Natural Capital Accounting

Land Accounting

Addis Ababa, Ethiopia

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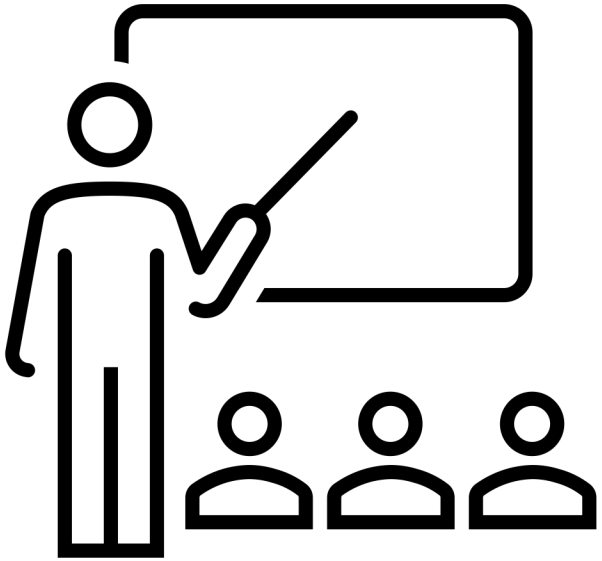
Outline of Session

A. Why land accounts?
B. Refresher
C. Land accounts
   - Land use
   - Land cover
D. Data sources and methods
E. Example land accounts
F. What is needed now?



Why land accounting?

Land is fundamental to economic production (all of it takes place in place)

A major proportion of most nations' total assets

Agriculture and forestry both require large areas of land

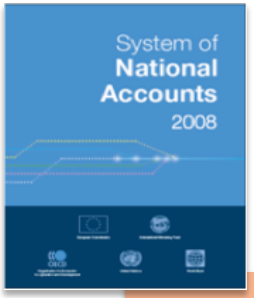
The starting point for most assessments of ecosystem services and using land effects the condition and capacity of ecosystems

Links economic and environmental data (the bridge between SEEA Central Framework to the SEEA Ecosystem Accounting)

Questions

REFRESHER

SNA and SEEA

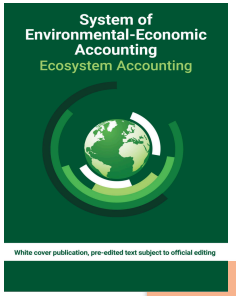


System of National Accounts

- Monetary measures
- Asset and production boundaries set by economics
- Production defined as being capable of being sold in markets
- Assets defined as being owned and capable of being used for economic gain

SEEA Central Framework

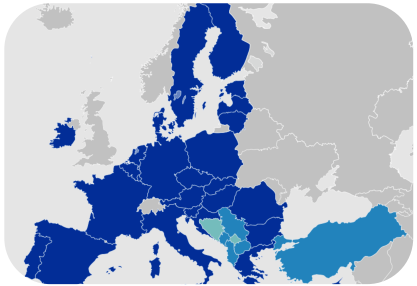
- Physical quantity measures added to monetary measures
- Asset boundary expanded
- Assets no longer have to be owned or capable of being used for economic gain



SEEA Ecosystems

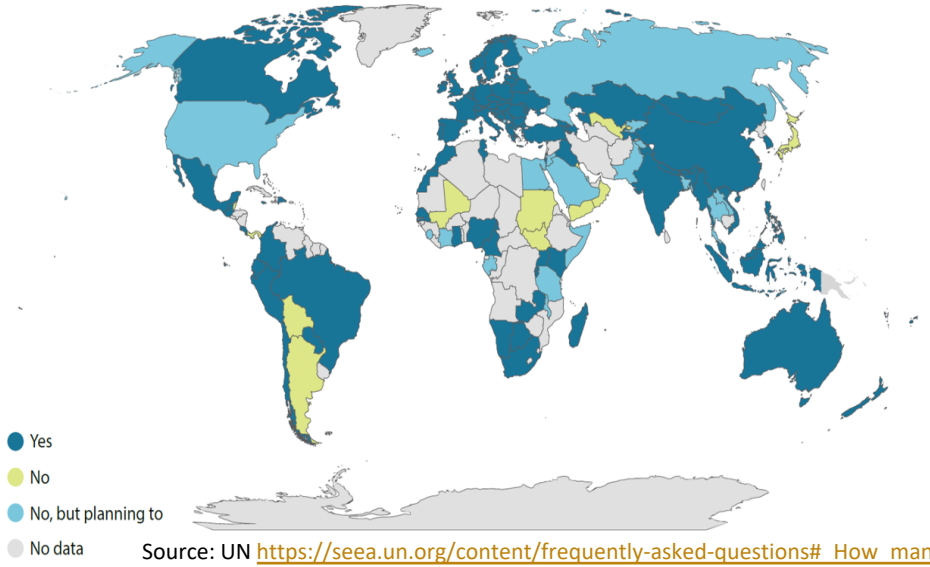
- Physical quality (or condition) measures added
- Production boundary extended
- Production from ecosystems recognized and does not need to be sold in markets

SEEA implementation



Accounts mandated in EU

More than 90 countries have compiled SEEA accounts



Source: UN https://seea.un.org/content/frequently-asked-questions#_How_many_countries

SEEA

"The adoption of this economic and environmental framework is a historic step towards transforming the way we view and value nature. … We must reflect nature's true value in all our policies, plans and economic systems. The rewards will be immense."

UN Secretary General, António Guterres (March 2021)

Three pairs of concepts for natural capital accounting

- Stocks are measured at a point in time (e.g. 1 January)
- Flows are measured as a rate (e.g. megalitres per annum, dollars per year)

- Physical measures like kilograms, hectares, litres, parts per million, etc.
- Monetary measures like $, €, ¥, £, etc.

