Introduction to Forest Accounting

National Workshop on Shared Environmental Information Systems (SEIS) and Environmental Statistics for the Sustainable Development Goals (SDGs)

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FORESTS

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Agenda

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1. What is an asset account?
2. Asset accounts for land (land use and land cover)
3. Forest Accounts
4. Timber Account
5. Exercise
6. Introduction to monetary asset accounts

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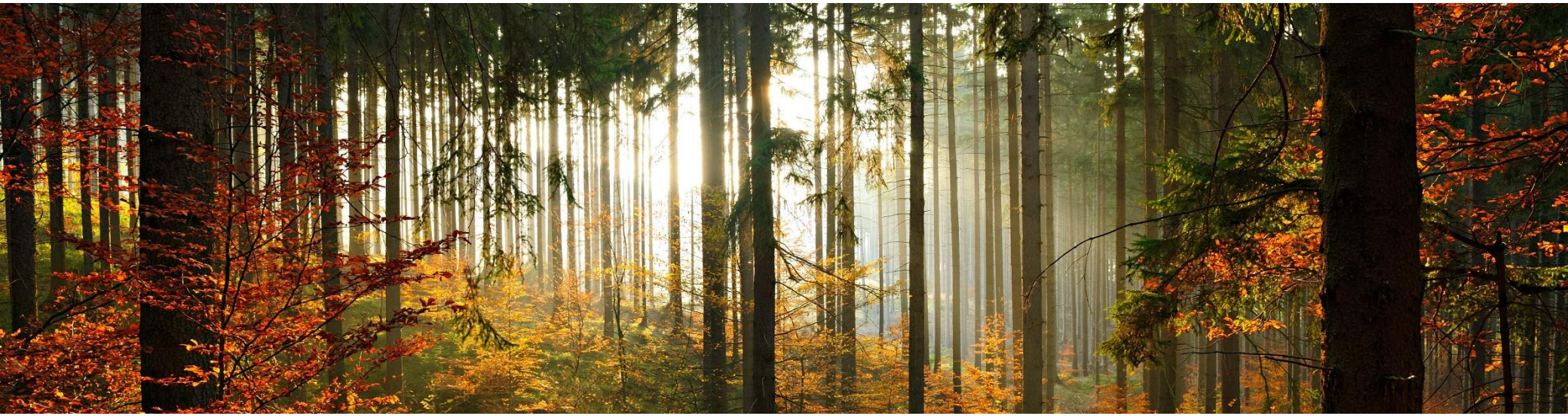
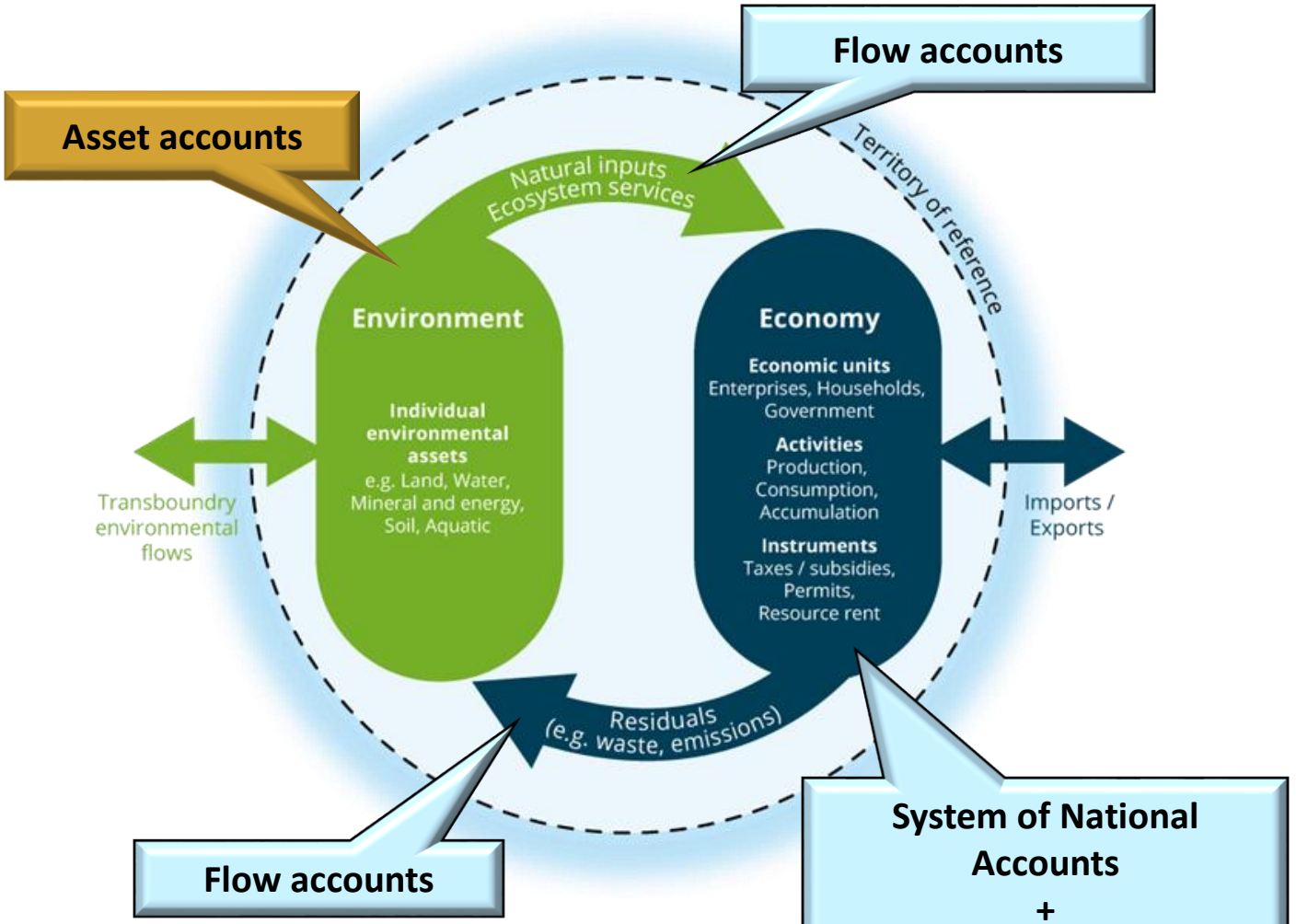
1 What is an asset account?



