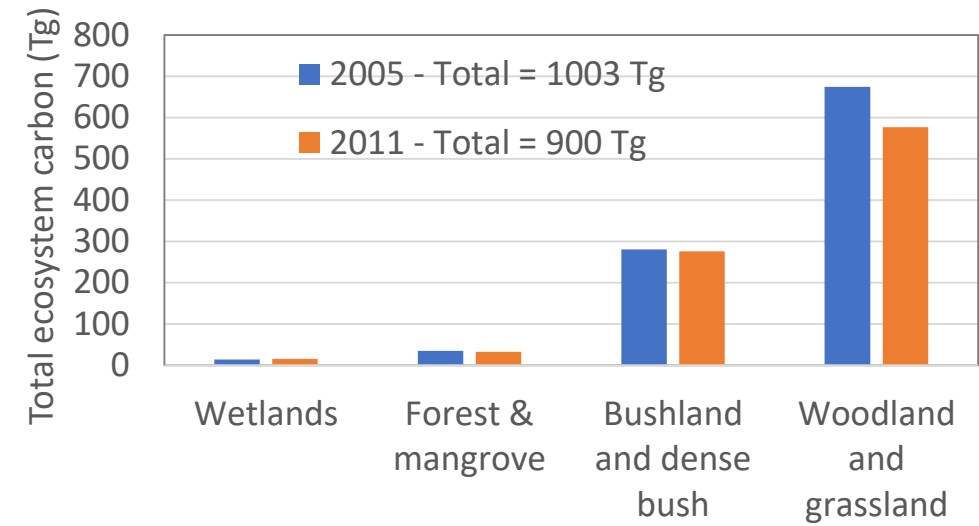
Regulating services: Habitat-based

Carbon retention

- Based on SA National Carbon Sink Assessment (DEA, 2015)
- Valued stocks in terms of avoided social cost to SA and ROW

Pollination

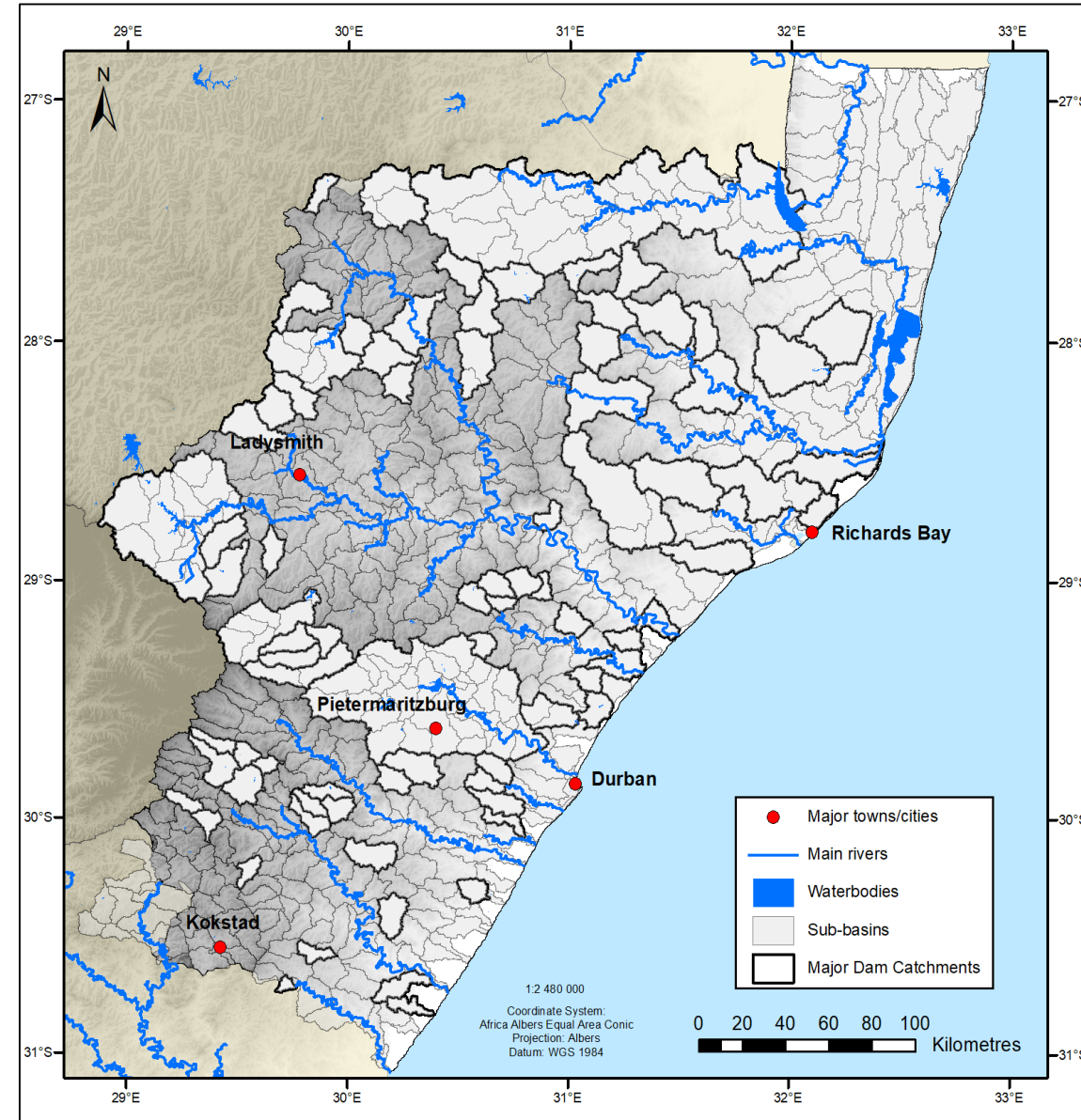
- Value function transfer using spatial data and model from a panel data study in E Africa