- Benefits may be in SNA (e.g. in GDP) or non-SNA (e.g. not in GDP), monetized or not
- Beneficiaries are people of groupings of people (e.g. farmers, government, miners)

The fried egg view of transactions

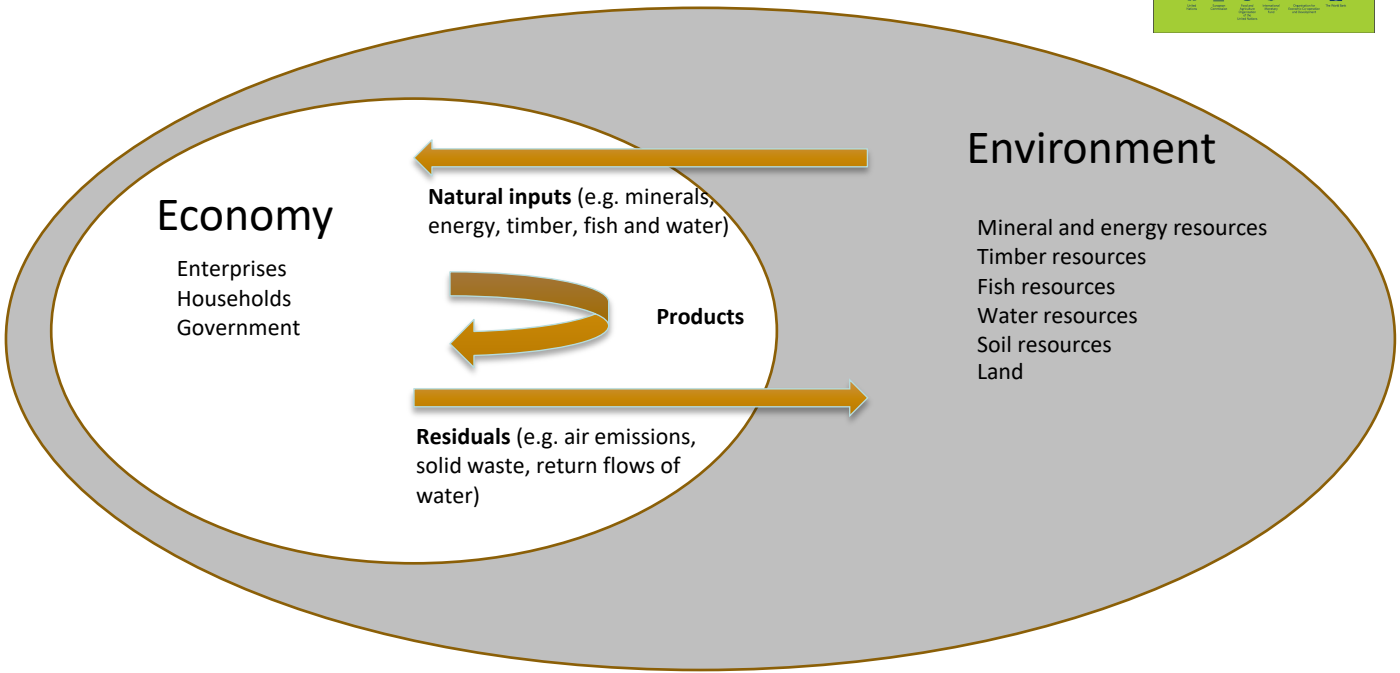
The environment as a party in transaction

Transactions between the environment and economy

- Natural resources
- Residuals

Flows within the economy

- Products (goods and services) for final and intermediate consumption



Source: UN SEEA Central Framework

The “economy”

Economic activities

- Production, Consumption, Accumulation

Economic products

- Goods and services

Economic assets

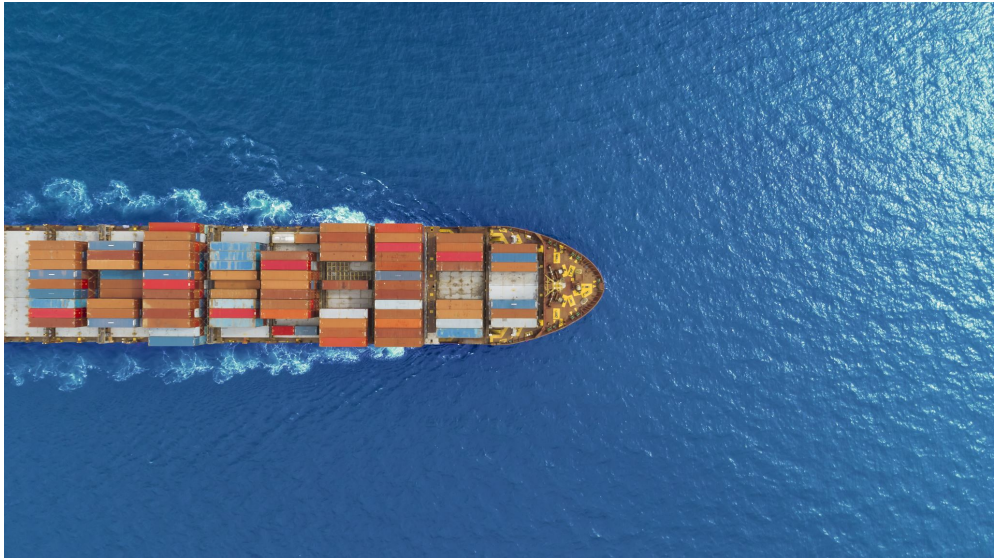
- Produced, Non-produced, Financial assets

Economic units

- Enterprises, establishments

Economic territory

- Residence, geographic coverage

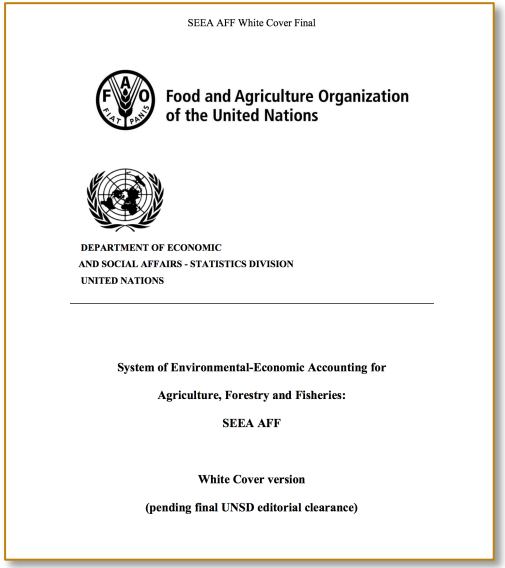


Questions

BASIC CONCEPTS

Land accounts are part of a system: Links to other accounts of SEEA and SNA are what make it different