Where does it fit in?



What is an environmental asset?

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"Environmental assets are the naturally occurring living and non-living components of the Earth, together comprising the bio-physical environment, that may provide benefits to humanity."

SEEA Central Framework

What is an environmental asset?

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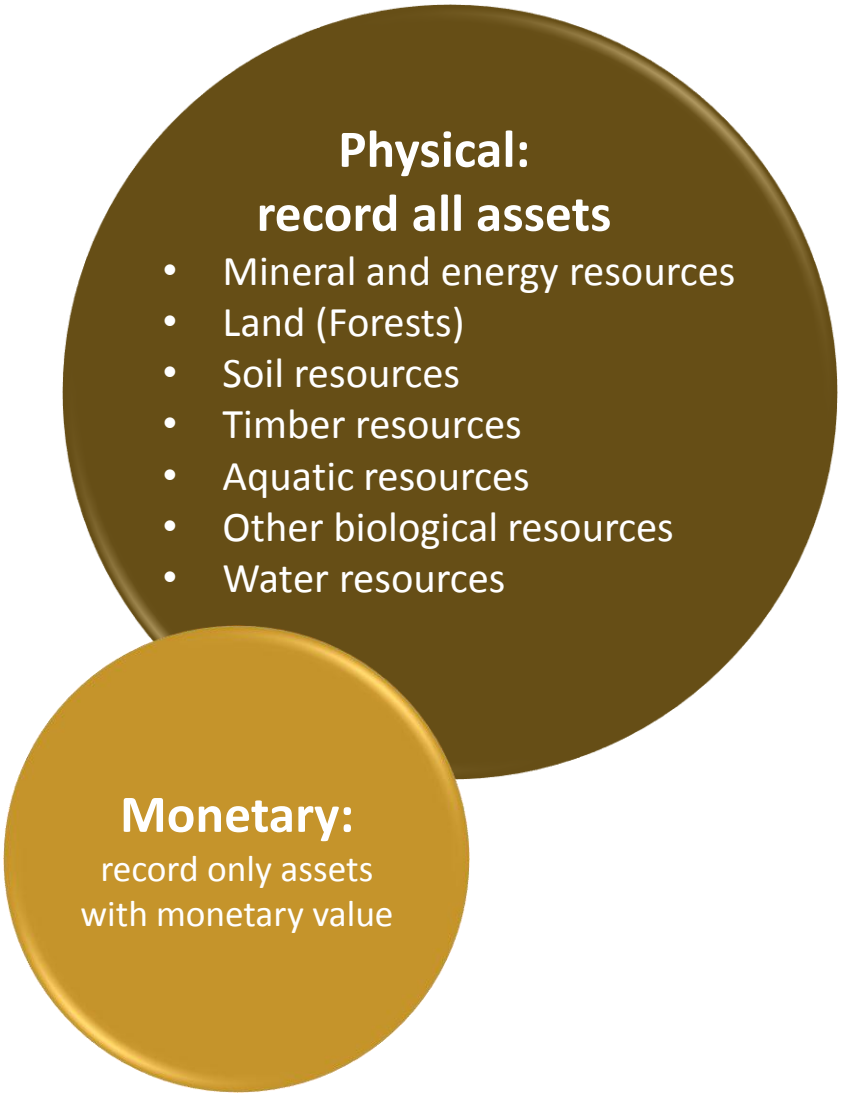
Assets

