System of Environmental Economic Accounting

Land Accounts

March 2018

United Nations

Land accounts

- Land cover
- Land use
- Land value
- Relationship to ecosystem accounting

Definition and scope

- Definition: 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.

- Scope: land area of a country including inland waters, coastal water bodies and intertidal areas.

Classifications

- Land cover, land use and land ownership

Land cover classification (SEEA-CF, Table 5.12, p.178)

1 Artificial surfaces (incl. urban and assoc. 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 herb. veg., aquatic or reg. 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

Land use classification (SEEA-CF, Table 5.11, p. 176)

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
2.1 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

Land ownership: by industry (e.g. agriculture, mining) or by sector (e.g. public or private)

Physical account for land cover (*hectares*)

	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.

Land cover change matrix (*hectares*)

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

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

Table 5.16
Monetary asset account for land *(currency units)*

	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

Issues with valuation

- Market values
- Based on recent transactions
- Composite asset
  - Soil resources
  - Buildings and structures
  - Land improvement
  - Etc…
- Changes in quality
  - Catastrophic events (floods)

Policy relevance

- Land cover
  - Agreement on what exists on surface of country
  - How and where this is changing (e.g., forests to crop?)
  - Alignment of economic, environmental and social policies (e.g., where could timber harvesting have less impact?)
  - Forest as a % of national territory
- Land use
  - Agreement on designated use (e.g., what activities are allowed and not allowed?)
- Monetary asset account for land
  - Is land being properly valued?
  - Contribution to national wealth (increasing or decreasing?)

Data Sources

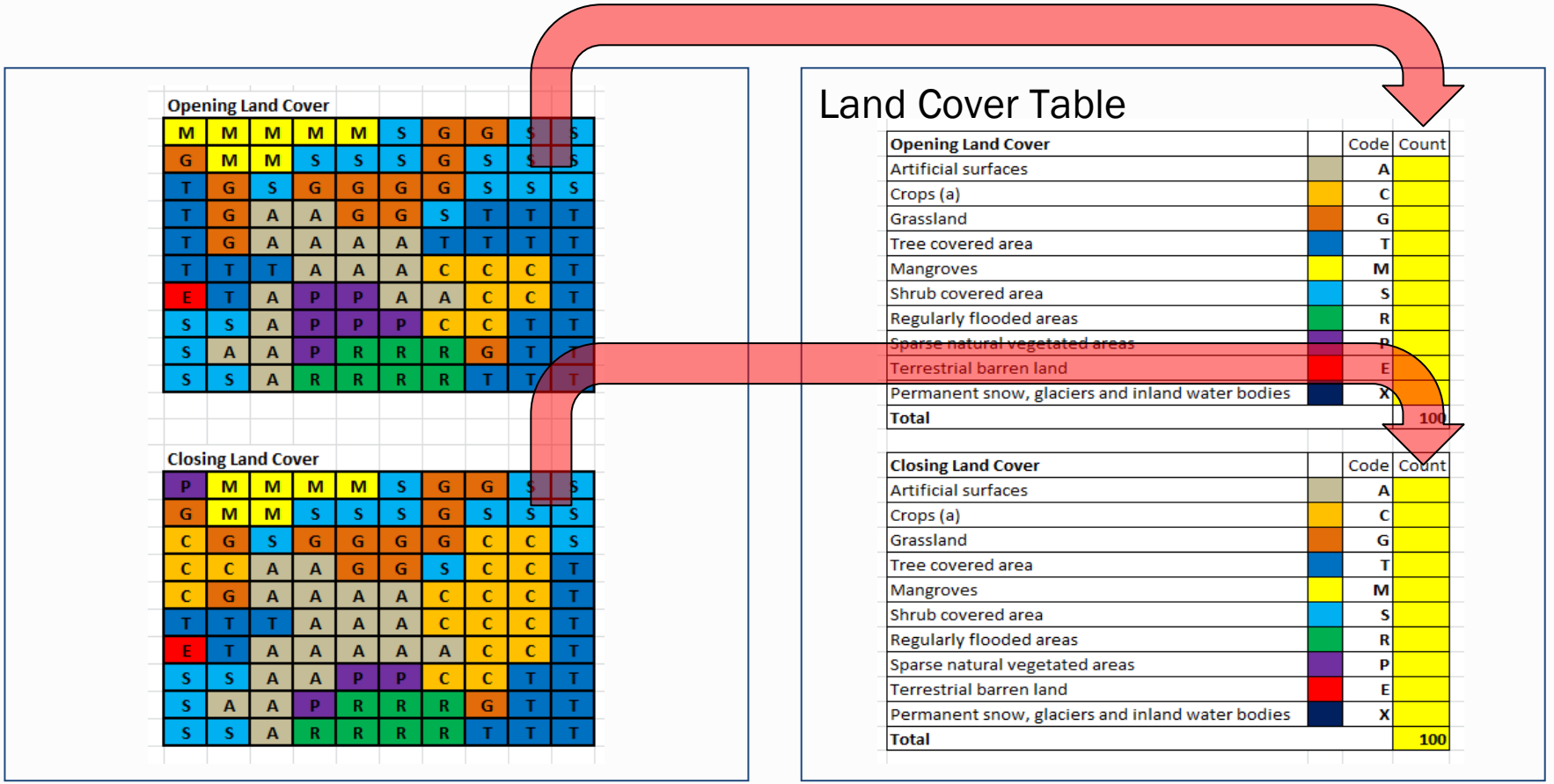
- Administrative sources – cadaster maintained by a land registry office, tax authorities, or land information center
- Collection sources – population and housing census, Agriculture survey and census, business survey, other type of survey and census data, and other governmental organizations information on land
- Satellite images sources – Images of Earth collected by satellites

