



System of  
Environmental  
Economic  
Accounting



# PILOT MONETARY ECOYSTEM ACCOUNTS FOR KWAZULU- NATAL, SOUTH AFRICA Progress Nov 2019

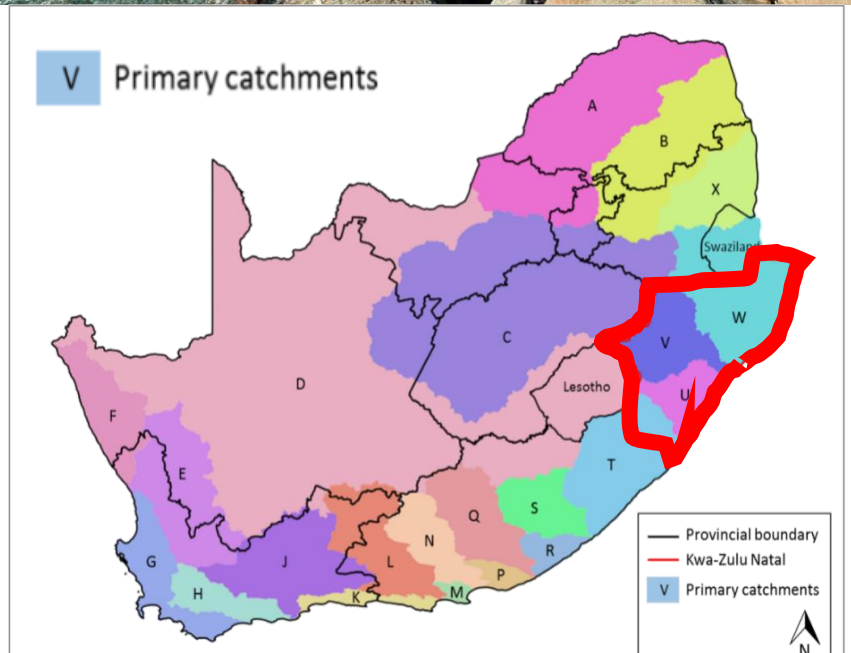
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Forum on Natural Capital Accounting

Beijing, 12-14 November 2019

# Introduction

- Pilot study commissioned as a part of the NCA&VES project being undertaken in 5 countries
- Produce monetary ecosystem accounts at regional scale using available data
- Provide recommendations, input into the development of the SEEA EEA and input into South Africa's National Capital Accounting Strategy
- Still in progress, completion Dec 2019



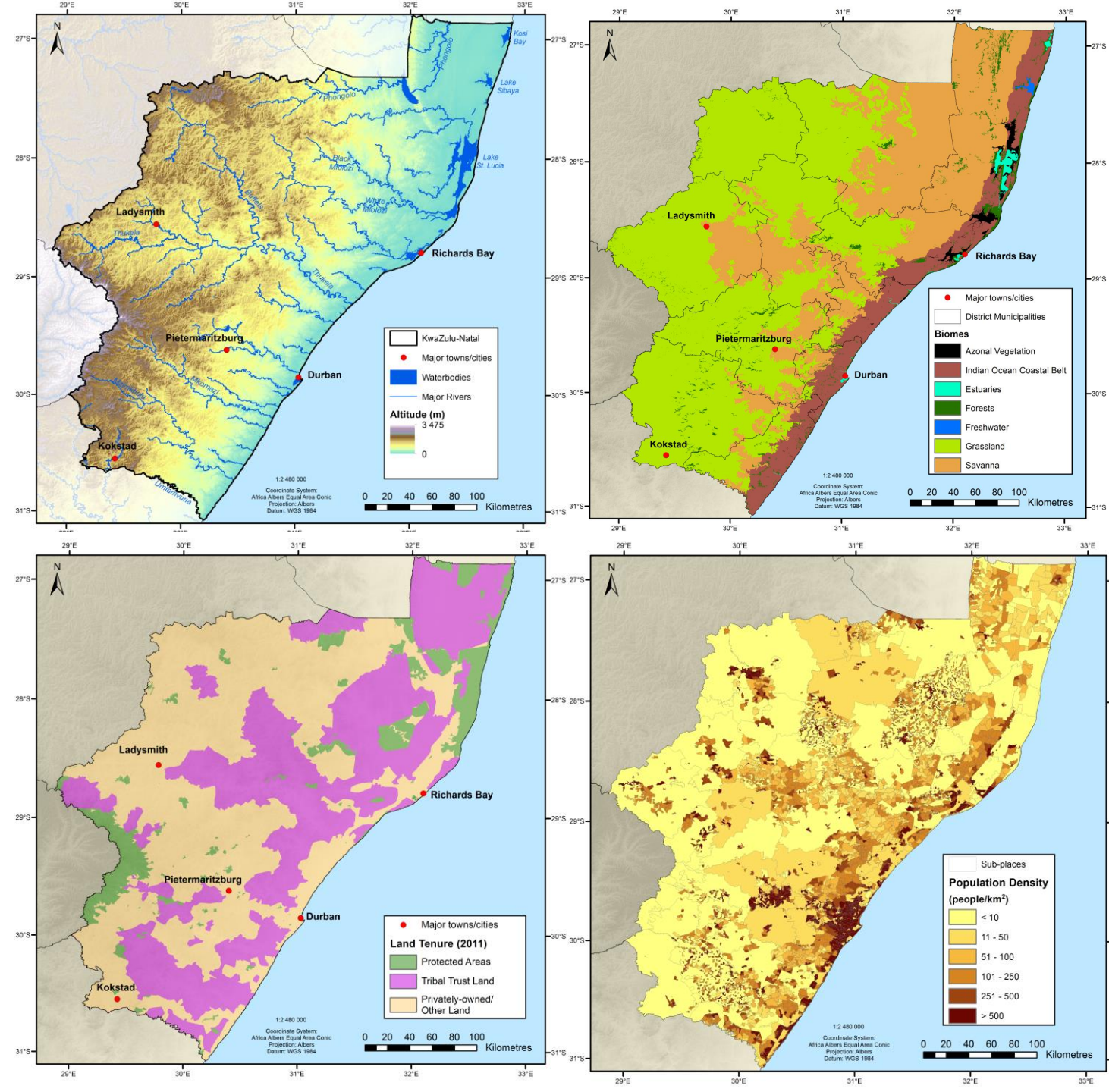


# Study area and methodological framework



# Study area

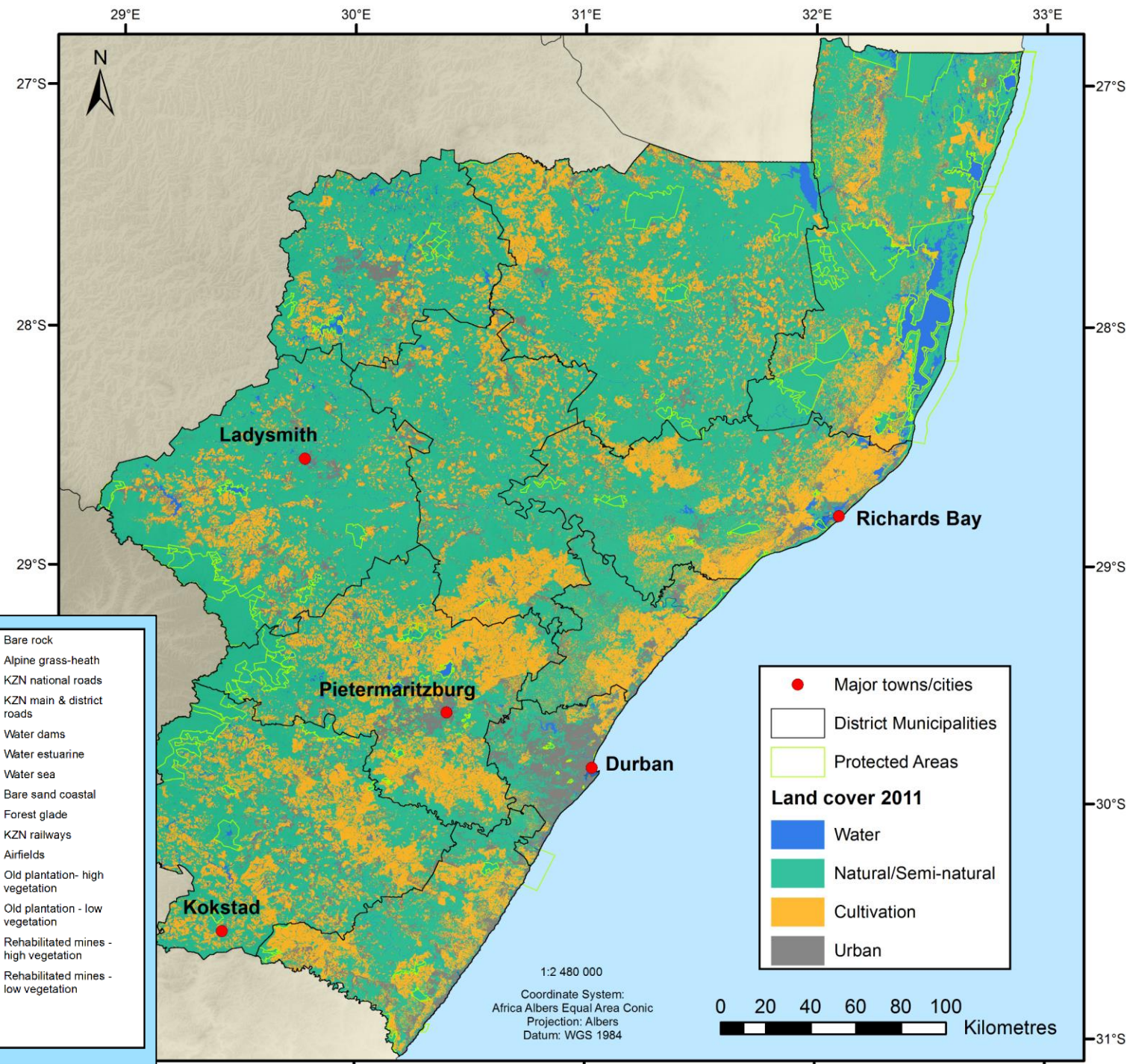
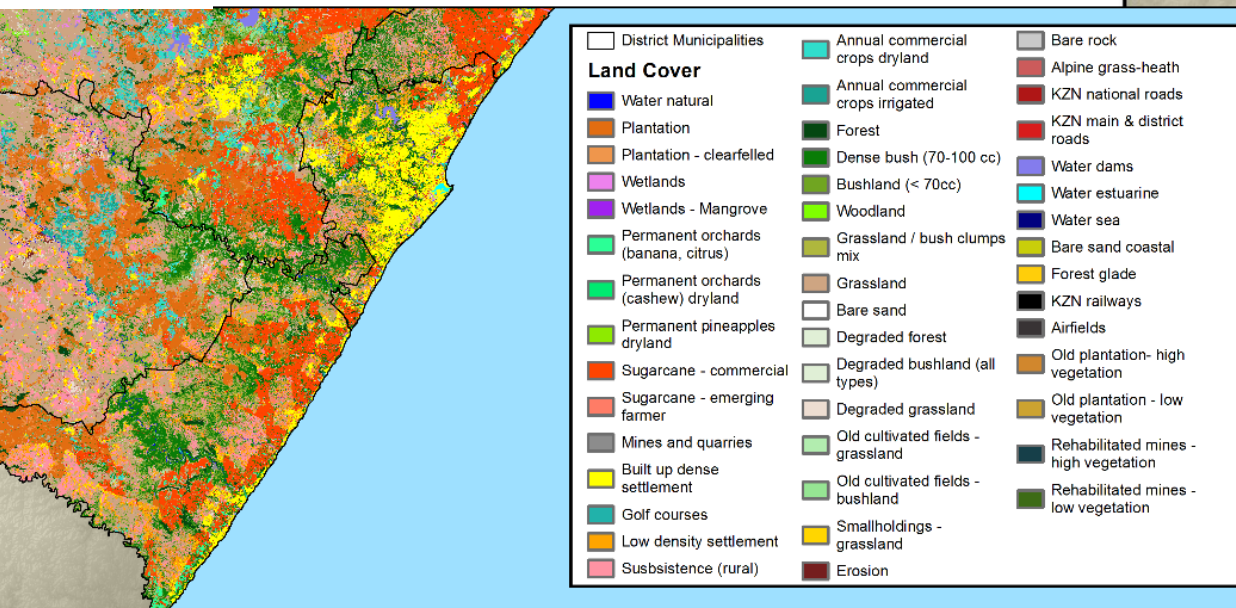
- Watershed to coast
- Grasslands, savanna, coastal bush/forest
- 8.7% protected, 39.4% tribal, 51.9% private
- Population 10m (109/km<sup>2</sup>), one major city (Durban)