- Items of **value to the society**
- In economics: assets have long been defined as **stores of value** that also provide **inputs to production processes**
- motivation for considering **environmental assets**:
  - concern that current patterns of economic activity are **depleting and degrading** them more quickly than those assets can be regenerated
  - concern about their **long-term availability**
  - Current generations may be seen as "stewards" for the range of environmental assets on behalf of future generations → **sustainable use of resources**

What is included?

Scope

- components that **make up the environment** and may **provide resources** for use in economic activity
- Resources may be **harvested, extracted or otherwise moved** for direct use in economic **production, consumption or accumulation**



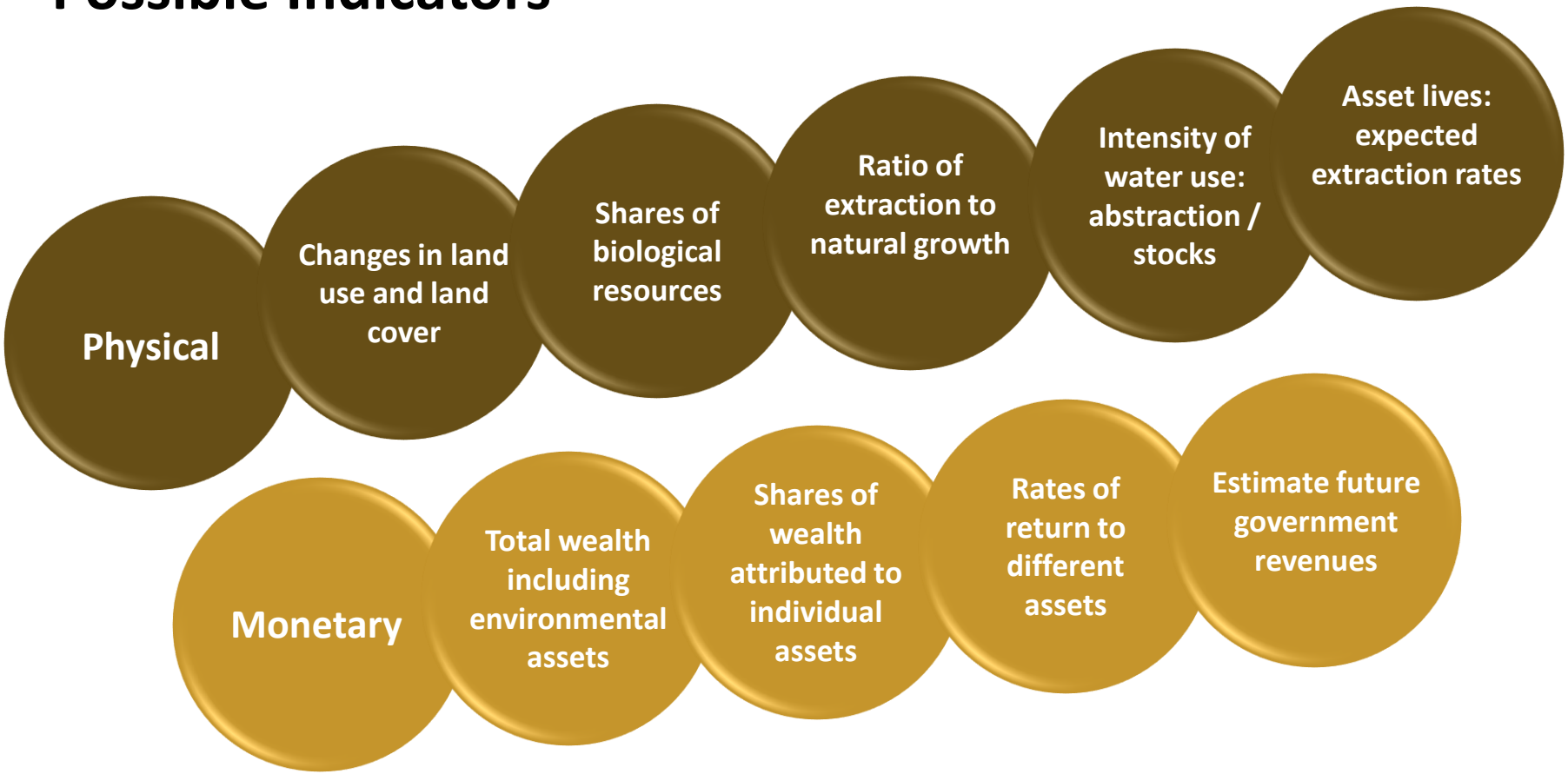
What is included?