A somewhat simple exercise

- Compilation Group Exercise (30m)
  - Situation:
    - Land cover units defined for two periods (Opening and Closing)
    - Need to calculate:
      - Land Cover Opening and Closing stocks,
      - Land Cover Change per class (with additions and reductions)
      - Physical Account for Land Cover
  - Objective (Groups of 3-5):
    1. Transfer Land Cover from map to table
    2. Calculate Land Cover Change Matrix
    3. Calculate Physical Account for Land Cover
    4. Report and discuss results

A somewhat simple exercise

Group Exercise: Step 1 – Calculate Land Cover



A somewhat simple exercise

Group Exercise: Step 2 – Calculate Land Cover Change

Land Cover Table

Opening Land Cover		Code	Count
Artificial surfaces		A	
Crops (a)		C	
Grassland		G	
Tree covered area		T	
Mangroves		M	
Shrub covered area		S	
Regularly flooded areas		R	
Sparse natural vegetated areas		P	
Terrestrial barren land		E	
Permanent snow, glaciers and inland water bodies		X	
Total			**100**

Closing Land Cover		Code	Count
Artificial surfaces		A	
Crops (a)		C	
Grassland		G	
Tree covered area		T	
Mangroves		M	
Shrub covered area		S	
Regularly flooded areas		R	
Sparse natural vegetated areas		P	
Terrestrial barren land		E	
Permanent snow, glaciers and inland water bodies		X	
Total			**100**

Land Cover Change Matrix

Table 1: Net Land Cover Change Matrix (hectares)

		Closing Land Cover										
		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	**Opening**
Opening Land Cover	Code	**A**	**C**	**G**	**T**	**M**	**S**	**R**	**P**	**E**	**X**	
Artificial surfaces	**A**											
Crops	**C**											
Grassland	**G**											
Tree covered area	**T**											
Mangroves	**M**											
Shrub covered area	**S**											
Regularly flooded areas	**R**											
Sparse natural vegetated areas	**P**											
Terrestrial barren land	**E**											
Permanent snow, glaciers and inland water bodies	**X**											
Closing												

Note: Rows represent reductions in stock; columns represent deletions in stock

Record “No change” in diagonal
Rows = No change + Reductions
Columns = No change + Additions

A somewhat simple exercise

Group Exercise: Step 23– Calculate Physical Land Cover

Land Cover Change Matrix

Table 1: Net Land Cover Change Matrix (hectares)

		Closing Land Cover										
		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	Opening
Opening Land Cover	Code	A	C	G	T	M	S	R	P	E	X	
Artificial surfaces	A											
Crops	C											
Grassland	G											
Tree covered area	T											
Mangroves	M											
Shrub covered area	S											
Regularly flooded areas	R											
Sparse natural vegetated areas	P											
Terrestrial barren land	E											
Permanent snow, glaciers and inland water bodies	X											
Closing												

Note: Rows represent reductions in stock; columns represent deletions in stock

Additions to (A) Artificial surfaces

Physical Land Cover Account

Table 2.: Physical Account for Land Cover

	Artificial surfaces	Crops	Grassland	Tree-covered areas	Mangroves	Shrub-covered areas	Regularly flooded areas	Sparsely natural vegetated areas	Terrestrial barren land	Permanent snow and glaciers and inland water bodies	TOTAL
Opening extent											
Additions to extent											
Reductions in extent											
Closing extent											

Additions = Column total – no change

Reductions = Row total – no change

A somewhat simple exercise

- Is everyone clear on the objectives?
- 30 minutes group work
- Please ask questions!
- Results:
  - Each group report:
    - Additions to extent
    - Reductions in extent
    - What were the largest sources of change?