# Land cover

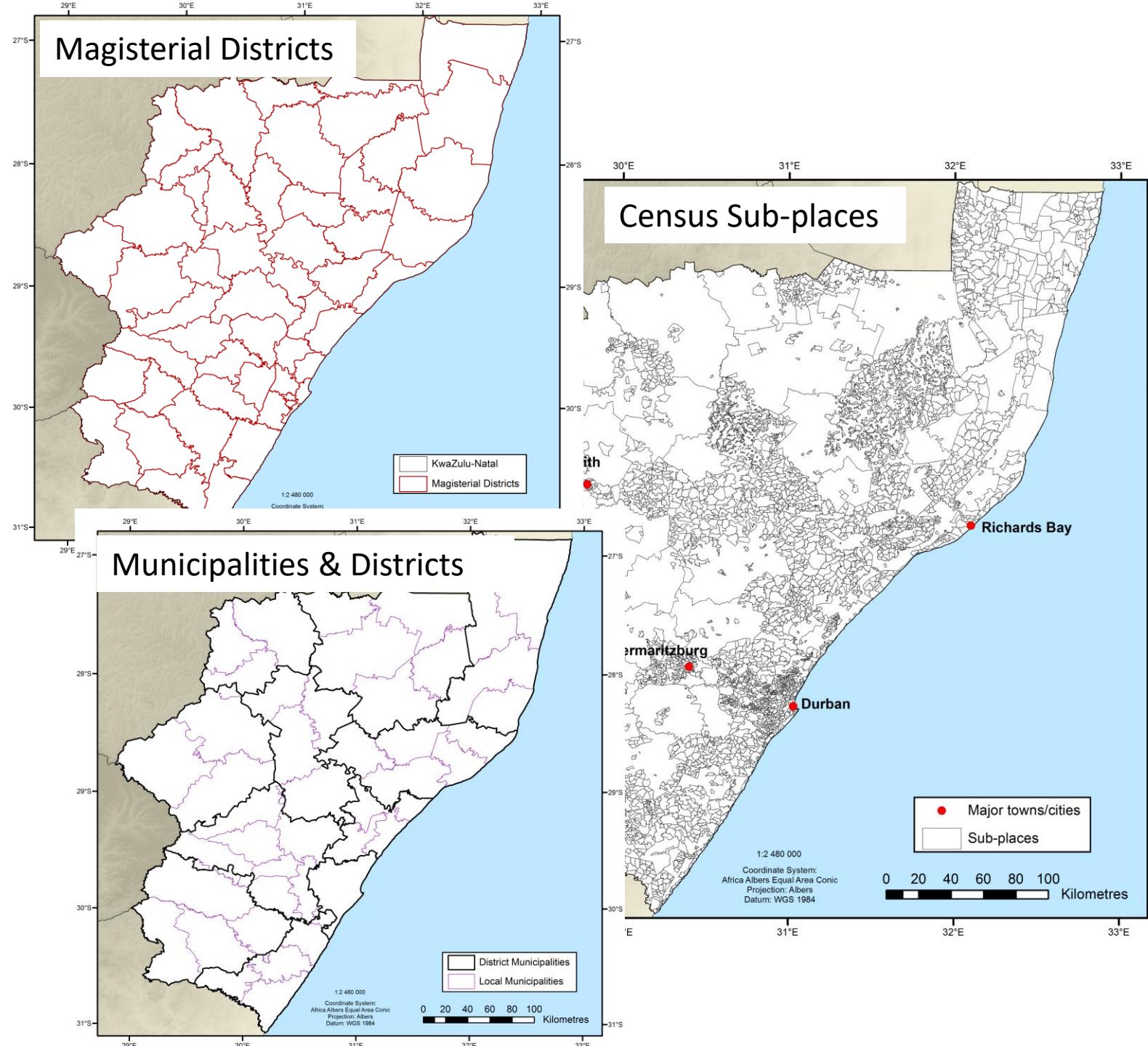
- KZN has own land cover, mapped to 37 types
  - Summarised at right into 4 types
- Differs from national in including ecosystem condition





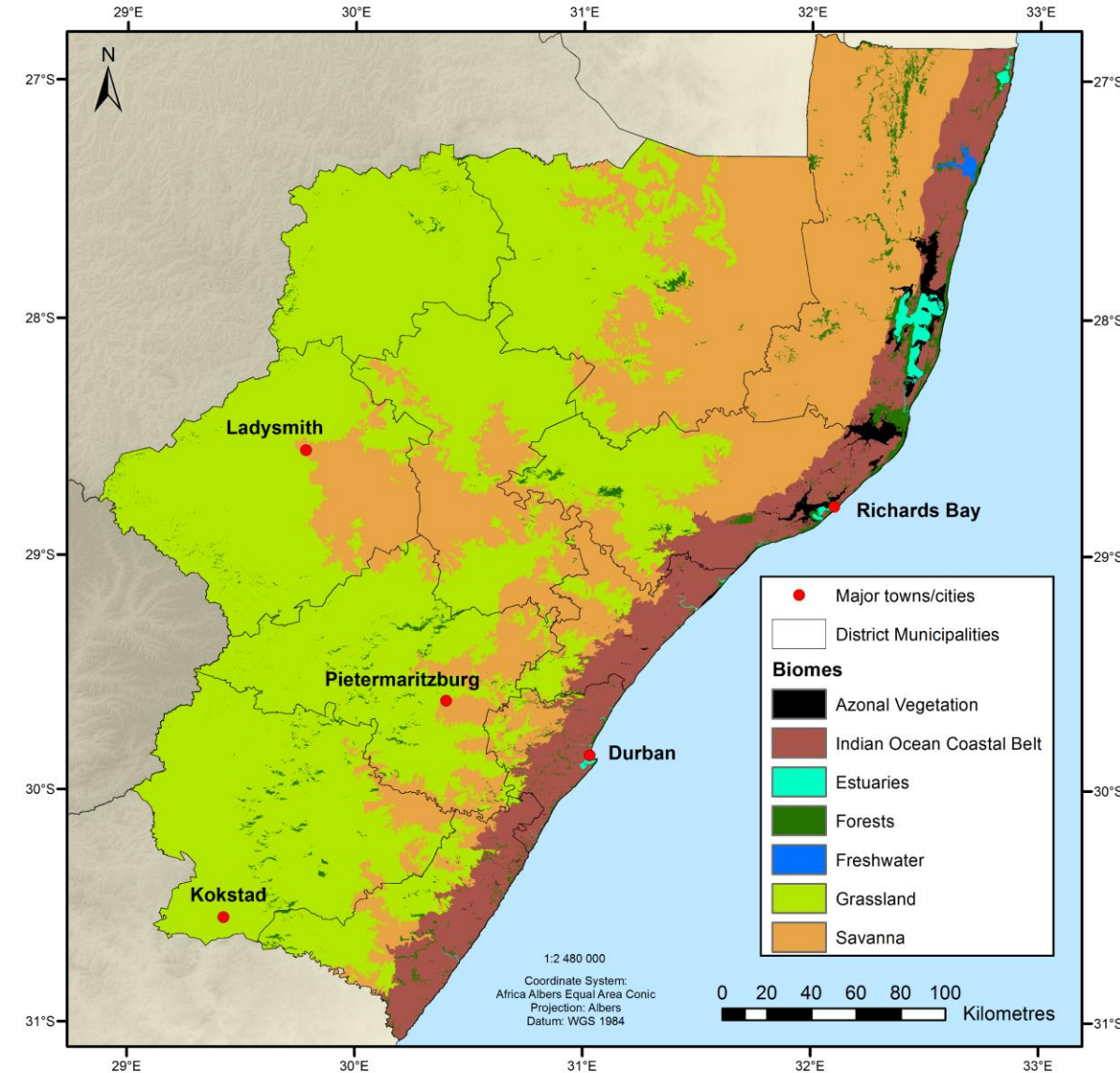
# Administrative & census units

- 52 Magisterial Districts
- 43 Local municipalities + 1 Metro
- 11 Districts
- 4198 Census sub-places



# Accounting framework

- Basic spatial unit = 1 ha grid cell
  - Official South African BSU grid created by StatsSA
  - Base layers were projected and then snapped to the BSU grid
- Physical and monetary supply and use tables summarised by biome (7 biomes)
- 2005 and 2011
- Monetary values standardised to 2010







# Ecosystem services

- Natural/semi-natural, cultivated, reservoirs and urban parks.
- Classification used here is modified from MEA & CICES;
  - excludes water and minerals
- Study include provisional estimates of a broad range of services\*, rather than narrow focus

Broad category	Ecosystem service
Provisioning services	Harvested wild biomass*
	Reared animal production*
	Cultivated production*
	Genetic resources
Cultural services	Experiential value associated with active or passive use*
	Existence (non-use) value
Regulating services	Sediment retention*
	Water quality amelioration*
	Seasonal flow regulation*
	Flood attenuation
	Carbon sequestration*
	Crop pollination & pest control
	Refugia and nursery functions





# Valuation

- **Provisioning and cultural services** are used directly, through joint contribution of natural and man-made capital and labour.
  - Ecosystem contribution can be valued in terms of net income (gross income less input costs)
- **Regulating services** make an indirect contribution. If lost could result in damages, or replaceable by engineering solutions,
  - Value = min (avoided damage cost, avoided replacement costs)
  - Net of human inputs where services are enhanced