Classification of environmental assets in the SEEA Central Framework

1	**Mineral and energy resources**
1.1	Oil resources
1.2	Natural gas resources
1.3	Coal and peat resources
1.4	Non-metallic mineral resources (excluding coal and peat resources)
1.5	Metallic mineral resources
2	**Land**
3	**Soil resources**
4	**Timber resources**
4.1	Cultivated timber resources
4.2	Natural timber resources
5	**Aquatic resources**
5.1	Cultivated aquatic resources
5.2	Natural aquatic resources
6	**Other biological resources** (excluding timber resources and aquatic resources)
7	**Water resources**
7.1	Surface water
7.2	Groundwater
7.3	Soil water

What can be derived?

Possible Indicators



What is the basic structure?

Assets accounts record:

- The opening stock
- The closing stock
- The changes over the accounting period

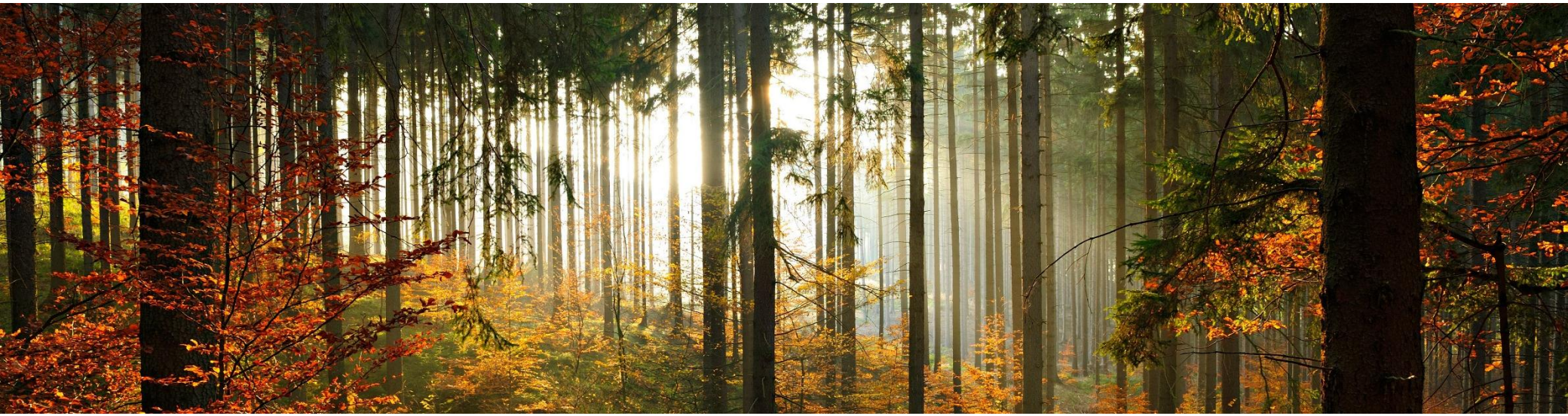
Physical Asset Accounts

Aggregation is **NOT** possible

Monetary Asset Accounts

Aggregation **IS** possible

2 Asset accounts for land (land use and land cover)



Land as an asset

"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

Why, what and how?