Table 2.: Physical Account for Land Cover

	Artificial surfaces	Crops	Grassland	Tree-covered areas	Mangroves	Shrub-covered areas	Regularly flooded areas	Sparsely natural vegetated areas	Terrestrial barren land	Permanent snow and glaciers and inland water bodies	TOTAL
Opening extent											
Additions to extent											
Reductions in extent											
Closing extent											

A somewhat simple exercise

- **Answers**

  - **Land Cover Change Matrix**
    - Rows add to Opening
    - Columns add to Closing

  - **Physical Account for Land Cover**
    - Additions to Stock = 3, 11, 0, 0, 0, 0, 0, 1, 0, 0
    - Reductions in Stock = 0, 0, 1, 8, 1, 2, 0, 3, 0, 0

Table 1: Net Land Cover Change Matrix (hectares)

		Closing Land Cover										
		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	Opening
Opening Land Cover	Code	A	C	G	T	M	S	R	P	E	X	
Artificial surfaces	A	16	0	0	0	0	0	0	0	0	0	16
Crops	C	0	7	0	0	0	0	0	0	0	0	7
Grassland	G	0	1	13	0	0	0	0	0	0	0	14
Tree covered area	T	0	8	0	15	0	0	0	0	0	0	23
Mangroves	M	0	0	0	0	6	0	0	1	0	0	7
Shrub covered area	S	0	2	0	0	0	17	0	0	0	0	19
Regularly flooded areas	R	0	0	0	0	0	0	7	0	0	0	7
Sparse natural vegetated areas	P	3	0	0	0	0	0	0	3	0	0	6
Terrestrial barren land	E	0	0	0	0	0	0	0	0	1	0	1
Permanent snow, glaciers and inland water bodies	X	0	0	0	0	0	0	0	0	0	0	0
Closing		19	18	13	15	6	17	7	4	1	0	100

Note: Rows represent reductions in stock; columns represent deletions in stock

Table 2.: Physical Account for Land Cover

	Artificial surfaces	Crops	Grassland	Tree-covered areas	Mangroves	Shrub-covered areas	Regularly flooded areas	Sparsely natural vegetated areas	Terrestrial barren land	Permanent snow and glaciers and inland water bodies	TOTAL
Opening extent	16	7	14	23	7	19	7	6	1	0	100
Additions to extent	3	11	0	0	0	0	0	1	0	0	15
Reductions in extent	0	0	1	8	1	2	0	3	0	0	15
Closing extent	19	18	13	15	6	17	7	4	1	0	100

Note: Reductions are sum of row, excluding areas that remained the same.

SEEA

An extension

Using land accounts to inform carbon accounts

- Increasing atmospheric carbon is causing climate change:
  - Increasing temperatures, changes in rainfall, sea level rise
- Information on carbon stocks and flows supports (among others):
  - Assessing the impact of changes in land cover and land use on carbon stocks and carbon sequestration
- Carbon-related ecosystem services
  - ***Storage*** = stored in soil, water and biomass
  - ***Sequestration*** = removal from the atmosphere

Compilation group exercise (30 min)

- Situation:
  - Have land cover account
  - Need to calculate: carbon stock and carbon sequestration
- Objective (in groups of 3-5):
  1. Calculate a simplified carbon stock account
  2. Calculate account for ecosystem services from carbon sequestration
  3. Report and discuss results

Group exercise: step 1

Step 1 – Calculate carbon stock account

Land cover account

Carbon stock account

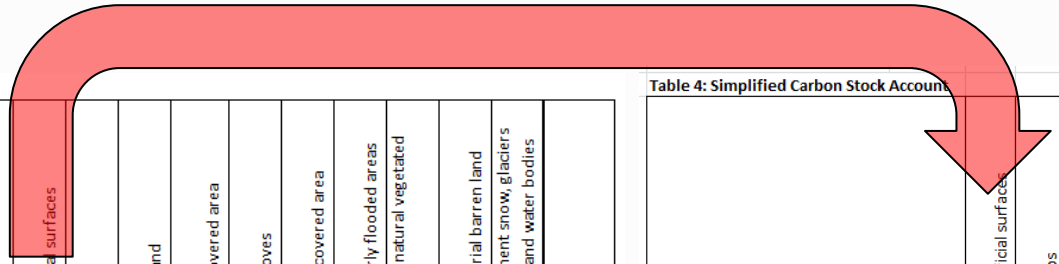


Table 1: Physical Account for Land Cover

	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	**Total**
Opening Stock	16	7	14	23	7	19	7	6	1	0	100
Additions to Stock	3	11	0	0	0	0	0	1	0	0	15
Reductions in Stock	0	0	1	8	1	2	0	3	0	0	15
Closing Stock	19	18	13	15	6	17	7	4	1	0	100

Table 4: Simplified Carbon Stock Account

	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	Total
Carbon Stored (tonnes/ha)	5	40	10	200	800	80	300	8	0	0	
Carbon Stock											
Opening											
Increases											
Decreases											
Net change											
Closing											