## Values

- Ecosystem service flows =  $R/\text{ha}/y$
- Asset value =  $R/\text{ha}$ ,  $R$ 
  - discounted annual flows over 20 years ( $R/\text{ha}$ ), social rate of discount (NPV)
  - Values per ha aggregated by ecosystem type ( $R$ )



# Ecosystem services & benefits





# Wild resources

## About the service

- Major benefit in KZN, millions of people rely on harvesting wild resources
- Large numbers of species involved, grouped based on function

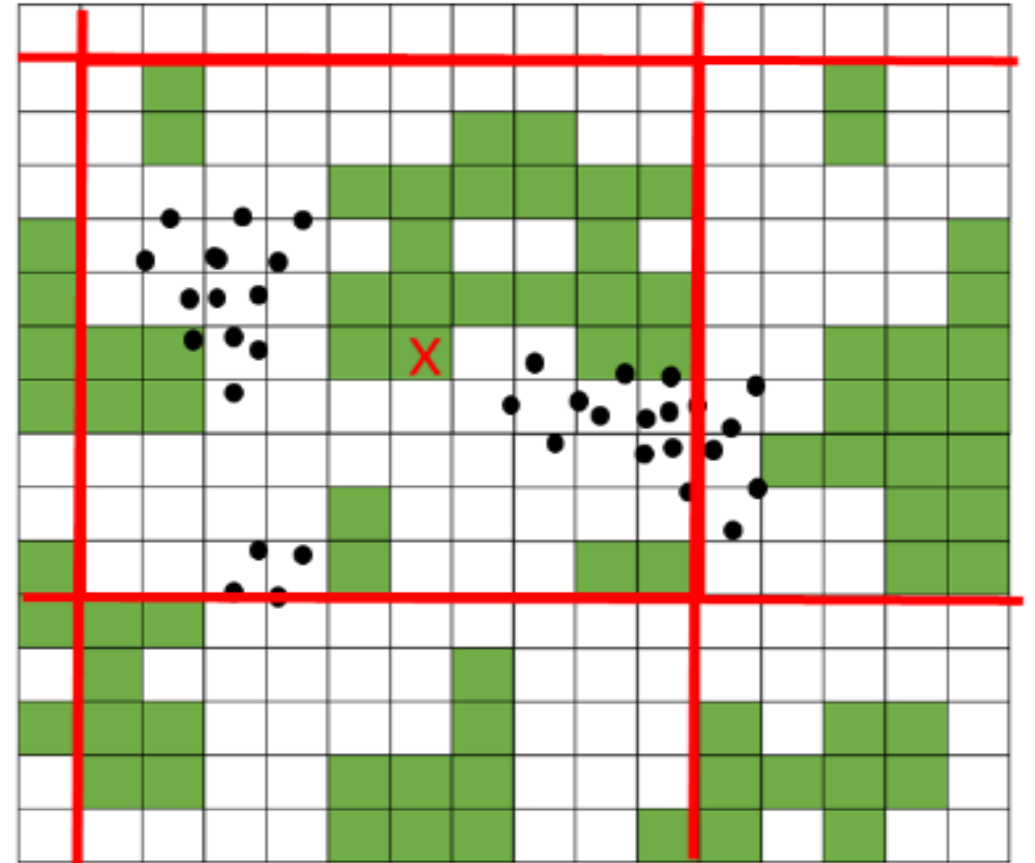


Wild plant resources	Nutrition and health	Wild plant foods and medicines
	Energy	Wood fuel
	Raw materials	Grass
		Reeds and sedges
		Palm leaves
		Poles and withies
Wild animal resources	Nutrition	Timber
		Bush meat
		Fisheries

# Wild resources

## Data & methods

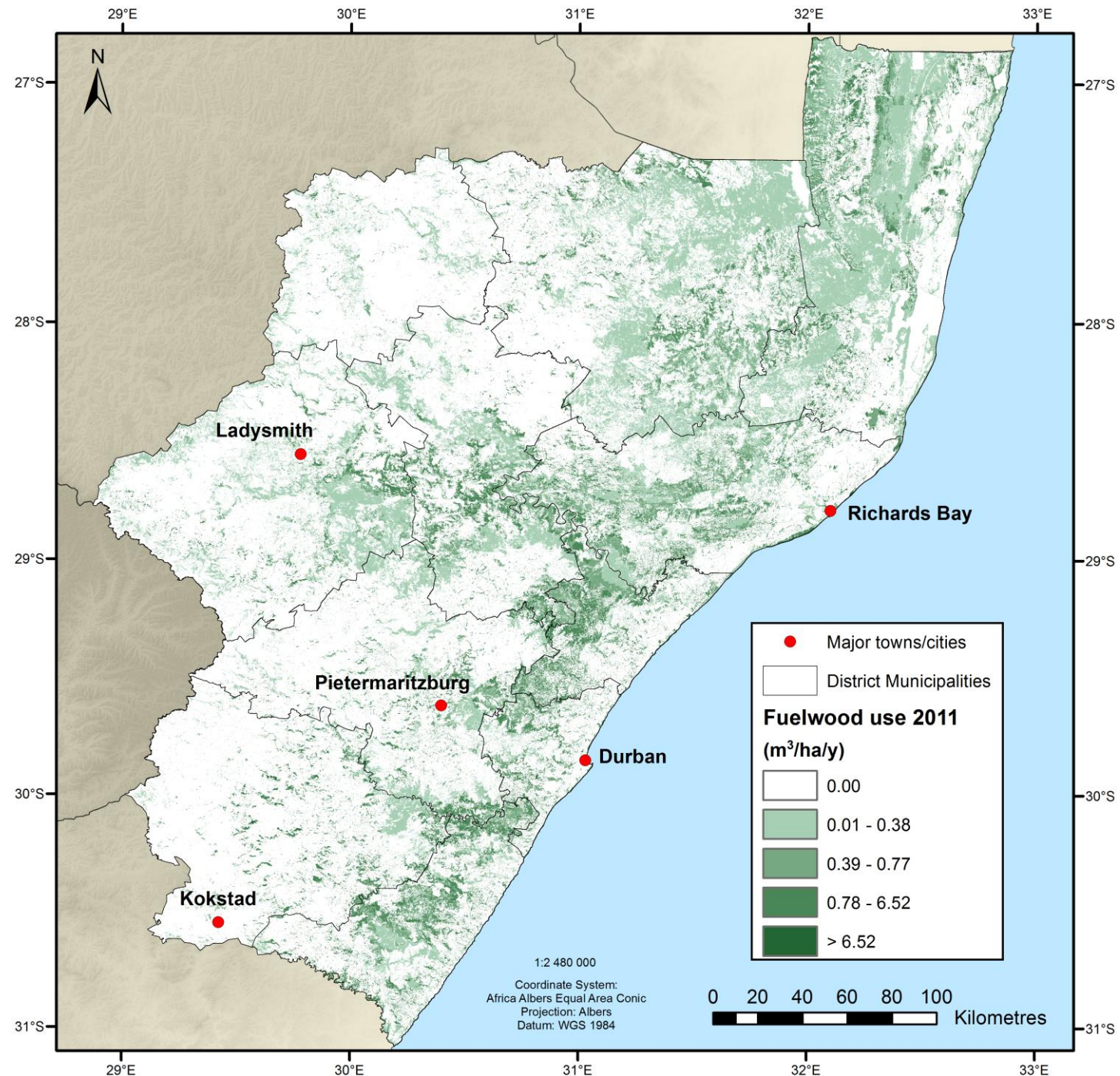
- **Availability** mapped in physical units/ha based on
  - land cover type
  - average stocks per ha from literature,
  - land tenure.
- **Demand** based on survey data, mapped to residential areas
- **Use** estimated using a rolling average method, under assumption of 5-10 km range of collection, limited by availability





# Wild resources

- Estimated use mapped as kg or m<sup>3</sup>/ha/y
- Converted to R/ha/y using average prices and input costs from literature
- Note limitations
  - Limited information on habitat condition and resource supply
  - Demand estimates from NE KZN extrapolated to rest
  - For high demand areas, resources likely to be collected from further afield using road transport