Physical asset accounts for land

- **Objective**: describe the area of land and changes in the area of land over an accounting period
- Measurement units: **hectares and square meters**
- Different types of physical asset accounts for land:

(by industry or institutional sector)

Land use?

Land use

- Reflects both:
  - **undertaken activities**
  - the **institutional arrangements** put in place for a given area for the purposes of economic production, or the maintenance and restoration of environmental functions
- Includes **both**:
  - Land in use
  - Land not in use
- Multiple uses? → **principle of primary or dominant use** should be employed

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

Land cover?

Land cover

- Refers to the observed **physical and biological cover** of the Earth's surface
- Includes **natural vegetation and abiotic** (non-living) **surfaces**
- Includes only land and inland waters, excludes coastal waters
- Uses the Land Cover Classification System (LCCS) developed by FAO

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

Changes in stock for land cover?

Possible changes to stock in the land cover account

Managed expansion	Increase in the area of a land cover type due to human activity
Natural expansion	Increase in area resulting from natural processes
Managed regression	Decrease in the area of a land cover type due to human activity.
Natural regression	Decrease in area resulting from natural processes
Reappraisals (upward or downward)	Changes due to the use of updated information that permits a reassessment of the size of the area of different land covers

What does it look like?

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Table 5.13
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.

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What does it look like?

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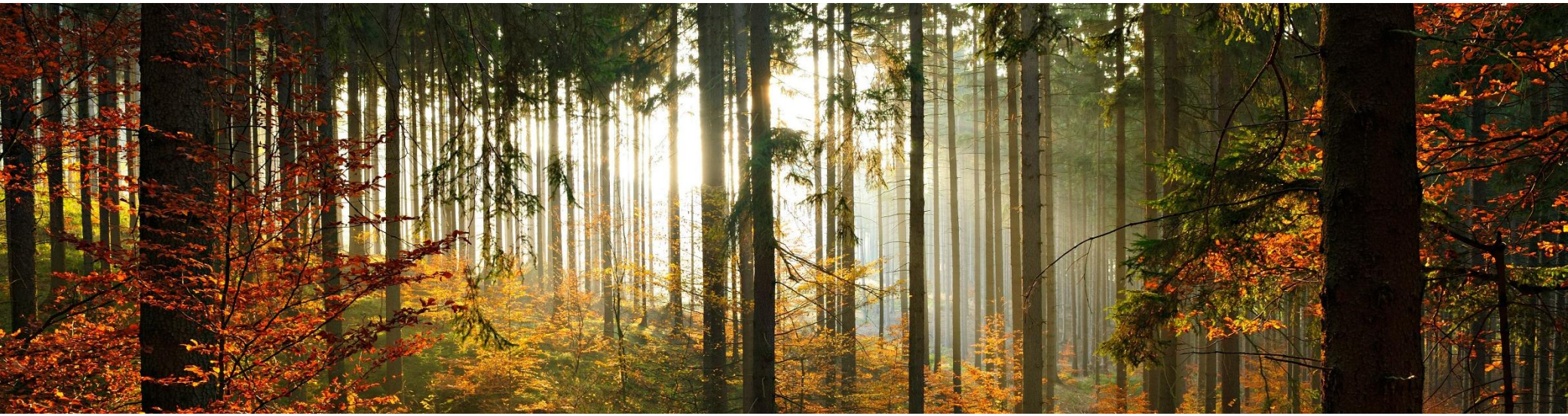
Table 5.14
Land cover change matrix (*hectares*)

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.

3 Forest Account



What is a forest account?

Physical asset account for forest and other wooded land

Is a specific version of the land account

Is often compiled in conjunction with the **asset account for timber resources**

Asset Account for **forest and other wooded land**

- **Area of land**
- Changes due to **deforestation and afforestation**
- Does not consider trees outside of forests

Asset account for **timber resources**

- **Volume**
- Changes due to **quantity and quality of timber removed**
- **NOT** limited to timber from forest and other wooded land

How are forests classified?