Regulating services:

Hydrological services

- **Flow regulation**
 - Physical modelling in SWAT
 - Reduction in storage needs
 - HH access to water in dry season
- **Sediment retention**
 - Physical modelling in InVEST
 - Replacement costs of reduced storage
- **Water quality regulation**
 - Physical modelling in InVEST
 - Cost modelling from treatment plant data
- **Flood attenuation (eThekweni only)**
 - Physical modelling in PC-SWMM
 - Engineering cost savings model

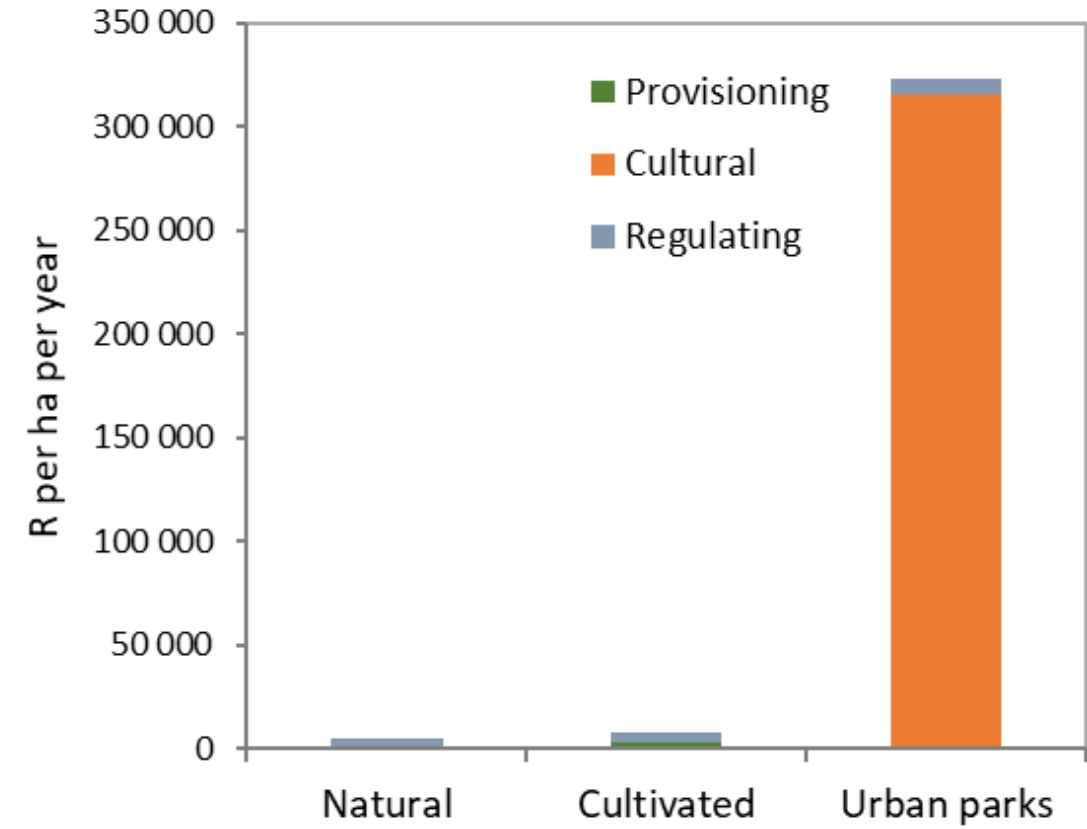
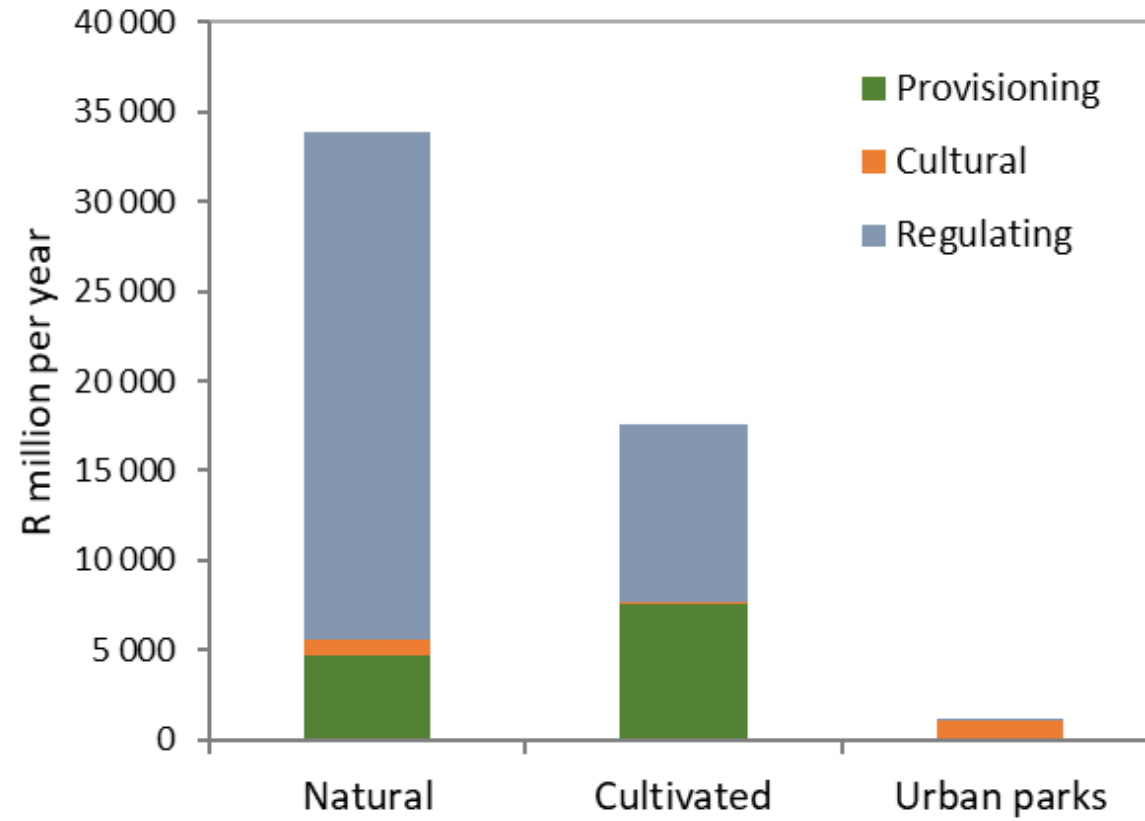