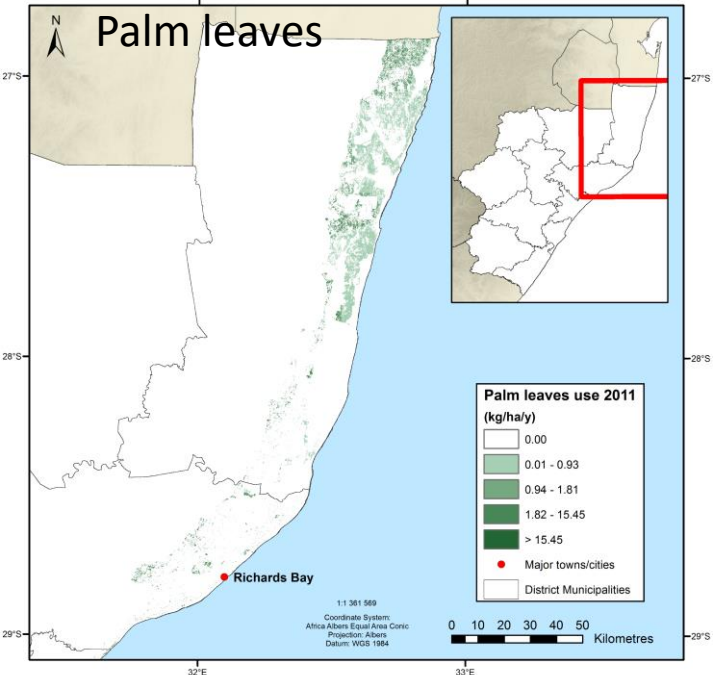
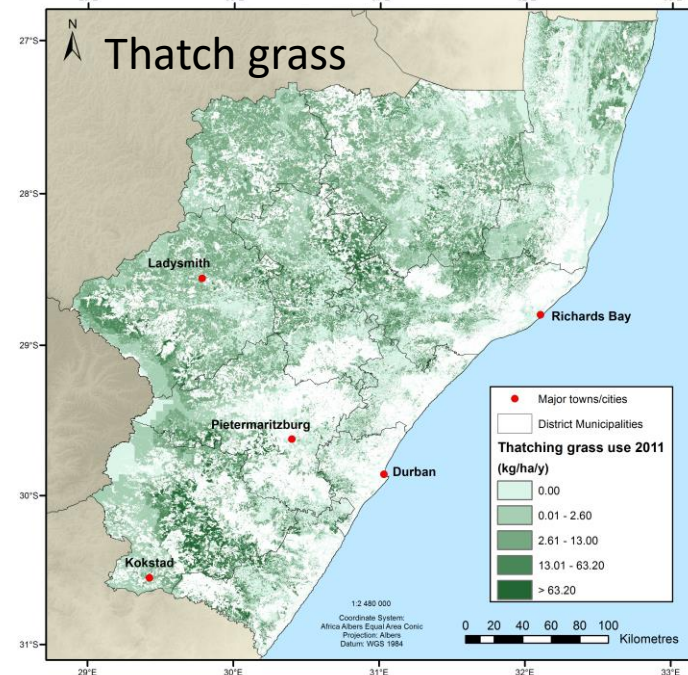
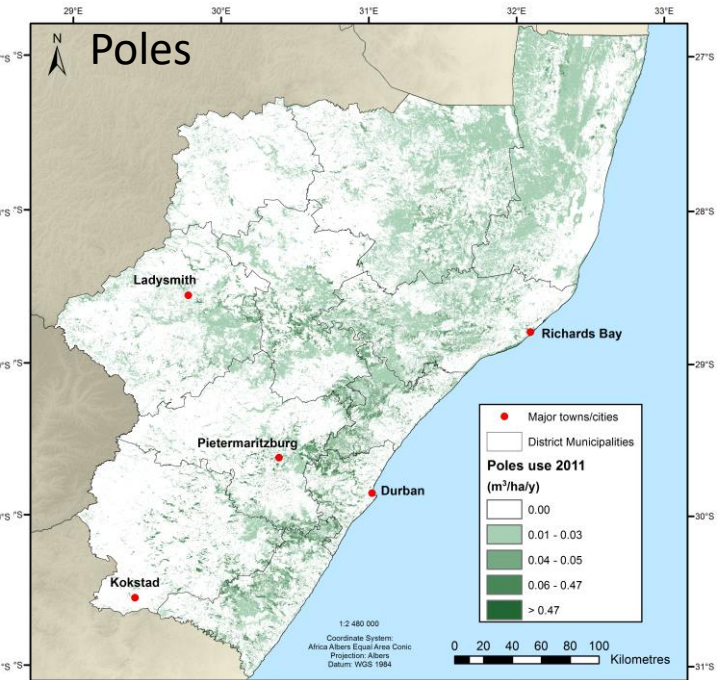
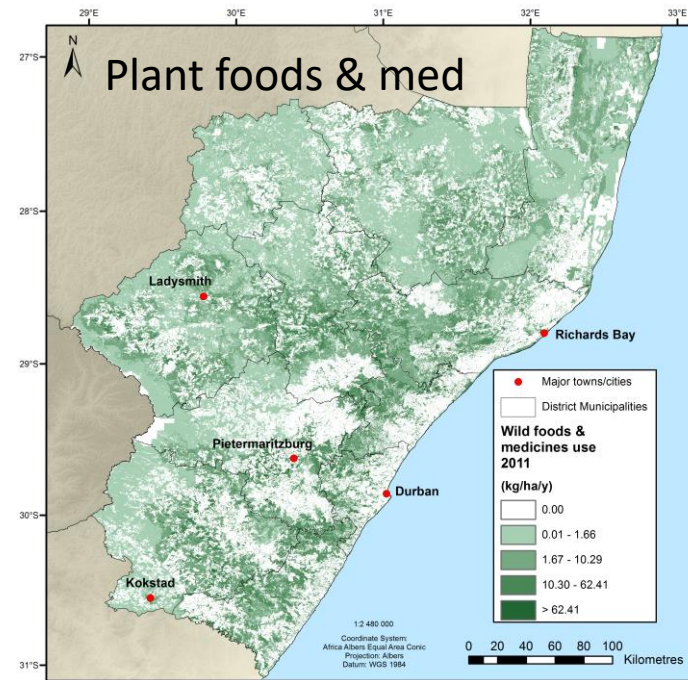




# Wild resources

## Comments

- Limited data in census, relied on data from previous studies
- Data on stocks and availability generalised, need better info
- Difficult to produce accurate spatial estimates – beyond some point people will transport and trade





# Wild resources – physical supply tables by biome

Biome PHYSICAL SUPPLY 2005	Azonal Vegetation (seashore & alluvial)	Freshwater	Grassland	Indian Ocean Coastal Belt	Savanna	Forests	Estuaries	TOTAL
Fuelwood (m <sup>3</sup> )	3 124	216	663 349	223 178	755 244	247 315	158	1 892 584
Poles (m <sup>3</sup> )	156	7	29 645	10 948	28 560	11 165	8	80 489
Timber (m <sup>3</sup> )	17	3	2 643	999	3 491	8 567	3	15 723
Thatching grass (tonnes)	27	10	43 871	6 068	26 676	70	2	76 724
Reeds & sedges (tonnes)	740	13	3 801	1 508	2 371	324	22	8 779
Palm leaves (tonnes)	-	-	-	292	-	-	-	292
Wild foods/med (tonnes)	118	4	14 483	4 951	13 113	2 327	6	35 001
Bushmeat (tonnes)	5	1	1 542	338	1 934	179	0	3 998
Fish (tonnes) (see note above)	35	7	315	75	298	22	8	759

Biome PHYSICAL SUPPLY 2011	Azonal Vegetation (seashore & alluvial)	Freshwater	Grassland	Indian Ocean Coastal Belt	Savanna	Forests	Estuaries	TOTAL
Fuelwood (m <sup>3</sup> )	3 419	204	577 156	199 665	684 019	228 188	181	1 692 832
Poles (m <sup>3</sup> )	157	5	27 922	9 231	25 318	10 504	7	73 144
Timber (m <sup>3</sup> )	14	2	1 359	415	2 516	8 410	2	12 719
Thatching grass (tonnes)	15	7	35 145	3 870	18 970	42	1	58 052
Reeds & sedges (tonnes)	591	7	3 796	1 176	2 578	192	14	8 355
Palm leaves (tonnes)	-	-	-	235	-	-	-	235
Wild foods/med (tonnes)	143	3	14 311	3 984	11 265	2 681	7	32 393
Bushmeat (tonnes)	3	1	1 161	220	1 404	138	0	2 926
Fish (tonnes) (see note above)	24	5	389	65	271	14	6	774

# Wild resources – monetary supply tables by biome

Biome	Azonal Vegetation (seashore & alluvial)	Freshwater	Grassland	Indian Ocean Coastal Belt	Savanna	Forests	Estuaries	TOTAL
MONETARY SUPPLY TABLE 2005								
Fuelwood	2.70	0.19	573.13	192.83	652.53	213.68	0.14	1 635.19
Poles	0.11	0.00	21.40	7.90	20.62	8.06	0.01	58.11
Timber	0.02	0.00	3.59	1.36	4.75	11.65	0.00	21.38
Thatching grass	0.64	0.24	1 052.90	145.64	640.23	1.68	0.04	1 841.38
Reeds & Sedges	18.49	0.32	95.03	37.71	59.28	8.09	0.56	219.49
Palm leaves	-	-	-	12.86	-	-	-	12.86
Wild foods & Medicines	1.85	0.06	228.10	77.98	206.54	36.64	0.10	551.27
Bushmeat	0.07	0.01	23.12	5.07	29.01	2.68	0.00	59.97
Fish	0.28	0.06	2.52	0.60	2.39	0.17	0.06	6.07
Total	23.89	0.83	1 997.29	481.35	1 612.96	282.48	0.85	4 405.73

Biome	Azonal Vegetation (seashore & alluvial)	Freshwater	Grassland	Indian Ocean Coastal Belt	Savanna	Forests	Estuaries	TOTAL
MONETARY SUPPLY TABLE 2011								
Fuelwood	2.95	0.18	498.66	172.51	590.99	197.15	0.16	1 462.61
Poles	0.11	0.00	20.16	6.66	18.28	7.58	0.01	52.81
Timber	0.02	0.00	1.85	0.56	3.42	11.44	0.00	17.30
Thatching grass	0.37	0.17	843.47	92.89	455.29	1.01	0.03	1 393.24
Reeds & Sedges	14.78	0.17	94.90	29.40	64.46	4.81	0.35	208.88
Palm leaves	-	-	-	10.34	-	-	-	10.34
Wild foods & Medicines	2.25	0.04	225.39	62.75	177.42	42.23	0.10	510.19
Bushmeat	0.05	0.01	17.41	3.30	21.06	2.06	0.00	43.90
Fish	0.27	0.05	4.28	0.72	2.98	0.15	0.07	8.51
Total	20.80	0.63	1 706.13	379.14	1 333.90	266.45	0.71	3 707.76



# Reared animal production

## About the service

- Extensive production of rangeland animals, including cattle, sheep, goats, horses, donkeys, and wildlife
- High input production in private lands, low input-output systems on communal land
- Lower production on private wildlife ranches as large component for tourism