Basic distinction

- **Naturally regenerated forest**

"Naturally regenerated forest is forest that is predominantly composed of trees established through natural regeneration. In this context, "predominantly" means that the trees established through natural regeneration are expected to constitute more than 50 per cent of the growing stock at maturity"

- **Planted forest**

How are forests classified?

Primary forest

is **naturally regenerated** forest of native species where there are **no clearly visible indications of human activities** and the ecological processes are not significantly disturbed.

Other naturally regenerated forest

is forest with **more than 50 per cent naturally regenerated trees** or clearly visible indications of human activities or naturally regenerated trees of introduced species.

Planted forests

are **predominantly** composed of trees established through **planting** or deliberate seeding which constitute more than 50 per cent of the growing stock.

Other wooded land

spans more than 0.5 hectares with trees higher than 5 meters and a canopy cover of 5 – 10 per cent, or with a combined cover of shrubs, bushes and trees above 10 per cent.

Changes in stock?

Possible changes to stock in the forest account

Afforestation	Increase due to the establishment of new forest on land that was previously not classified as forest land
Natural expansion	Increase in area resulting from natural seeding, sprouting, suckering or layering
Deforestation	Decrease due to the complete loss of tree cover and transfer of forest land to other uses
Natural regression	Decrease in area for natural reasons

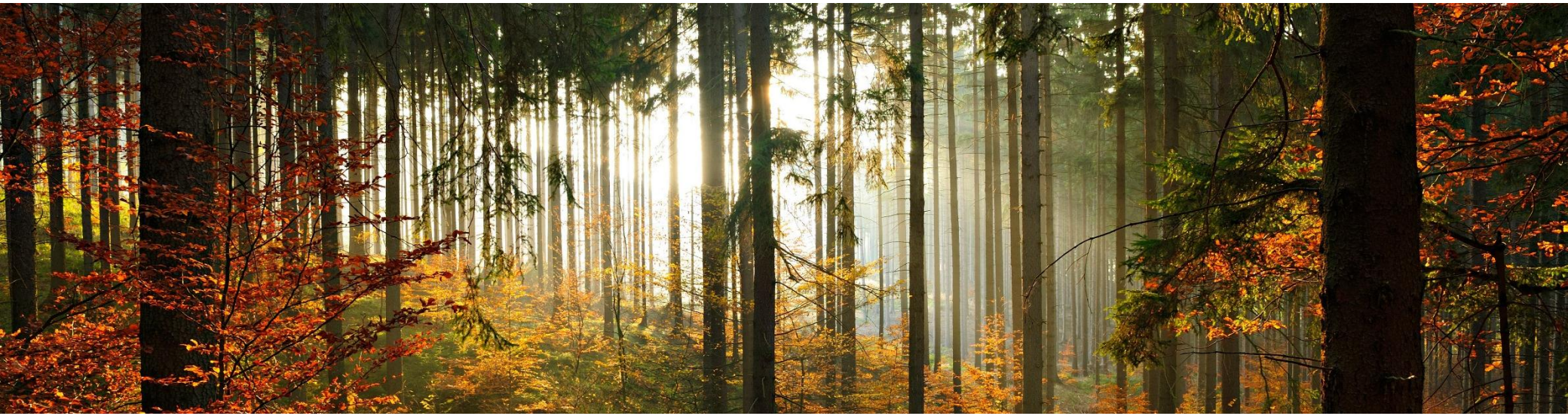
What does it look like?

Table 5.15

Physical asset account for forest and other wooded land (*hectares*)

	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

4 Timber Account



What are timber resources?

"Timber resources are defined by the volume of trees, living or dead, and include all trees regardless of diameter, tops of stems, large branches and dead trees lying on the ground that can still be used for timber or fuel."

SEEA Central Framework

What is included?

Basic principles

- Timber resources may or may not be available for felling (→ wood supply)
  - areas in which logging operations are restricted or prohibited
  - areas that are inaccessible or remote (not economically viable)
  - from a biological perspective, trees don't belong to a commercially useful species

Accounts in physical terms: **Included!**

Accounts in monetary terms: **Excluded!**

- The volume should be measured as the stem volume over bark at a minimum breast height from the ground level or stump height up to the top (principle: commercially usable)
- Cultivated vs. natural timber resources

Changes in stock?