- SEEA Agricultural, Forestry and Fisheries
- SEEA Ecosystems Accounting
- Energy accounting
- Water accounting
- National Balance Sheet
- Provides the spatial dimension


SEEA AFF White Cover Final

Food and Agriculture Organization of the United Nations

DEPARTMENT OF ECONOMIC
AND SOCIAL AFFAIRS - STATISTICS DIVISION
UNITED NATIONS

System of Environmental-Economic Accounting for
Agriculture, Forestry and Fisheries:
SEEA AFF

White Cover version
(pending final UNSD editorial clearance)

https://seea.un.org/sites/seea.un.org/files/seea_aff_final_clean_03.pdf

Definition of land

- Land is a unique environmental asset that delineates the space in which economic activities and environmental processes take place and within which environmental assets and economic assets are located (SEEA Central Framework, para. 5.239)
- Water surface, both freshwater and seas or oceans, is also included
  - the concept is really surface area
- Includes urban land

Classifications used in land accounting

Industry

- International Standard Industry Classification (ISIC)

Institutional sector

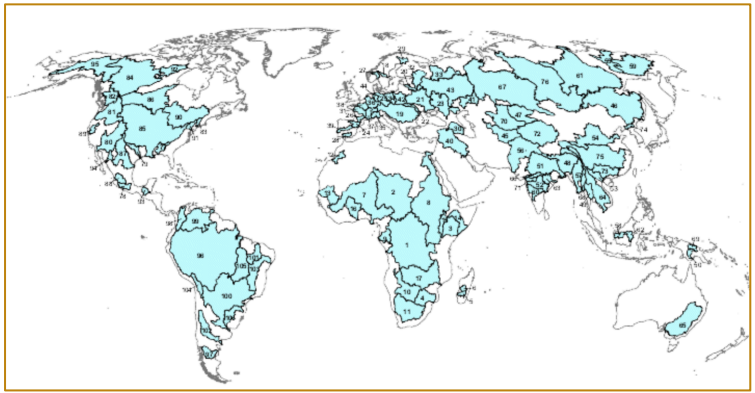
- Corporations (financial and non-financial), government, not-for-profit, households

Boundaries

- Geographic (e.g., river basins)
- Administrative (e.g., states and provinces)

Land cover

Land use



Source: World Resources Institute- Watersheds of the world
http://earthtrends.wri.org/maps_spatial/maps_detail_static.cfm?map_select=274&theme=2

Definition and classification land cover

Definition

- Land cover refers to the observed physical and biological cover of the Earth's surface and includes natural vegetation and abiotic (non-living) surfaces (SEEA Central Framework, para. 5.257)

Classification

- Land Cover Classification System, version 3 (LCCS 3), FAO 2009

Table 5.12
Land cover classification

	Category
1	Artificial surfaces (including urban and associated areas)
2	Herbaceous crops
3	Woody crops
4	Multiple or layered crops
5	Grassland
6	Tree-covered areas
7	Mangroves
8	Shrub-covered areas
9	Shrubs and/or herbaceous vegetation, aquatic or regularly flooded
10	Sparsely natural vegetated areas
11	Terrestrial barren land
12	Permanent snow and glaciers
13	Inland water bodies
14	Coastal water bodies and intertidal areas

Source SEEA Central Framework

Definition and classification of land use

Definition

- Land use reflects both (a) the activities undertaken and (b) the institutional arrangements put in place for a given area for the purposes of economic production, or the maintenance and restoration of environmental functions (SEEA Central Framework, para. 5.246)

Can also use industry (i.e., ISIC) as the land user

- Using industry means link is directly to national accounts and other environmental accounts that use industry

Table 5.11
Land use classification

1	**Land**
1.1	Agriculture
1.2	Forestry
1.3	Land used for aquaculture
1.4	Use of built-up and related areas
1.5	Land used for maintenance and restoration of environmental functions
1.6	Other uses of land n.e.c.
1.7	Land not in use
2	**Inland waters**
2.1	Inland waters used for aquaculture or holding facilities
2.2	Inland waters used for maintenance and restoration of environmental functions
2.3	Other uses of inland waters n.e.c.
2.4	Inland waters not in use

Source SEEA Central Framework

Raster and cadastre (vector) – two views of the world

Raster – environmental

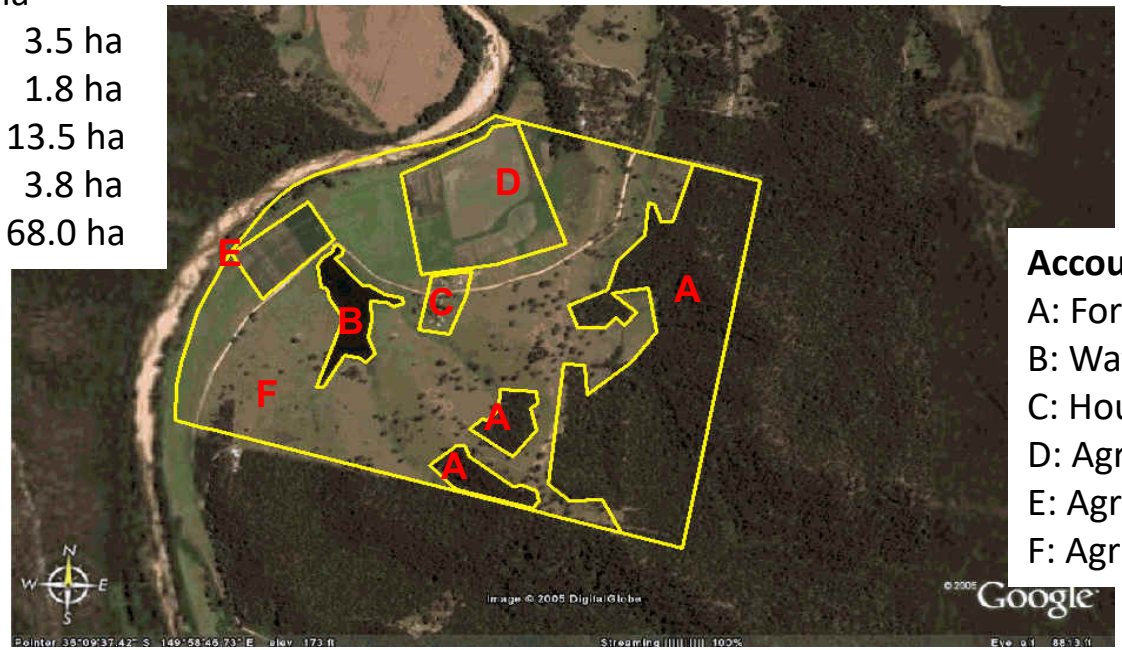
Cadaster (vector) – economic ownership and management