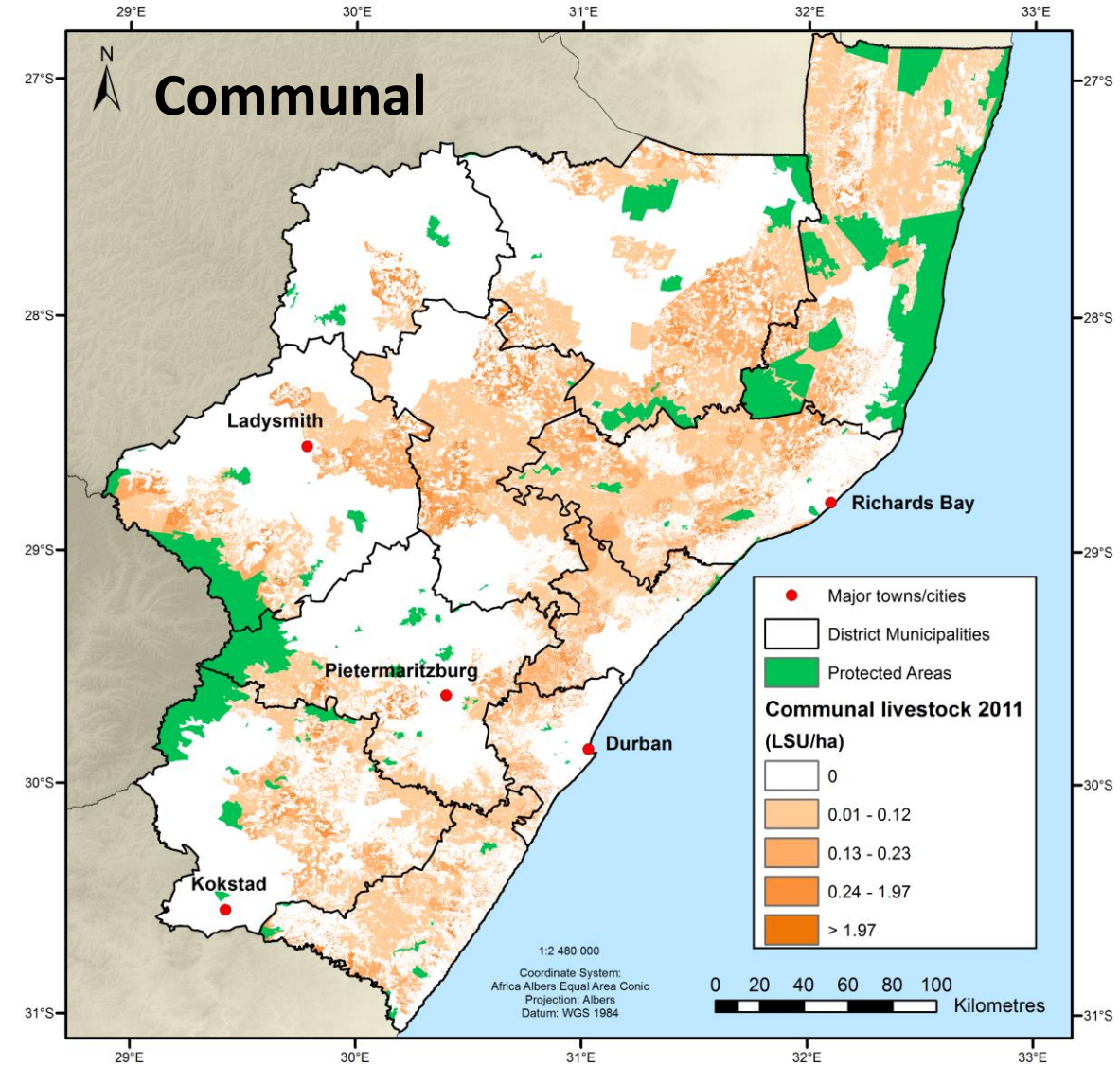
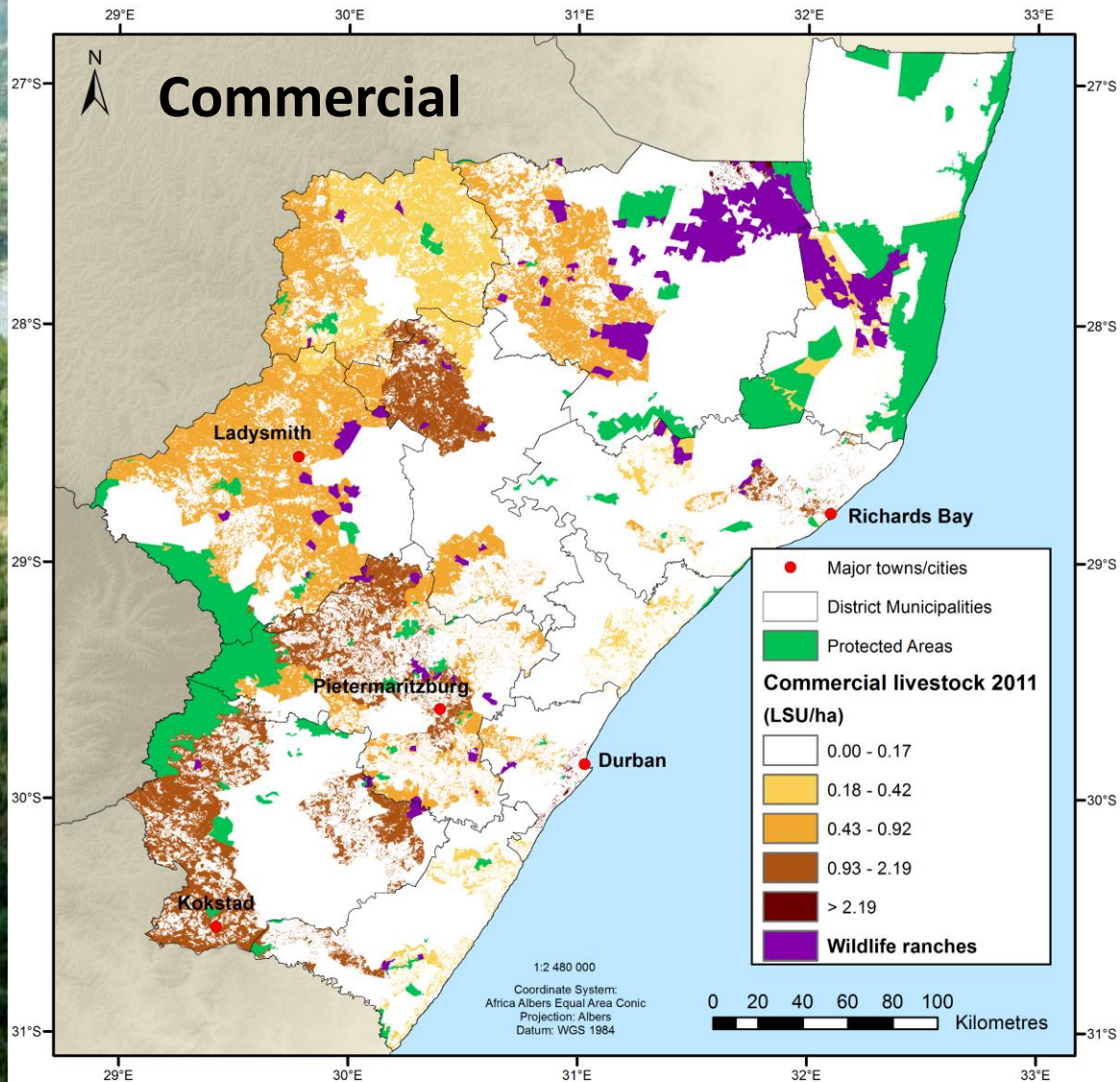


## Data & methods

- Commercial livestock
  - Production, values by [Magisterial District](#) from Census of Commercial Agriculture 2002, 2007
  - Long term quarterly [provincial](#) statistics
- Communal livestock
  - Agric hh survey (Census 2011) by ward
  - Meissner et al. (2013) estimate for province
  - 2005 estimate based on % difference in no. traditional households
- Wildlife ranching
  - Offtake/ha in KZN, values from Taylor et al. (2015)



# Reared animal production





# Cultivation

## The service

- Land inputs to cultivated production including crops, orchards and timber plantations
- Production net of human inputs and intermediate service inputs from adjacent habitats (pollination, pest control)
- Service expressed as total production per ha for practical reasons, and valued as income net of all inputs



## Data and methods

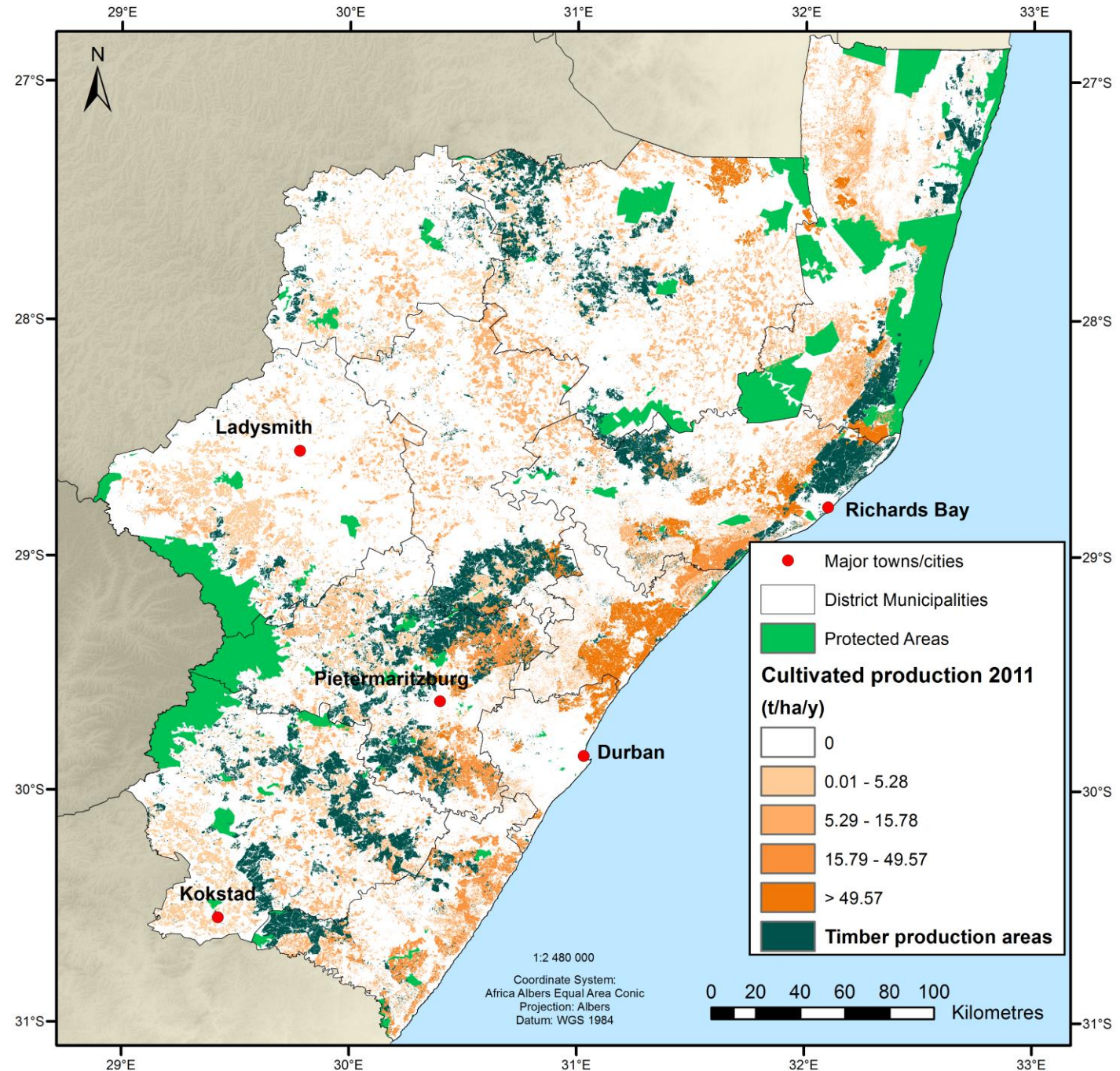
- Commercial crop production and prices from 2002 and 2007 Agricultural Census, at Magisterial District scale (selected crops) and provincial scale (all crops)
  - Ave per crop grouping (aligned to land cover classes), per district
- Commercial silviculture production and prices for KZN from Forestry South Africa (2011 data)
  - Single average value per ha for province
- Communal crop production and prices from literature from N KZN
  - Single average value per ha for province