Possible Additions to stock in the timber account

Natural growth	Is measured in terms of the **gross annual increment**
Reclassification	Increase in the **areas of land** that lead to increases in the volume of available timber resources

Changes in stock?

Possible Reductions to stock in the timber account

Removals	Volume of timber resources removed from forest land including removals of trees felled in earlier periods and trees killed or damaged by natural causes
Felling residues	Timber resources that are rotten, damaged or in excess in terms of size requirements
Natural losses	Due to mortality from causes other than felling (e.g. insect attack, fire etc. than are **reasonably expected**)
Catastrophic losses	Losses that are **exceptional and significant** losses due to natural causes (only if there is no possibility that the timber resource can be removed)
Reclassification	Decrease in the **areas of land** that lead to decreases in the volume of available timber resources

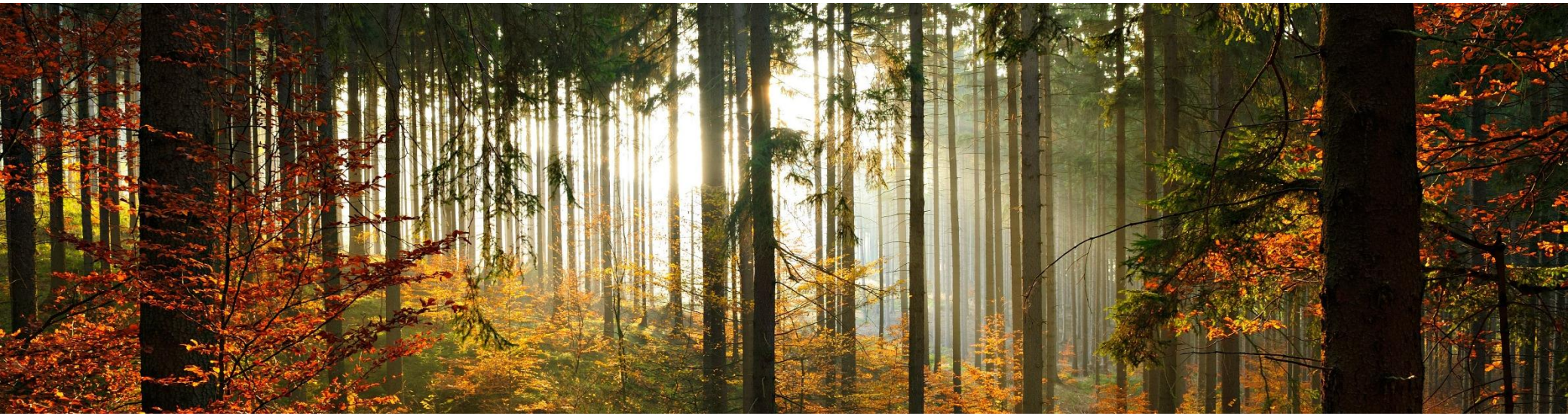
What does it look like?

Table 5.19
Physical asset account for timber resources (*thousands of cubic metres over bark*)