Accounting for land cover and land use in a land parcel (an property under single ownership)_

Accounting for land cover

A: Forest	39.0 ha
B: Water	3.5 ha
C: Residence	1.8 ha
D: Irrigated crop	13.5 ha
E: Other crop	3.8 ha
F: Grassland	68.0 ha

Total area 129.5 ha



Accounting for land use

A: Forestry ?	39.0 ha
B: Water storage	3.5 ha
C: Household	1.8 ha
D: Agriculture	13.5 ha
E: Agriculture	3.8 ha
F: Agriculture	68.0 ha

Questions

LAND ACCOUNTS

SEEA land accounting tables

1. Physical account for land (Table 5.13)
2. Land cover change matrix (5.14)

   Note: The structure of the land cover change matrix has the opening and closing stocks in the columns. This presentation changed by many to show the opening and closing stocks in rows
3. Physical asset account for forest and other wooded land (Table 5.15)
4. Monetary asset account for land (Table 5.16)

SEEA Central Framework: Physical account for land cover (hectares)

Attribution of change

	Artificial surfaces	Crops	Grassland	Tree-covered area	Mangroves	Shrub-covered area	Regularly flooded areas	Sparse natural vegetated areas	Terrestrial barren land	Permanent snow, glaciers and inland water bodies	Coastal water and inter-tidal areas
Opening stock of resources	12 292.5	445 431.0	106 180.5	338 514.0	214.5	66 475.5	73.5	1 966.5		12 949.5	19 351.5
Additions to stock											
Managed expansion	183.0	9 357.0									
Natural expansion			64.5								1.5
Upward reappraisals			4.5								
Total additions to stock	183.0	9 357.0	69.0								1.5
Reductions in stock											
Managed regression		147.0	4 704.0	3 118.5	9.0	1 560.0	1.5				
Natural regression					1.5	64.5					
Downward reappraisals						4.5					
Total reductions in stock		147.0	4 704.0	3 118.5	10.5	1 629.0	1.5				
Closing stock	12 475.5	454 641.0	101 545.5	335 395.5	204.0	64 846.5	72.0	1 966.5		12 949.5	19 353.0

Note: Crops include herbaceous crops, woody crops, and multiple or layered crops.

Source SEEA Central Framework, Table 5.13

SEEA Central Framework:
Land cover change matrix (hectares)

Matrix helps with the attribution of change

Some easy

- Trees to crops by humans (managed)

Some harder

- Trees to shrubs?

Land cover	Opening area	Increases (positive numbers) and decreases (negative numbers) from other land covers											Net change (increase-decrease)	Closing area
		Artificial surfaces	Crops	Grassland	Tree-covered area	Mangroves	Shrub-covered area	Regularly flooded areas	Sparse natural vegetated areas	Terrestrial barren land	Permanent snow, glaciers and inland water bodies	Coastal water and intertidal areas		
Artificial surfaces	12 292.5		147.0	27.0		9.0							183.0	12 475.5
Crops	445 431.0	-147.0		4 677.0	3 118.5		1 560.0	1.5					9 210.0	454 641.0
Grassland	106 180.5	- 27.0	- 4 677.0				69.0						- 4 635.0	101 545.5
Tree-covered area	338 514.0		- 3 118.5										- 3 118.5	335 395.5
Mangroves	214.5	-9.0										-1.5	-10.5	204.0
Shrub-covered area	66 475.5		-1 560.0	-69.0									-1 629.0	64 846.5
Regularly flooded areas	73.5		-1.5										-1.5	72.0
Sparse natural vegetated areas	1 966.5													1 966.5
Terrestrial barren land														
Permanent snow, glaciers and inland water bodies	12 949.5													12 949.5
Coastal water and intertidal areas	19 351.5					1.5							1.5	19 353.0

Counterpart entries

Note: Including herbaceous crops, woody crops and multiple or layered crops.

Source SEEA Central Framework, Table 5.14

SEEA Central Framework: Physical account for forest and other wooded land (hectares)

Possible to have separate accounts

- Specific land covers (E.g. Forests)
- Specific areas (e.g., protected areas)

	Type of forest and other wooded land				
	Primary forest	Other naturally regenerated forest	Planted forest	Other wooded land	Total
Opening stock of forest and other wooded land	20	100	150	130	400
Additions to stock					
Afforestation		2	5		7
Natural expansion		3			3
Total additions to stock		5	5		10
Reductions in stock					
Deforestation	2	10		5	17
Natural regression				3	3
Total reductions in stock	2	10	0	8	20
Closing stock of forest and other wooded land	18	95	155	122	390

Source SEEA Central Framework, Table 5.15

SEEA Central Framework: Monetary account for land (currency units)

Data from sales or land tax

	Type of land use								
	Agriculture	Forestry	Land used for aquaculture	Use of built-up and related areas	Land used for maintenance and restoration of environmental functions	Other uses of land n.e.c.	Land not in use	Inland water	Total
Opening value of stock of land	420 000	187 500		386 000	2 000				995 500
Additions to stock									
Acquisitions of land	3 500								3 500
Reclassifications		200		2 500					2 700
Total additions to stock	3 500	200		2 500					6 200
Reductions in stock									
Disposals of land		3 500							3 500
Reclassifications		1 250			200				1 450
Total reductions in stock		4 750			200				4 950
Revaluations	18 250	15 350		65 000					98 600
Closing value of stock of land	441 750	198 300		453 500	1 800				1 095 350