# Cultivation

## Results and comments

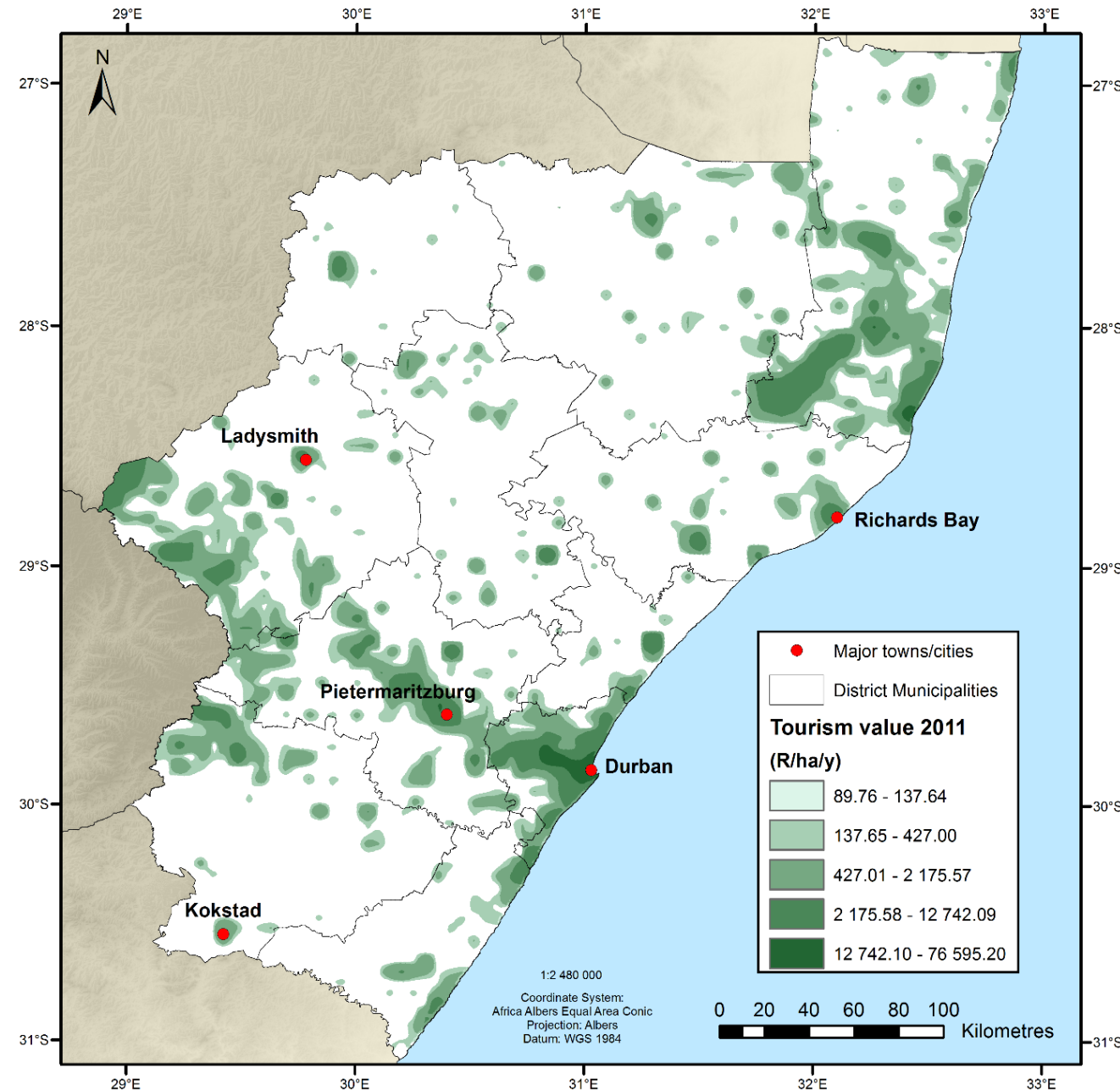
- In 2011, roughly 25% of the KZN was cultivated
- Value grew from R18.5 bn (2005) to R21.2 bn (2011)
- Spatial variation limited to provincial and district level





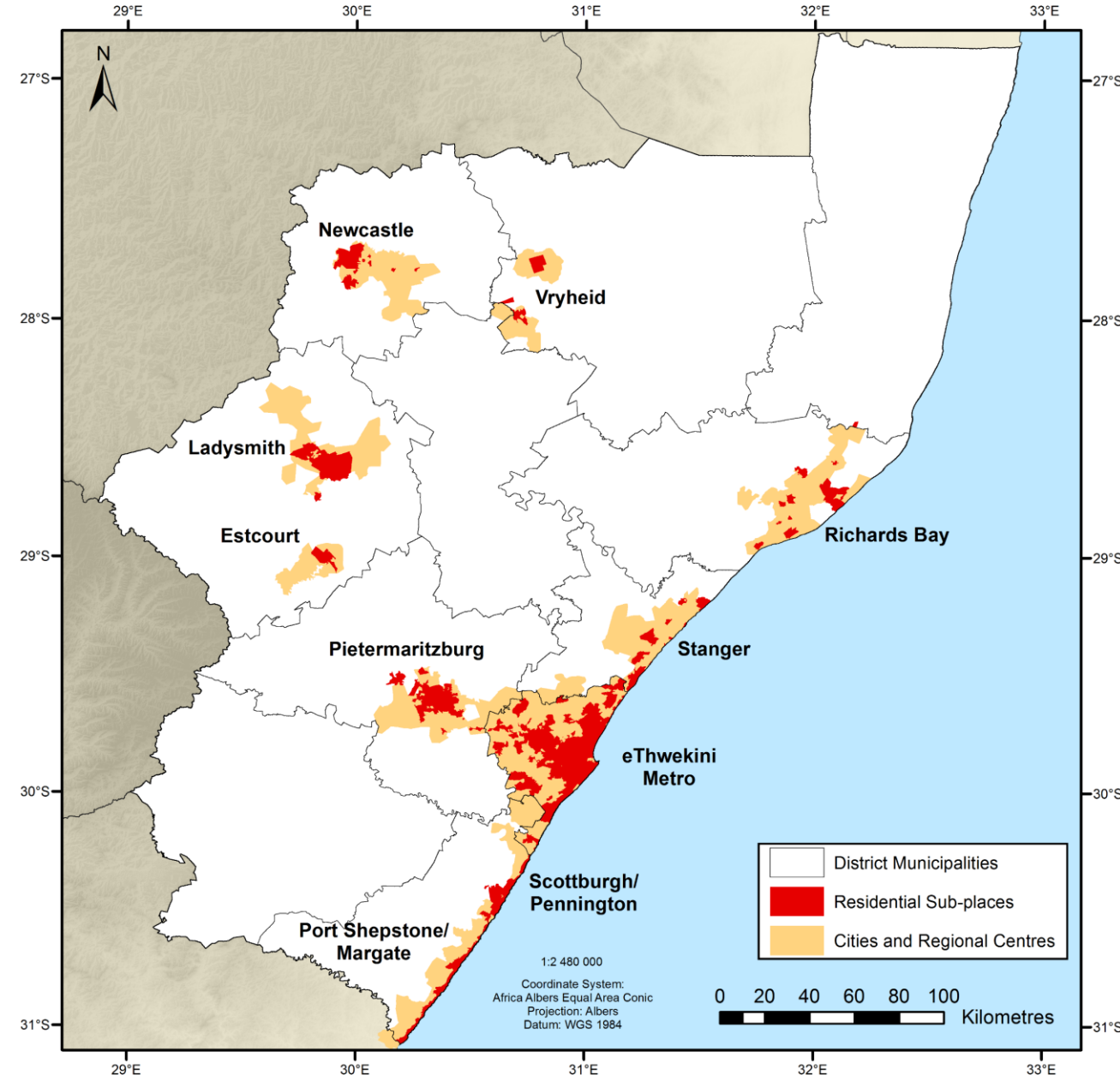
# Tourism value

- The total leisure tourism value for KZN was spatialised using density of geotagged photos.
- Total value for inland KZN was **R2 billion** in 2005 and **R3.2 billion** in 2011
- Value from natural/semi-natural areas made up 64% and 57% of this, respectively.
- Value from Tribal Trust land made up 16% and 15%, respectively



# Property premiums from urban green space

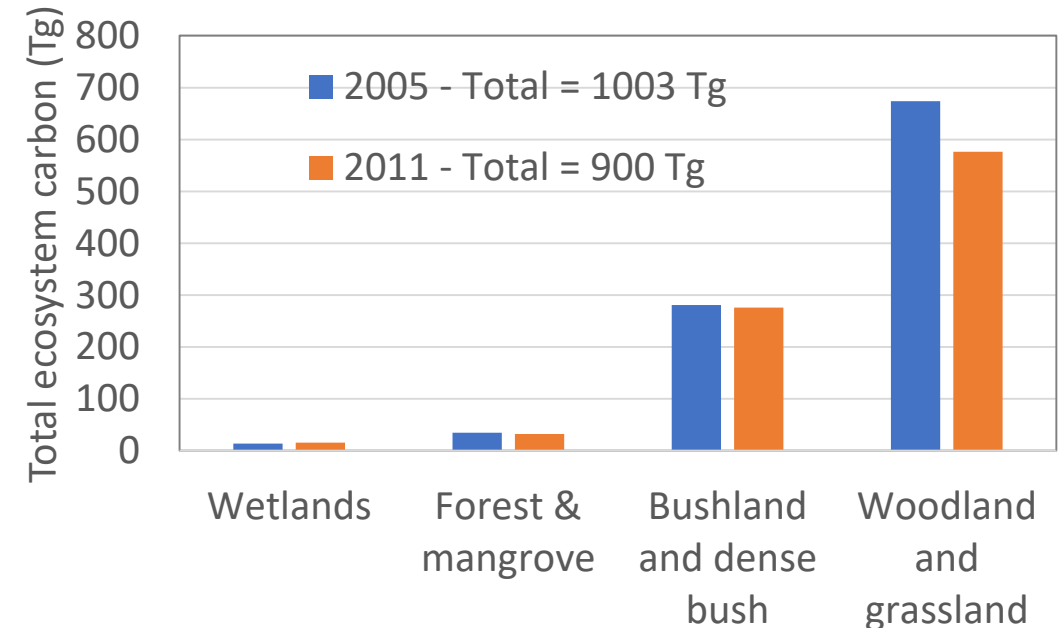
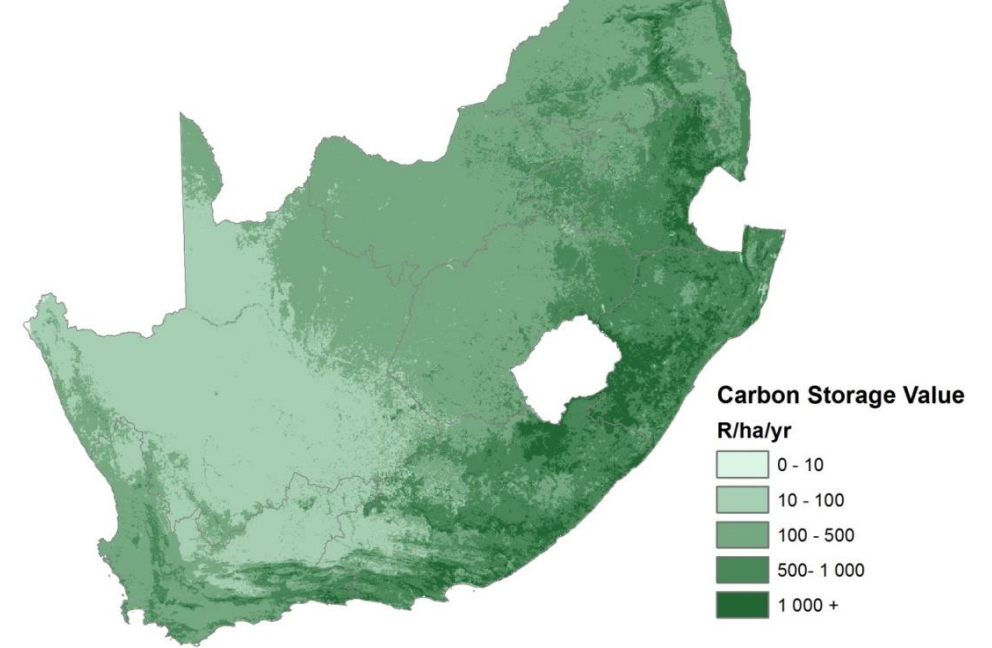
- Estimated based on a hedonic study of Durban, giving average values per suburb.
- Derived statistical model of R/ha vs household income
- Applied to KZN's 10 main towns at subplace scale
  - Not likely to be applicable to smaller towns
- Total contribution **R1.9 bn per year**, 68% in Durban.
  - Excludes coastal/beach values
- Values could not be mapped using the KZN land cover map