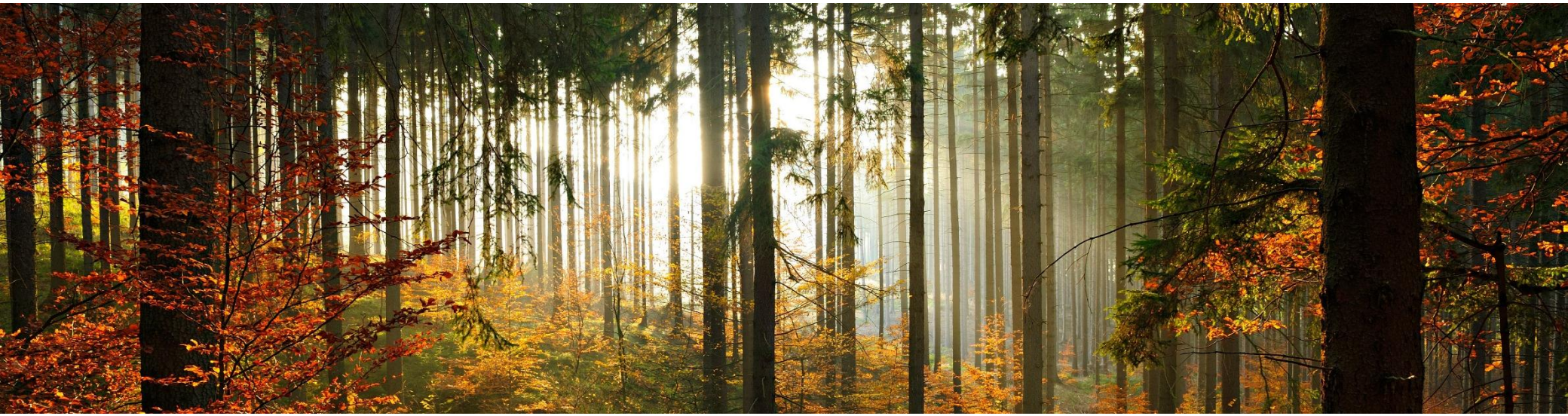
	Type of timber resource		
	Cultivated timber resources	Natural timber resources	
		Available for wood supply	Not available for wood supply
Opening stock of timber resources	8 400	8 000	1 600
Additions to stock			
Natural growth	1 200	1 100	20
Reclassifications	50	150	
Total additions to stock	1 250	1 250	20
Reductions in stock			
Removals	1 300	1 000	
Felling residues	170	120	
Natural losses	30	30	20
Catastrophic losses			
Reclassifications	150		150
Total reductions in stock	1 650	1 150	170
Closing stock of timber resources	8 000	8 100	1 450
Supplementary information			
Fellings	1 250	1 050	

- ✓ Distinction cultivated vs. natural
- ✓ Distinction available vs. not available

5 Exercise



6 Introduction to monetary asset accounts



What is a monetary asset account?

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The monetary account reflects a **valuation of the physical asset account**

- The definitions of the entries presented in the monetary accounts **align exactly** with the same entries as defined in physical terms
- For some assets, the **measurement scope** is **smaller** (e.g. timber resources not used for wood supply are excluded)
- The only additional entry: **revaluations**

Table 5.3
Conceptual form of the monetary asset account (*currency units*)

Opening stock of resources
Additions to stock of resources
Growth in stock
Discoveries of new stock
Upward reappraisals
Reclassifications
Total additions to stock
Reductions in stock of resources
Extractions
Normal loss of stock
Catastrophic losses
Downward reappraisals
Reclassifications
Total reductions in stock
Revaluation of the stock of resources
Closing stock of resources

Why do a monetary valuation?

Advantages of monetary asset valuation

- Different environmental assets can be compared
- environmental assets can be compared against other (economic) assets in order to assess relative returns, national wealth and similar types of analysis
- may provide useful information for assessing future streams of income for government

Many environmental assets are **not purchased in a market place**, the estimation of values requires the use of **assumptions and models**

How to estimate market prices?

When the items in question have not been purchased or sold on the market in the recent past, an estimation has to be made what the prices would be if a regular market existed.

Market price equivalents	Prices for similar products or assets
Written down replacement costs	Equal to the original purchase price adjusted for depreciation and the current replacement cost
Net present value (NPV)	Assesses the value of the future flow of benefits (income) from using or owning the asset

What is the NPV?

Principles of the NPV

- Typically, NPV projections are based on the **history of returns** earned from the use of the asset
- It is assumed that **returns earned in the current period are worth** more to the extractor than returns earned in the future
- Therefore **the stream of expected returns is discounted** to reflect the value that a buyer would be prepared to pay for the asset in the current period

What is the logic of the NPV?

1. Estimate past resource rent from sale of resources
2. Estimate the physical stock and remaining asset life assuming a rate of extraction
3. Estimate future annual flows of resource rent over the asset life
4. Discount each future annual estimate of resource rent
5. Sum the discounted estimates

How is the NPV calculated?

NPV formula

$$V_t = \sum_{\tau=1}^{N_t} \frac{RR_{t+\tau}}{(1+r_t)^{\tau}}$$

- V_t = value of the asset of time t
- N = asset life
- RR = resource rent
- r = nominal discount rent

Thank you!

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