Changes in price per ha

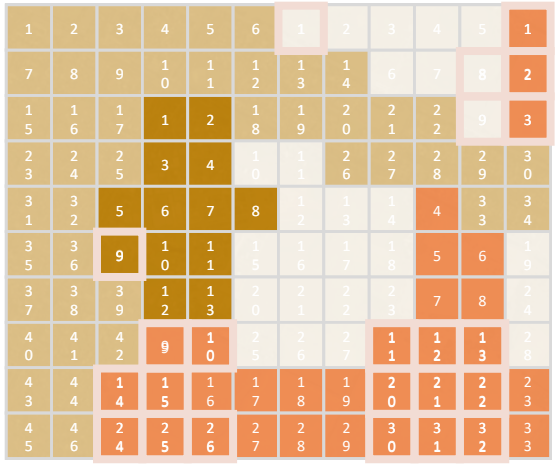
Value = price x volume

Source SEEA Central Framework, Table 5.16

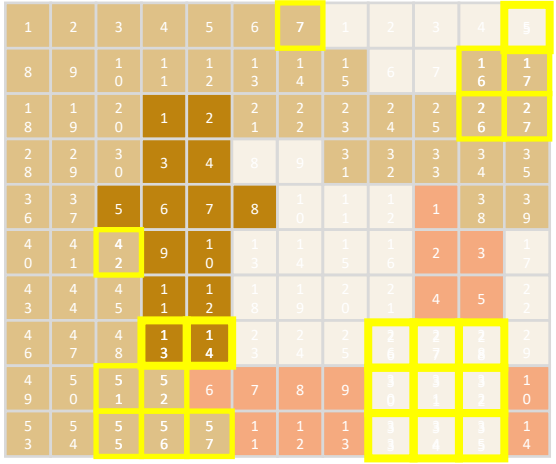
Simplified physical Account for land use (area hectares)

	Residential	Industry	Agriculture	Vacant Land	Total
Opening stock	46	13	28	33	120
Additions to stock	11	2	10	0	23
Reductions to stock	-0	-1	-3	-19	-23
Closing stock	57	14	35	14	120

Land use 2006



Land use 2016

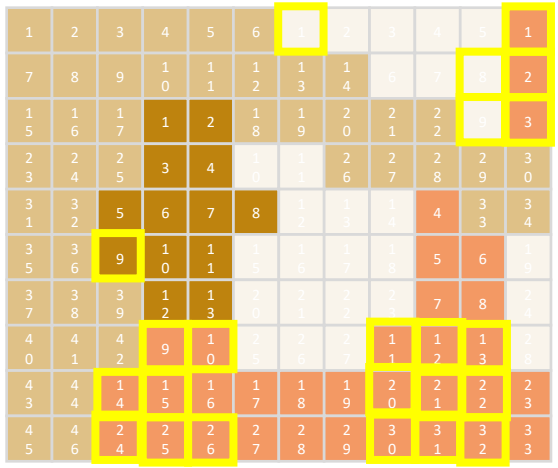


Legend Residential Industry Agriculture Vacant Land

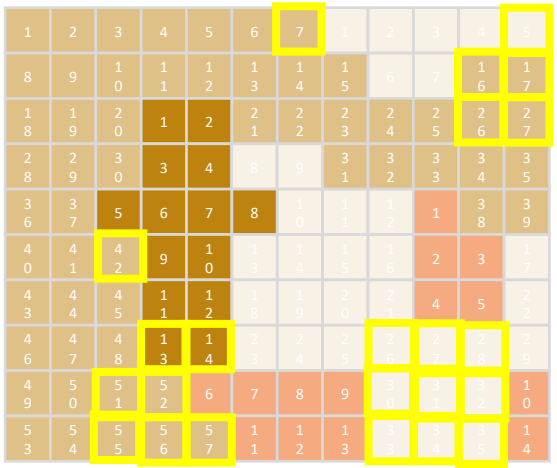
Net change matrix for land use (area hectares)

	Residential	Industry	Agriculture	Vacant Land
Opening stock	46	13	28	33
Residential	0	-1	-3	-7
Industry	1	0	0	-2
Agriculture	3	0	0	-10
Vacant Land	7	2	10	0
Total Net Change	11	1	7	-19
Closing stock	57	14	35	14