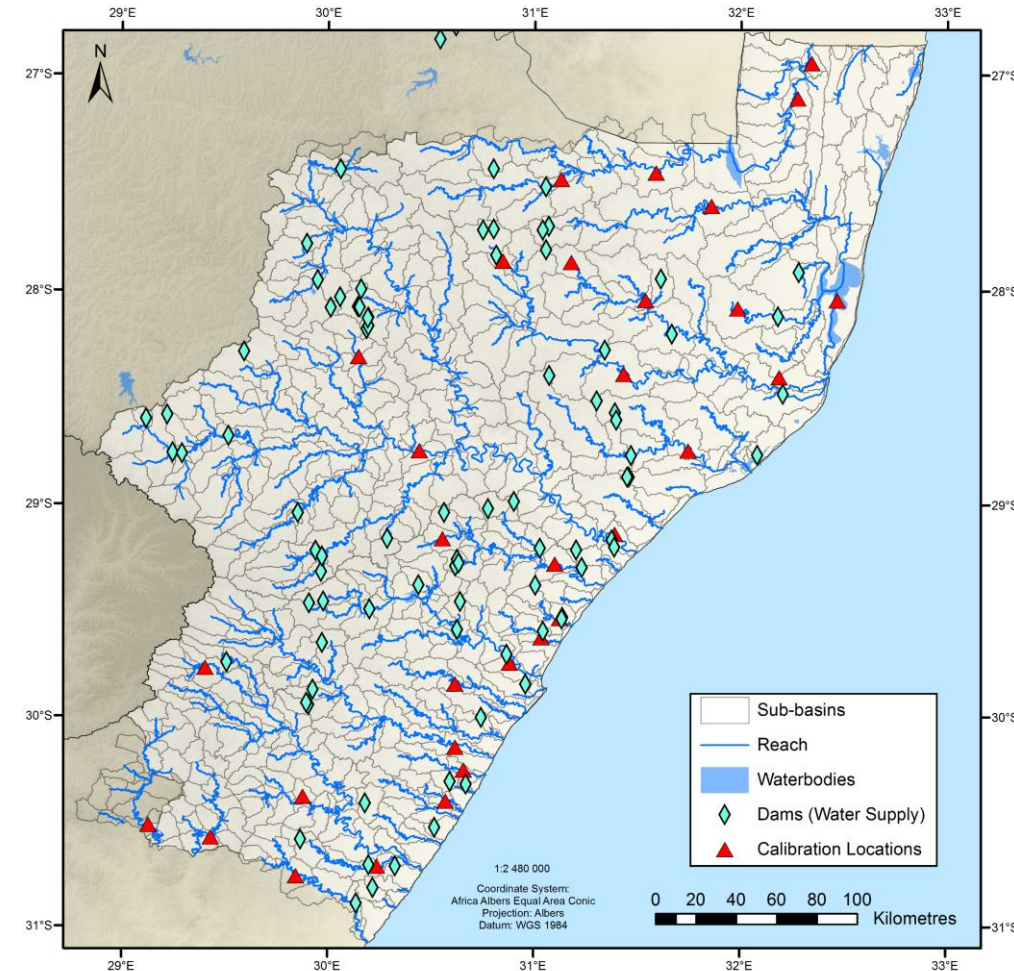
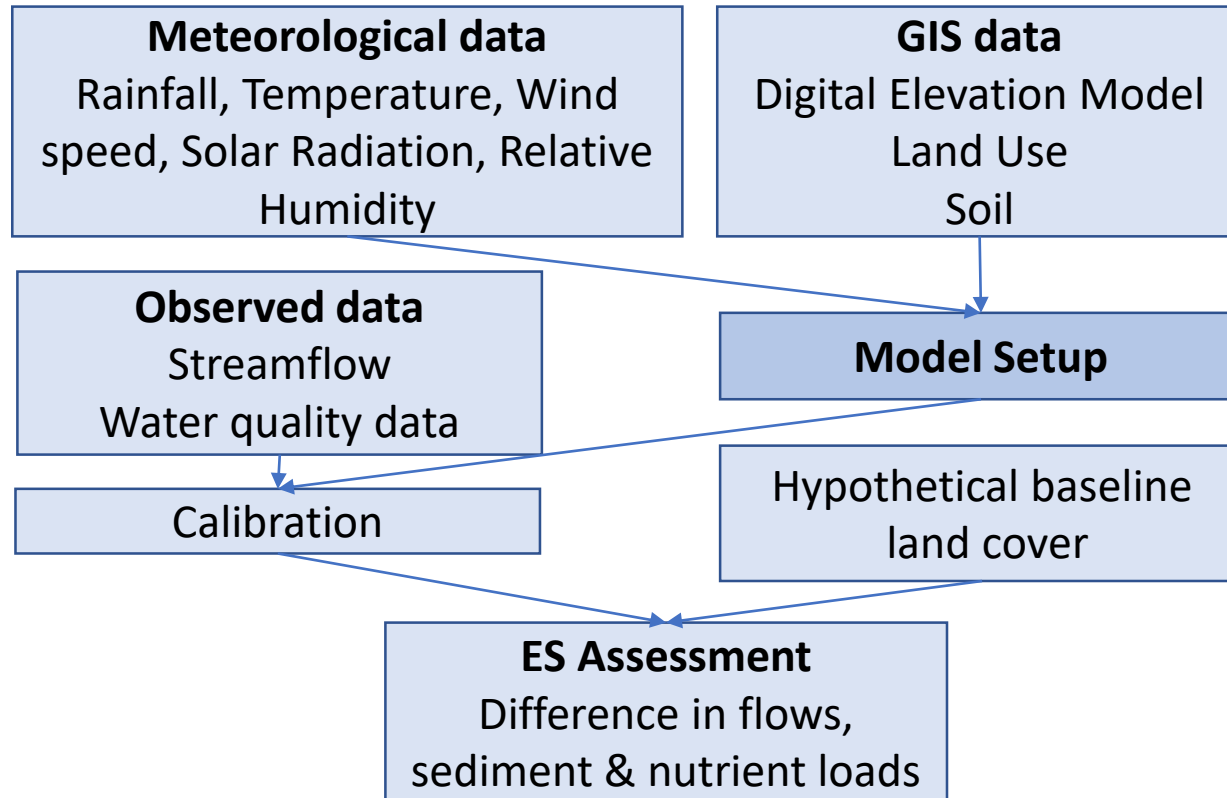
# Carbon

- Based on spatial data from South African National Carbon Sink Assessment (DEA, 2015)
- Total ecosystem carbon in KZN for 2005 and 2011 was estimated based on mean value of carbon ( $\text{g C/m}^2$ ) for each natural land cover type from
- 10% loss of stored carbon from 2005 to 2011
  - mainly from reduced area/health of grassland, woodland and bushland,
  - offset by bush densification in some areas
- Only net change is estimated in this study.
  - Future studies should attempt to estimate gains and losses
- Net gains/losses valued in terms of SA share (0.35%) of global social cost of carbon (R/tonne)
  - Value and African share from Nordhaus
  - South African sub-share based on relative vulnerability within Africa



# Hydro-regulating services (in progress)

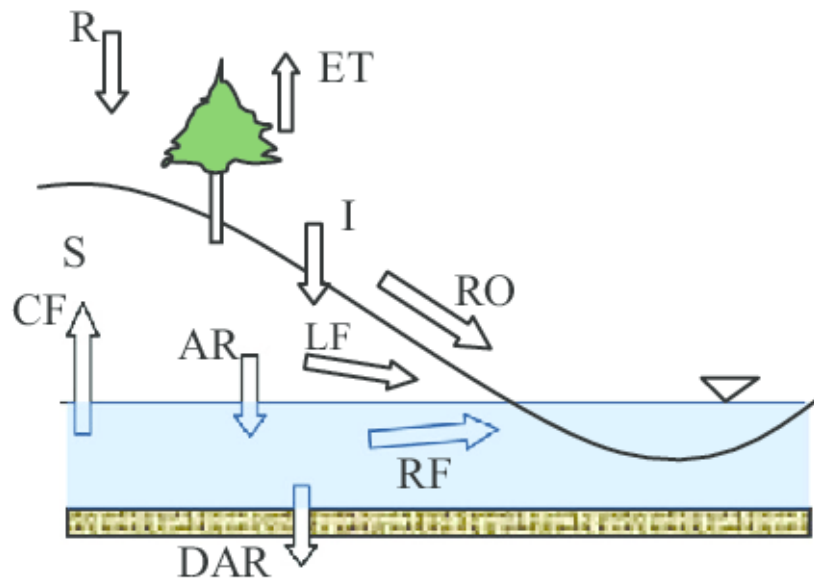
- SWAT models set up for the river catchments in KZN
  - Medium resolution due to scale - ~564 sub-basins
- Theoretical comparison for ecosystem services = degraded (types run separately)