Summary annual flows

Class	Ecosystem service	2005 R m/y	2011 R m/y
Provisioning	Wild resources	3 722	3 180
	Animal production	1 673	1 473
	Cultivation	6 457	7 535
Cultural	Nature-based tourism	533	799
	Property	1 165	1 328
Regulating	Carbon storage (to SA)	236	273
	Carbon storage (to ROW)	29 686	34 306
	Pollination	51	48
	Flow regulation	3 248	3 167
	Flood attenuation (Dbn)	31	24
	Sediment retention	436	330
	WQ amelioration	20	16
Total annual value		47 259	52 479

- Services included amounted to 12% of regional GDP
- Incomplete:
 - Marine ES
 - Coastal protection
 - Local recreation
 - Water supply
- Imperfect:
 - Data deficiencies
 - Models

Summary results



Supply tables (Monetary, in R millions)

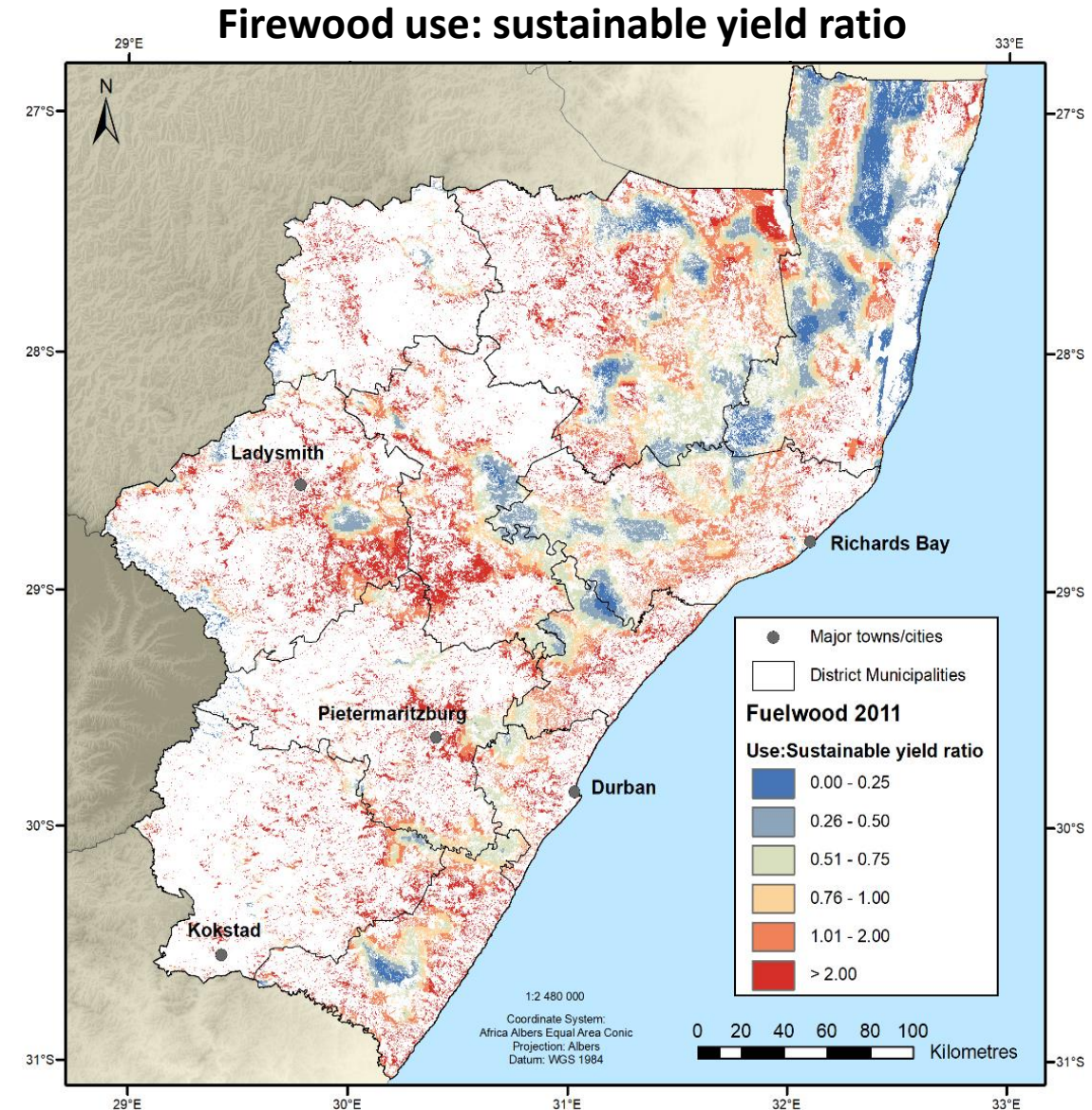
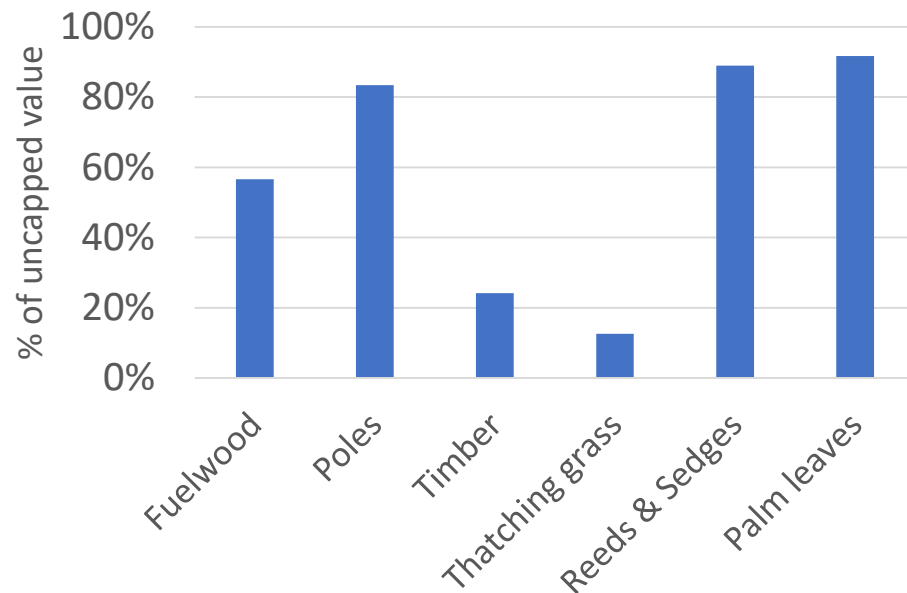
2005		Freshwater ecosystems	Grassland	Indian Ocean Coastal Belt		Savanna	Forests	Estuaries	Cultivated	Built	TOTAL
Wood products		3.0	598.1	202.1		677.9	233.4	0.1	2 389.8		4 104.5
Non-wood products		22.1	982.2	238.2		715.1	49.1	0.8			2 007.5
Livestock production		2.6	1 038.3	106.7		521.0	3.8	0.6			1 673.0