Land use 2006



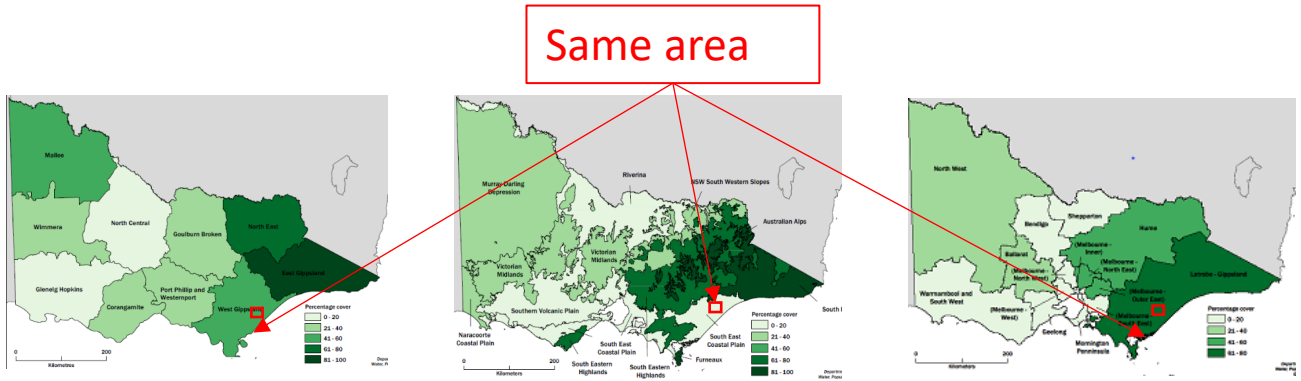
Land use 2016



Legend Residential Industry Agriculture Vacant Land

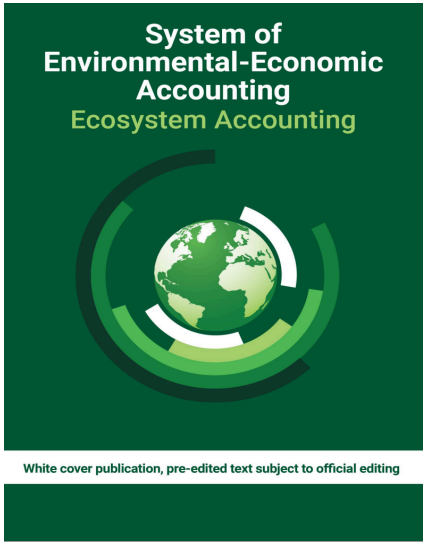
Area of aggregation is important

- Same BSUs aggregated in different ways give different results
- Known as the Modifiable Areal Unit Problem
- Example from Land Accounts, Victoria, Australia, percentage of native vegetation remaining



Source: Australian Bureau of Statisitcs http://www.abs.gov.au/ausstats/abs@.nsf/Products/4609.0.55.002~2012~Main+Features~Maps?OpenDocument

Basis for ecosystem accounts



Questions

DATA SOURCES AND METHODS

Data sources

Administrative sources

- Land titles agency
- Protected area database

Agricultural survey/census

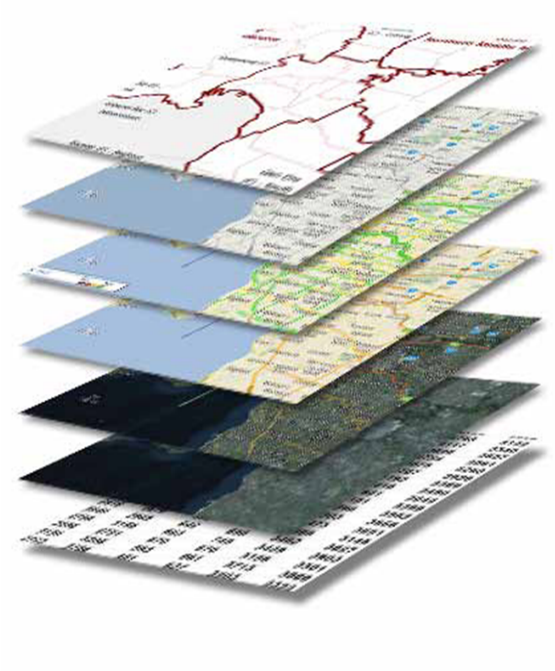
- Area of crops and grazing land

Remote sensing

- Area of forest, grassland, urban areas, etc.

Geographic information systems (GIS)

- Overlaying and integration of data



Issues with data

Different reference periods (years) for data sources (e.g. calendar years versus financial years)

Multiple classifications used

Spatial resolutions

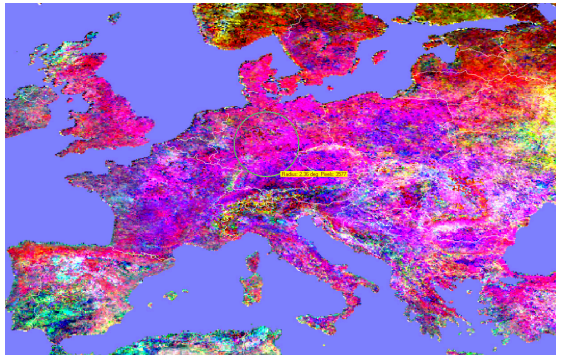
Linking economic units to cadastral parcels

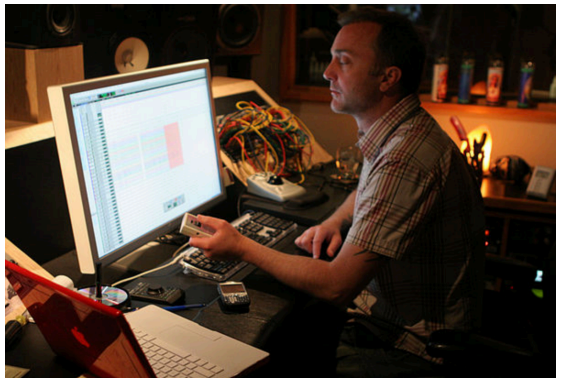
- One to many (big business with much land) and many to one relationships (multiple business on one land parcel)
- Data inaccuracy – e.g. cadastral boundaries shift over time

Multiple land uses allocated to the same property

What you need for land accounting

- Coordination between government agencies
- Expertise in geographic information systems (GIS)
- Environmental, economic and social data and expertise
- People need to understand each other





Questions

EXAMPLE LAND ACCOUNTS

Applications

Natural resource industries

- Agriculture
- Forestry
- Fishing
- Water supply
- “tourism”

Macroeconomic planning

- Development Plans
- Green economy

Environmental issues

- Climate Change
  - Adaptation
  - Mitigation
- Biodiversity loss
  - Protected area management
  - Endangered species management

Security

- Water
- Food (land degradation)
- Energy

Examples of land accounts

Europe

- Netherlands
- UK

Africa

- South Africa
- Uganda

North and South America

- Costa Rica
- Guatemala (in Spanish)
- USA

Australasia

- India
- Indonesia
- Australia


Office for National Statistics

17 March 2015

UK Natural Capital – Land Cover in the UK

Author Name(s): Vahé Nafilyan; Office for National Statistics

Abstract

In this paper ONS develops Land Cover ecosystem accounts for the United Kingdom (UK). The initial land cover accounts based on data from the Countryside Survey show that the land cover changed significantly in the UK between 1998 and 2007. The cultivated land area decreased by over 550 thousand hectares, while the corresponding increase in the area of pasture and semi-natural grassland was about 295 and 155 thousand hectares respectively. The area of broadleaved, mixed and yew woodland increased by approximately 84 thousand hectares. Land Cover in England shows similar patterns of change as in the UK as a whole, while changes were less pronounced in Scotland and Wales. Changes in land cover in Northern Ireland displayed slightly different patterns.