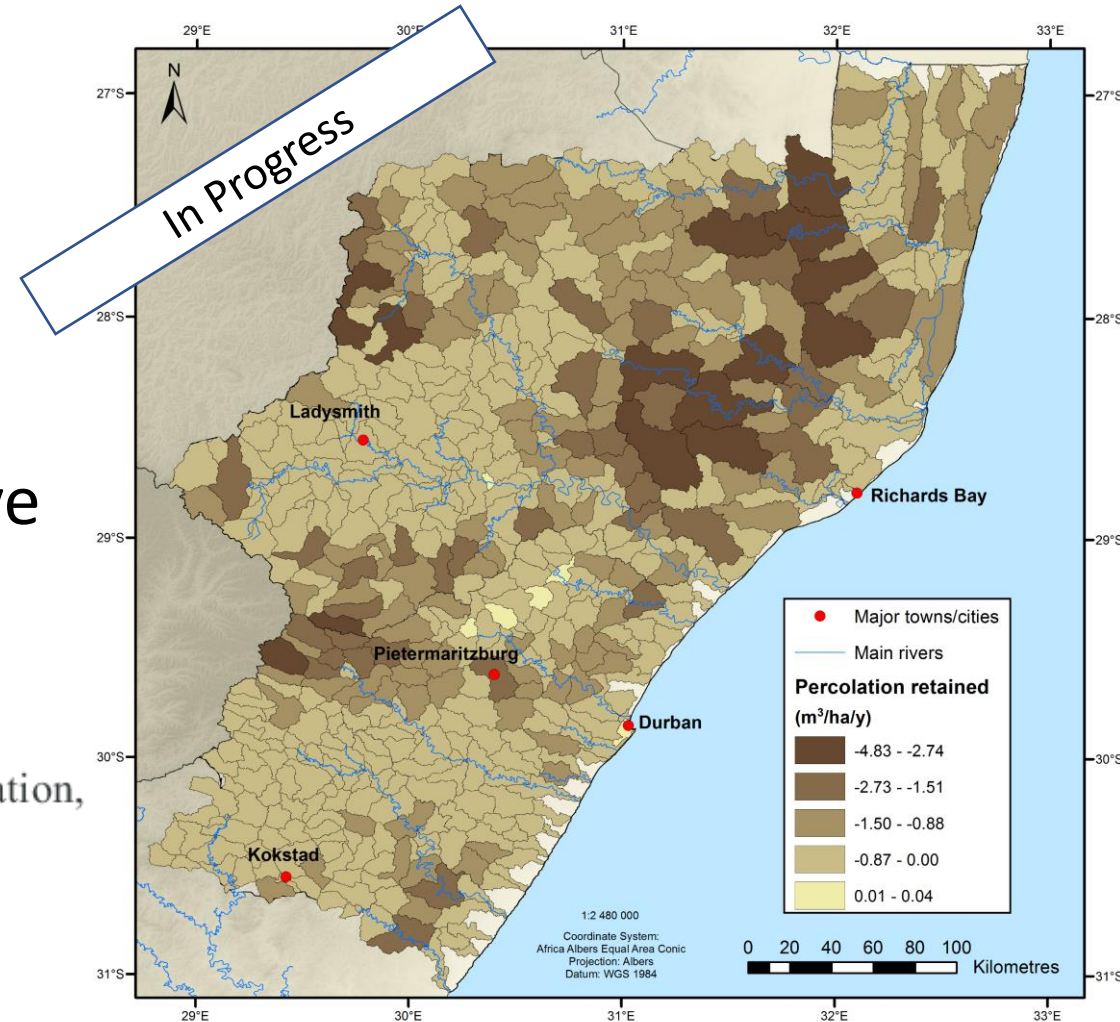


# Flow regulation

- Infiltration delays water entering streams and reservoirs, reducing infrastructure required to maintain given system yield.
- Service = amount of infiltration relative to degraded scenario ( $\text{m}^3/\text{ha}$ )



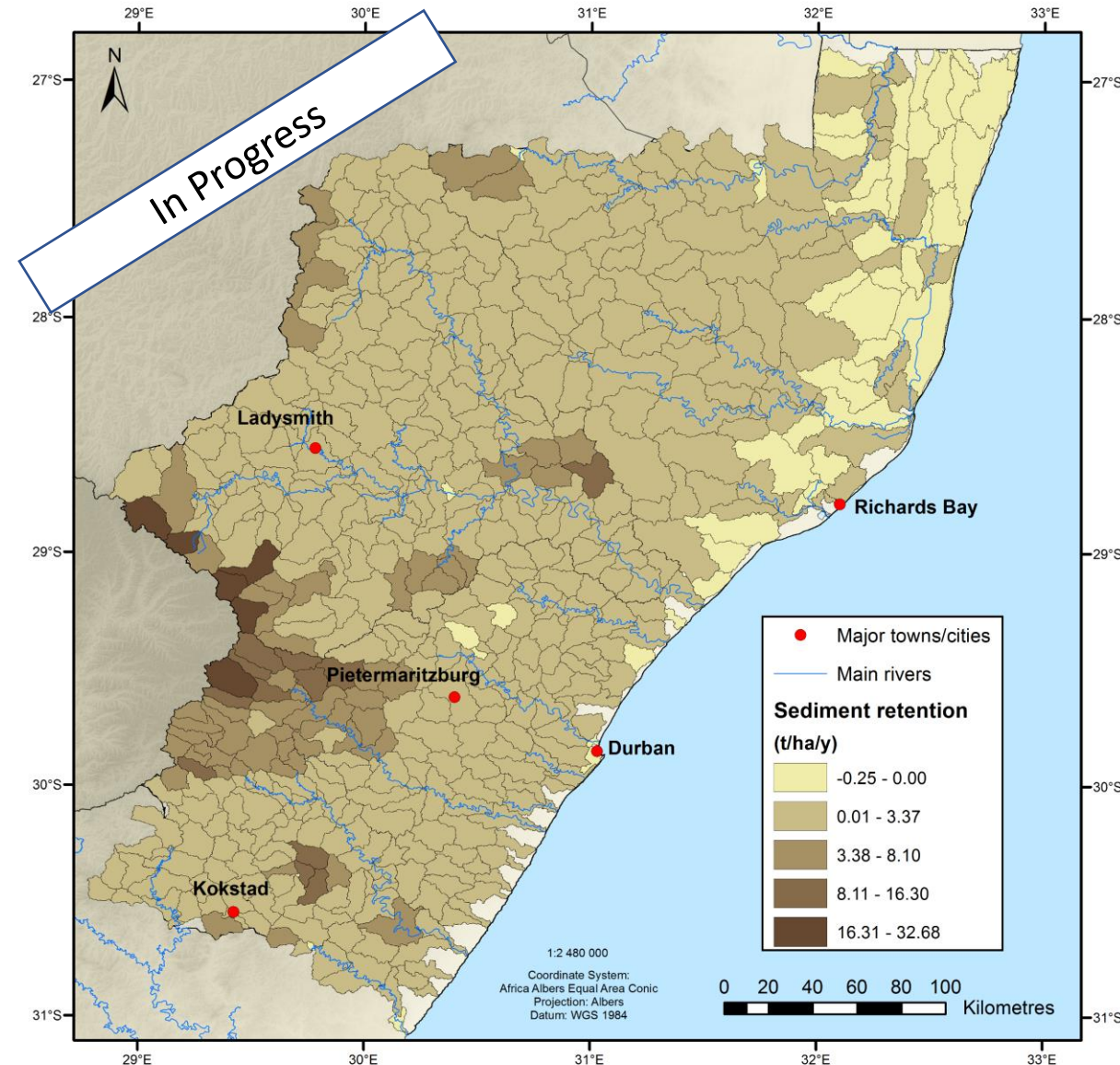
R=rainfall,  
ET=evapotranspiration,  
I=infiltration,  
RO=runoff,  
RF=return flow,  
LF=Lateral flow  
CF=capillary flow,  
AR=aquifer recharge,  
DAR=deep aquifer recharge  
S=Soil moisture



- Valued in terms of constructing equivalent storage (not perfect)

# Sediment retention

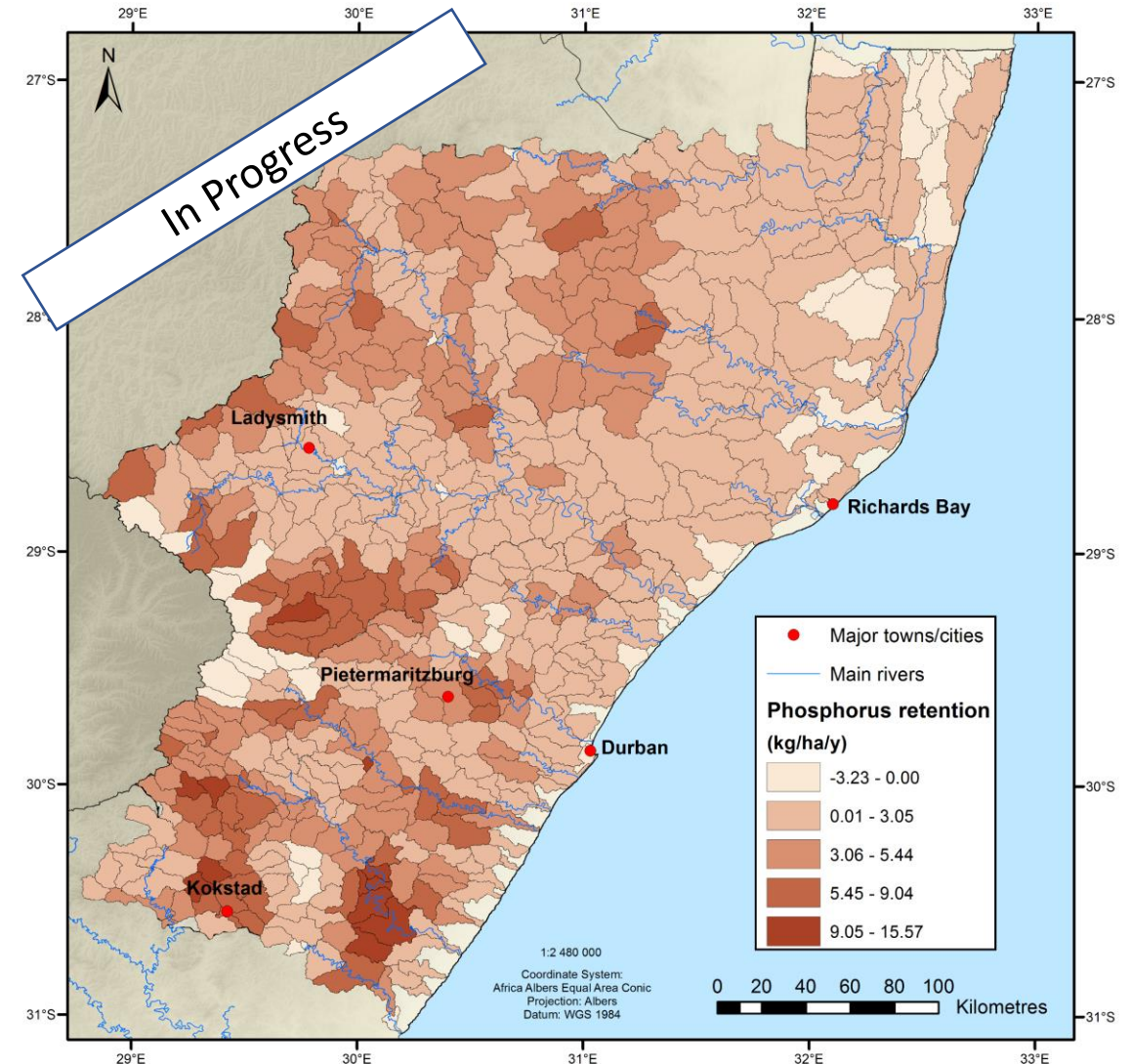
- In situ sediment retained and eroded sediment loads trapped by vegetated ecosystems
- Difference in sediment yields relative to degraded baseline (t/ha, m<sup>3</sup>/ha)
  - Issues to resolve – approach works for natural land cover types, but what is the baseline for cultivated areas.
- Valued in terms of hypothetical storage losses (R/m<sup>3</sup>)





# Water quality amelioration

- Natural and anthropogenic nutrient loads trapped by vegetated ecosystems, reducing eutrophication effects downstream ecosystems
  - P for freshwater, N for marine
- Difference in nutrient and suspended sediment loads relative to degraded baseline (kg/y)
- P retention valued using model of water treatment costs





Thank you!