Crop production	2011		Freshwater ecosystems	Grassland	Indian Ocean Coastal Belt	Savanna	Forests	Estuaries	Cultivated	Bu	
Experiential value											
Carbon storage											
Pollination (R millic	Wood products		3.3	520.7	179.7	612.7	216.2	0.2	2 513.5		
Flow regulation	Non-wood products		18.1	866.6	175.2	537.2	49.9	0.5			
Flood attenuation	Livestock production		3.0	985.0	95.1	384.3	5.0	0.5			
Sediment retentio	Crop production								5 022.0		
Water quality ame	Experiential value		21.1	326.0	193.9	297.4	80.9	36.3	161.9	1	
Total R millions	Carbon storage		133.3	13 261.2	1 421.9	9 010.0	909.2	4.4	9 839.4		
% of total val	Pollination (R millions)		0.1	11.1	5.0	29.7	1.8	0.0			
area (ha)	Flow regulation		23.3	2 014.1	22.6	1 020.6	85.2	1.1			
Value R/ha	Flood attenuation										
	Sediment retention		6.0	167.8	22.3	94.6	39.5	0.3			
	Water quality amelioration		-	12.9	0.1	2.7	0.4	-			
	Total R millions		208.0	18 165.2	2 115.8	11 989.1	1 388.1	43.3	17 536.7	1	
	% of total value		0%	35%	4%	23%	3%	0%	33%	2%	
	Area (ha)		54 901	3 354 881	362 944	2 292 315	181 604	39 425	2 361 582	68	
	Value R/ha		3 789	5 415	5 830	5 230	7 644	1 098	7 426		