Acknowledgements

1. I would like to thank Lisa Horton from the Centre for Ecology and Hydrology (CEH) and Claire McGinn and Mark Wright from the Northern Ireland Department of the Environment for providing ONS with the data from the Countryside Survey and the Northern Ireland Countryside Survey and Fiona Bloor (UK Hydrographic Office) for providing data on the area of territorial waters and Exclusive Economic Zone. This study benefitted greatly from the comments from Rocky Harris and Colin Smith (DEFRA). Peter Henryks (CSIH), Geoff Bright, Faizan Din, Glenn Everett, Jawed Khan and Helen Loft (ONS). I am sincerely grateful to Catherine Healey (ONS) for her earlier in-house work on land cover.

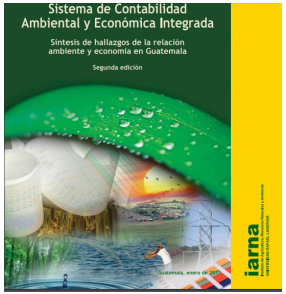
Introduction

In December 2012 ONS published a roadmap, "Accounting for the value of nature in the UK (786.5 Kb PdF)", to include the natural capital within the UK Environmental Accounts. The roadmap set out a timetable to develop land use and land cover accounts. In June 2013 ONS published experimental land use accounts for the UK (827.8 Kb Pdf). However, since both land use and land cover are important in understanding the changes in the ecosystems and ecosystem services, the roadmap planned to develop land cover accounts in addition to land use accounts.

The purpose of this study is twofold. First, ONS's aim is to develop land cover accounts in accordance with the System of Environmental-Economic Accounting-Experimental Ecosystem Accounting" (SEEA-EEA) framework. This will be primarily used for international comparison purposes. Second, ONS aims to produce land cover accounts based on the UK National Ecosystem

http://webarchive.nationalarchives.gov.uk/20160105173306/http://www.ons.gov.uk/ons/rel/environmental/uk-natural-capital/land-cover-in-the-uk/art---uk-natural-capital----land-cover-in-the-uk.html

http://www.eea.europa.eu/data-and-maps/data/data-viewers/land-accounts



https://www.url.edu.gt/publicacionesurl/pPublicacion.aspx?pb=763

Australia

- Australian Capital Territory

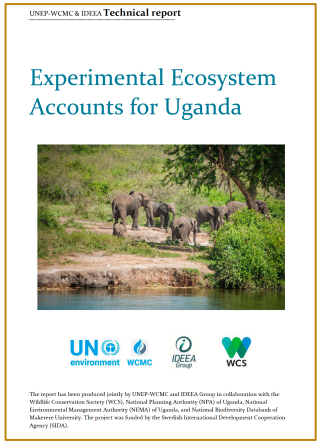
http://www.environmentcommissioner.act.gov.au/publications/environmental-economic-accounts

Land accounts in Uganda: National

Part of an ecosystem accounting project

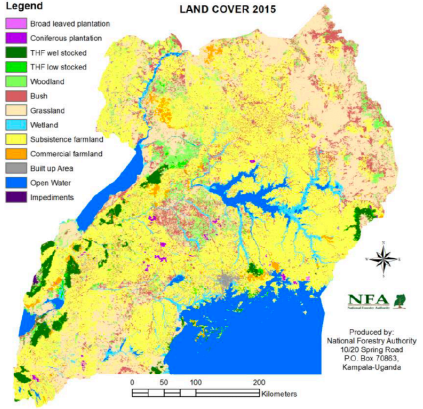
Land cover account Uganda 1990 to 2015 (Table 7)

Land Cover	1990	2005	2010	2015
Broad leaved plantations	18,736	14,740	18,779	43,900
Built up area	36,553	97,266	100,056	134,884
Bush	1,417,678	2,965,292	2,365,727	1,877,278
Commercial Farmland	68,456	106,494	137,363	259,102
Coniferous plantation	16,244	18,661	39,032	55,428
Grassland	5,109,964	4,057,838	5,000,112	5,126,140
Impediments	3,750	7,817	12,964	14,626
Open Water	3,663,772	3,680,264	3,709,407	3,665,445
Small scale farm land	8,396,117	8,841,450	9,723,790	10,461,271
Tropical high forest low stock	272,835	191,678	114,872	143,448
Tropical high forest well stocked	650,679	600,161	551,220	516,129
Wetland	483,561	752,140	762,570	755,958
Woodland	3,970,470	2,774,971	1,586,190	1,078,131
Other	36,583	36,626	23,316	13,658
Grand Total	24,145,398	24,145,398	24,145,398	24,145,398



https://www.unep-wcmc.org/resources-and-data/experimental-ecosystem-accounts-for-uganda

Land cover in Uganda 2015



Land accounts in South Africa: Provincial

- Part of an ecosystem accounting project

Ecosystem extent account in Kwazulu-Natal, Table B

Hectares	Grassland	Savanna	Indian Ocean Coastal Belt	Wetland	Forest
Opening balance 1840	4 581 933	3 259 059	893 967	393 718	202 822
Total reductions in stock	1 651 736	840 380	528 754	107 567	18 208
Total reductions as a % of 1840	36	26	59	27	9
Opening balance 2005	2 930 197	2 418 679	365 213	286 151	184 614
Total reductions in stock	277 108	208 607	59 723	18 276	9 792
Total reductions as a % of 1840	6	6	7	5	5
Opening balance 2008	2 653 090	2 210 072	305 490	267 875	174 822
Total reductions in stock	68 092	34 757	11 782	9 082	3 128
Total reductions as a % of 1840	1	1	1	2	2
Opening balance 2011	2 584 998	2 175 315	293 708	258 793	171 694

http://www.statssa.gov.za/wp-content/uploads/2016/08/Land-and-Ecosystem-Accounting-in-KZN-Discussion-Document-FINAL.pdf