Note: Opening is Opening Land area * Carbon Stored

Net change is Increases - Decreases

Multiply land cover area by carbon stored (lookup table)
e.g. opening 16ha artificial surface * 5 tonnes/ha = 80 tonnes
Net change = increases - decreases

Group exercise: step 2

Step 2 – Calculate carbon sequestration

Land cover account

Carbon sequestration service

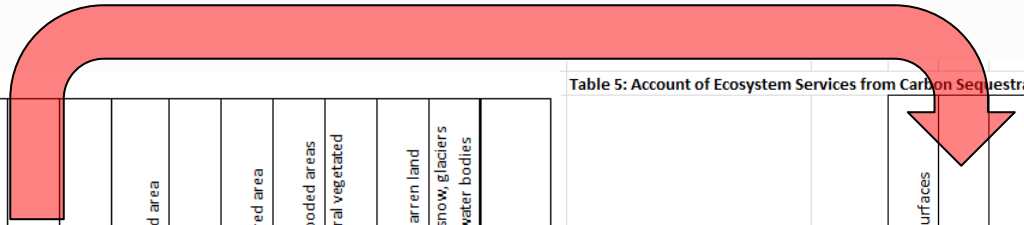


Table 1: Physical Account for Land Cover

	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	**Total**
Opening Stock	16	7	14	23	7	19	7	6	1	0	100
Additions to Stock	3	11	0	0	0	0	0	1	0	0	15
Reductions in Stock	0	0	1	8	1	2	0	3	0	0	15
Closing Stock	19	18	13	15	6	17	7	4	1	0	100

Table 5: Account of Ecosystem Services from Carbon Sequestration (tonnes/ha/year)

	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	Total
Carbon Sequestration (tonnes/ha/year)	0	20	2	30	100	5	40	1	0	0	
Carbon Sequestration (tonnes/year)											
Opening: Carbon Sequestration											
Closing: Carbon Sequestration											
Net change											

Note: Opening is Opening land area * Carbon Sequestration

Multiply land cover area by carbon sequestration (lookup table)
e.g. opening 7ha crops * 20 tonnes/ha/year = 140 tonnes/year
Net change = closing - opening

Group exercise: questions

- Is everyone clear on the objectives?
- 30 minutes group work
- Please ask questions!
- Questions:
  - Each group report:
    - Net change in storage
    - Net change in sequestration
    - What was the main source of change?

Table 4: Simplified Carbon Stock Account

	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	Total
Carbon Stored (tonnes/ha)	5	40	10	200	800	80	300	8	0	0	
Carbon Stock											
Opening											
Increases											
Decreases											
Net change											
Closing											

Note: Opening is Opening Land area * Carbon Stored
Net change is Increases - Decreases

Table 5: Account of Ecosystem Services from Carbon Sequestration (tonnes/ha/year)

	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	Total
Carbon Sequestration (tonnes/ha/year)	0	20	2	30	100	5	40	1	0	0	
Carbon Sequestration (tonnes/year)											
Opening: Carbon Sequestration											
Closing: Carbon Sequestration											
Net change											

Note: Opening is Opening land area * Carbon Sequestration

Group exercise: results

Simplified carbon stock account

- Net change in storage = -2,131

Main source of change = loss of tree covered areas

Table 2: Simplified Carbon Stock Account

	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	**Total**
Carbon Stored (tonnes/ha)	5	40	10	200	800	80	300	8	0	0	
Carbon Stock (tonnes)											
Opening	**80**	**280**	**140**	**4,600**	**5,600**	**1,520**	**2,100**	**48**	**0**	**0**	**14,368**
Increases	15	440	0	0	0	0	0	8	0	0	463
Decreases	0	0	10	1,600	800	160	0	24	0	0	2,594
Net change	*15*	*440*	*-10*	*-1,600*	*-800*	*-160*	*0*	*-16*	*0*	*0*	*-2,131*
Closing	**95**	**720**	**130**	**3,000**	**4,800**	**1,360**	**2,100**	**32**	**0**	**0**	**12,237**

Carbon sequestration

- Net change in sequestration = -131

Table 3: Account of Ecosystem Services from Carbon Sequestration (tonnes/year)

	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	**Total**
Carbon Sequestration (tonnes/ha/year)	1	20	2	30	100	5	40	1	0	0	
Carbon Sequestration (tonnes/year)											
Opening: Carbon Sequestration	16	140	28	690	700	95	280	6	0	0	1,955
Closing: Carbon Sequestration	19	360	26	450	600	85	280	4	0	0	1,824
Net change	*3*	*220*	*-2*	*-240*	*-100*	*-10*	*0*	*-2*	*0*	*0*	*-131*

SEEA

THANK YOU

seea@un.org