Use tables

2005	Agric, Forestry and Fisheries	Water supply	Trade, catering & accommodation	Other sectors	Households	Government	Rest of world	Total
Wood products	2 389.8				1 714.7			4 104.5
Non-wood products					2 007.5			2 007.5
Livestock production	849.3				823.6			1 673.0
2011	Agric, Forestry and Fisheries	Water supply	Trade, catering & accom	Other sectors	Households	Government	Rest of world	Total
Wood products	2 513.5				1 532.7			4 046.2
Non-wood products					1 647.5			1 647.5
Livestock production	815.4				657.4			1 472.9
Crop production	3 441.2				1 580.7			5 022.0
Experiential value			798.8	1 327.8				2 126.6
Carbon storage						273.2	34 306.2	34 579.3
Pollination (R millions)					47.7			47.7
Flow regulation		3 166.8						3 166.8
Flood attenuation					23.5			23.5
Sediment retention		330.4						330.4
Water quality amelioration		16.0						16.0
Total R millions	6 770.1	3 513.2	798.8	1 327.8	5 489.6	273.2	34 306.2	52 478.9
Within South Africa								18 173
Within SNA	6 770	-	799	1 328	-	-	-	8 897

Calculation of asset values

- Net present value of ES flows over 25 years, $\delta = 3.66$
- Flows of provisioning services projected based on sustainability of use



Asset account 2005-2011 (R millions)

2005-2011	Freshwater ecosystems	Grassland	Indian Ocean Coastal Belt	Savanna	Forests	Estuaries	Cultivated	Urban parks	TOTAL
Opening stock (2005)	2 797	269 912	33 384	181 814	18 792	566	215 198	14 845	737 307
Change due to change in ecosystem extent	-122	-25 360	-5 845	-19 720	-467	-2	64 233	3 018	15 736
Change due to change in service capacity or demand	642	37 104	4 201	25 702	2 716	135	4 656	-1 135	74 020
Net change	520	11 745	-1 644	5 982	2 249	133	68 889	1 883	89 756
Closing stock (2011)	3 317	281 657	31 739	187 796	21 041	700	284 087	16 727	827 063
Net change %	18.6%	4.4%	-4.9%	3.3%	12.0%	23.5%	32.0%	12.7%	12.2%



Some lessons learned

- Reliable cover products are key
- Spatial and temporal alignment of datasets
- Methods for scaling up need further development
- Primary research gaps e.g. local recreation
- Interpretation required



Will monetary ES accounts send right message?

- Gives aggregate and average values, not marginal values.
- Agricultural land value higher than natural ecosystems, but
 - Subsequent conversions likely to return decreasing values
 - Value of natural ecosystems will increase as they contract into critical areas.
- Policy analysis involves projection of non-linear functions as well as conversion of accounting to welfare values.
- Accounting will go a long way to informing policy analysis and inclusive wealth accounting
 - especially as long term datasets emerge



Thank you!

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Paper will be out shortly in *One Ecosystem*

One Ecosystem : Research Article



Accounting for ecosystem services and asset value: pilot accounts for KwaZulu-Natal, South Africa

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Abstract

Pilot monetary ecosystem accounts were compiled for KwaZulu-Natal Province, South Africa, in order to highlight any data, methodological or process issues in their compilation and to contribute towards charting a strategy for ecosystem accounting. The Province is highly diverse, with eight biomes, large proportions under communal, private and state tenure, globally important biodiversity, variable landscape condition and encompassing catchment areas of nine river systems. We accounted for the supply and use of wild biomass, reared animal production, cultivation (including silviculture), nature-based tourism,