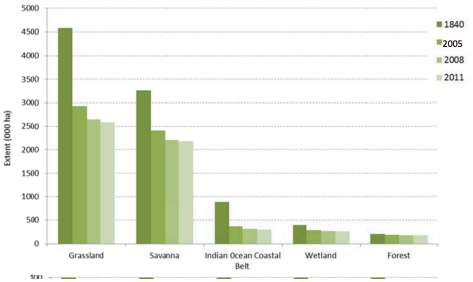


Fig. A

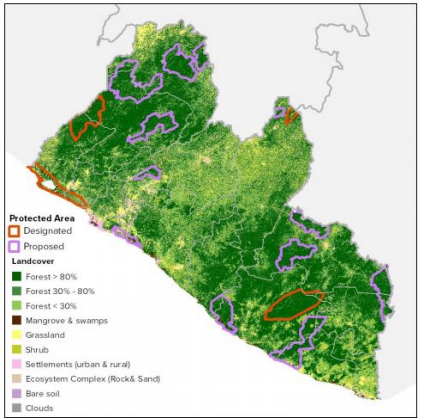
Land accounts in Liberia: Protected areas

Area in different landcover types, and within designated and proposed protected areas

Landcover	Area (ha)	Percent	Area in Designated PAs (ha)	Percent in Designated PAs	Area in Proposed PAs (ha)	Percent in Proposed PAs	Area in Designated & Proposed PAs (ha)	Percent in Designated & Proposed PAs
Forest >80%	4,364,751	45.37%	246,190	5.6%	648,289	14.9%	894,479	20.5%
Forest 30-80%	2,167,707	22.53%	59,081	2.7%	139,961	6.5%	199,042	9.2%
Forest <30%	1,523,056	15.83%	8,538	0.6%	64,380	4.2%	72,918	4.8%
Mangrove	37,142	0.39%	8,268	22.3%	8,656	23.3%	16,924	45.6%
Settlements	44,604	0.46%	254	0.6%	211	0.5%	466	1.0%
Water	60,529	0.63%	15,591	25.8%	4,749	7.8%	20,340	33.6%
Grassland	626,038	6.51%	16,484	2.6%	19,551	3.1%	36,035	5.8%
Shrub	606,919	6.31%	5,666	0.9%	13,936	2.3%	19,601	3.2%
Bare soil	173,917	1.81%	1,738	1.0%	3,831	2.2%	5,568	3.2%
Ecosystem complex (rock and sand)	2,252	0.02%	446	19.8%	386	17.1%	832	36.9%
(Clouds)	14,391	0.15%	0	0.0%	5,553	38.6%	5,553	38.6%
TOTAL	**9,621,306**	**100%**	**362,256**	**3.8%**	**909,503**	**9.5%**	**1,271,759**	**13.2%**

https://static1.squarespace.com/static/52026c1ee4b0ee324ff265f3/t/59770fa303596e3d20385100/1500975073796/Mapping+Natural+Capital+Liberia+8May2017.pdf

Map of Land cover, designated protected areas, and proposed protected areas



Questions

USES OF LAND ACCOUNTS

Uses of land accounting

Informing debates on:

Population settlement

Agricultural productivity

Health of the environment

Costs and benefits of economic activities

Investment environmental protection, e.g. biodiversity conservation

Disaster management and planning

LESSONS AND WHAT NEXT

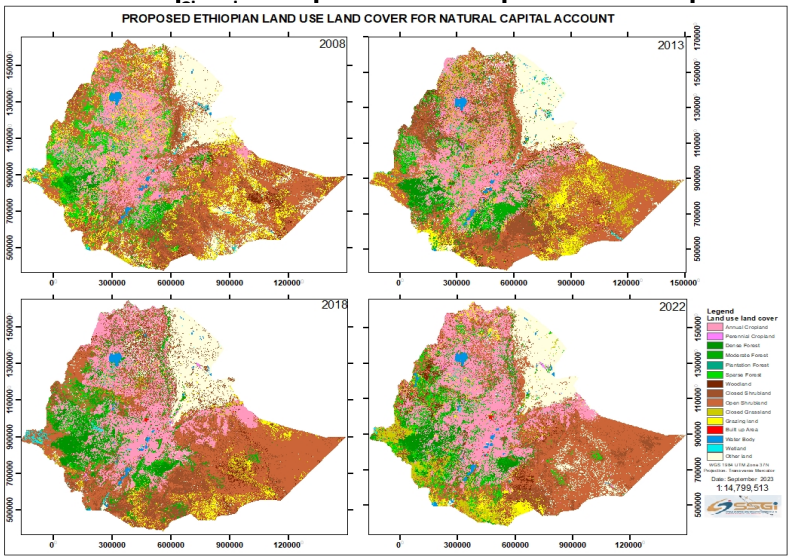
Lesson learnt

- Many data sources – Takes time to locate and understand
- Conflicting data sources - For land use and land cover
- Need to attribute change as well as detect change (managed and unmanaged)
  - Change matrix helps
- Data Quality – Variable between datasets, particularly for measuring change
- Consistency – Remain comparable to national economic and other environmental accounts
- Cooperation, cooperation, cooperation!

What next for land accounts

- Finalize land classification
- Relate land classification to other classifications
- Finalize land accounts and change matrices
  - National, regions and cities
- Indicators (e.g., landscape stability).
- Description of data sources and methods
- Data quality assessment
- Report structure
- Task list and responsibilities
  - Agencies and people
- Timeline

LAND USE LAND COVER AREA IN SQUARE KILOMETER				
Area_Cover	2008	2013	2018	2022
Dense Forest	36412.2522	64619.0838	50047.2927	41006.1881
Moderate Forest	21164.5944	26973.1476	56992.815	61277.2756
Sparse Forest	80240.0553	47919.897	46288.0044	54021.6193
Woodland	14554.4211	23899.86	17640.9405	19398.0003
Closed Grassland	11328.7311	71154.1251	12905.6508	52329.9522
Grazing land	111645.8577	62820.8118	31090.4442	31754.0366
			19.9015	105775.4886
			83.6406	337001.7188
			69.9246	3292.9916
			36.4896	278891.4326
			40.3261	2895.5026
			57.2787	10771.9108
			21.9283	3042.6639
			30.4705	130538.2153
			99.8484	1237.194
			324.956	1133234.19



Questions

THANK YOU

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