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Forest Accounts

System of Environmental Economic Accounting

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Outline

- Why accounts?

1. Land Accounts
2. Forest Asset Accounts
3. Supply and Use Accounts

- Suggest policy applications as we discuss the accounts.

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Why accounts?

- Apply accounting principles (stocks/flows)
- Comprehensive view (all forests, all timber, all uses and users)
- SEEA uses same classifications as SNA to link to economic statistics
- Consistent units of measure (hectares, m^3, tonnes, currency)
- Consistent valuation methods
- Identify inconsistencies in data (coverage, errors, concepts)

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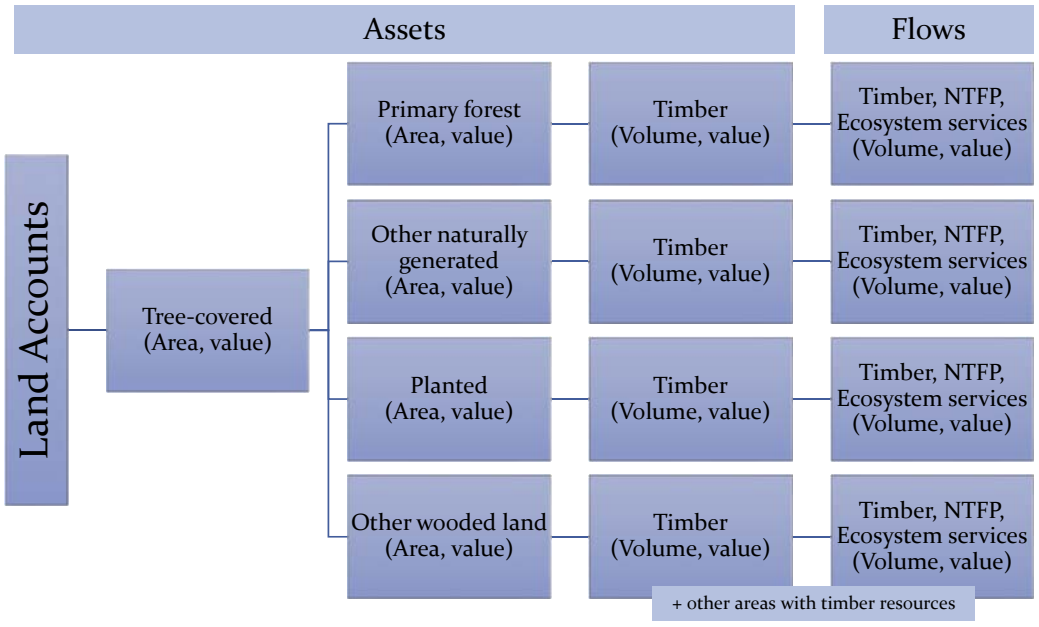
Forest accounts

- Subset of Land, Ecosystems, "Forestry"



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It's not all in one place!

TABLE 2: Coverage of accounting frameworks with respect to forests

Framework	Type of forest information								
	Flow of forest products		Timber resources		Economic activity connected to forestry	Forest-land	Forest condition	Forest ecosystem services	
	Physical	Monetary	Physical	Monetary				Physical	Monetary
SNA		✓		✓	✓				
SEEA CF			✓	✓	✓	✓			
SEEA AFF	✓	✓	✓	✓	✓	✓			
SEEA EEA						✓	✓	✓	✓

Source: World Bank. 2017. Forest Accounting Sourcebook.

SNA = System of National Accounts: records economic production, investment and wealth
SEEA-CF = System of Environmental-Economic Accounting: records assets and flows
SEEA-AFF = Agriculture, Forestry and Fisheries: Industry focus on assets and flows
SEEA-EEA = Experimental Ecosystem Accounting: records contribution of ecosystems

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Examples of forest-related SDG targets

- **6.6** By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
- **15.1** By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements
- **15.2** By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally
- **15.3** By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world
- **15.b** Mobilize significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation

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SEEA forest-related accounts

- SEEA Central Framework (SEEA-CF)
  1. Land accounts
     - 5.13 Land Cover: Tree-covered area (hectares)
     - Land Use: Land used for forestry (also other uses) (hectares)
     - 5.16 Monetary asset account for land (currency units)
  2. Forest asset accounts
     - 5.15 Physical asset account for forest and other wooded land (hectares)
     - 5.19 Physical asset account for timber (cubic metres)
     - 5.20 Monetary asset account for timber (currency units)
- SEEA Experimental Ecosystem Accounting (SEEA-EEA)
  3. Supply and use (physical and monetary)
     - Marketed forest goods and services (in SNA)
     - Other forest goods and services (not in SNA)

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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.

http://www.unescap.org/our-work/statistics

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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: 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	Net change (increase-decrease)	Closing area
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.

Matching entry
Beginning of accounting period
Changed to Crop
End of accounting period

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1. Land Accounts

Land use classification

- How land is being used, managed or designated
- **Forest** = cover; **Forestry** = use

Land use classification (SEEA-CF, Table 5.11, p. 176; and Annex 1 p. 289)

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!

1.2.1 Forest land
1.2.1.1 Primary regenerated forest
…

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!

3. Coastal waters…
4. Exclusive economic Zone (EEZ)…

1. Land Accounts

5.16: Monetary asset account for land (currency units)

- Value of land by type of land use
  - Market value of land
  - Based on recent transactions (observed prices)
  - Also consider: land is a composite asset (includes soil, buildings, infrastructure, improvements, biological resources)
  - Changes in value due to changes in use, improvements, changes in quality…

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								
Reclassifications		200							
Total additions to stock	3 500	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

Acquisition/Disposal = change in land use (e.g., purchase/sale between economic units)

Revaluations = changes in price

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1. Land Accounts

Key policy considerations

- Land cover
  - Agreement on what exists on surface of country
  - How and where this is changing (e.g., forests → 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?)

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2. Forest asset accounts

- 5.15 Physical asset account for **forest and other wooded land** (hectares)
  - Subset of land accounts
- 5.19 Physical asset account for **timber** (cubic metres)
  - Accounts for stock of exploitable timber
- 5.20 Monetary asset account for **timber** (currency units)
  - Accounts for value of exploitable timber

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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

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2. Forest Asset Accounts

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

Forest and other wooded land types

Forest land
- land spanning more than 0.5 hectares
- with trees higher than 5 metres and
- canopy cover of more than 10 %, or trees able to reach thresholds in situ
- **Excludes** tree-covered land used for agricultural or urban purposes

Primary forest
- naturally regenerated forest of native species
- no clearly visible indications of human activities and
- ecological processes are not significantly disturbed.

Other naturally regenerated forest
- clearly visible indications of human activities.

Planted forests
- trees established through planting and/or deliberate seeding.

Other wooded land
- land not classified as forest land, spanning more than 0.5 hectares
- with trees higher than 5 metres and
- canopy cover of 5-10% or trees able to reach these thresholds in situ
- **or** a combined cover of shrubs, bushes and trees above 10%

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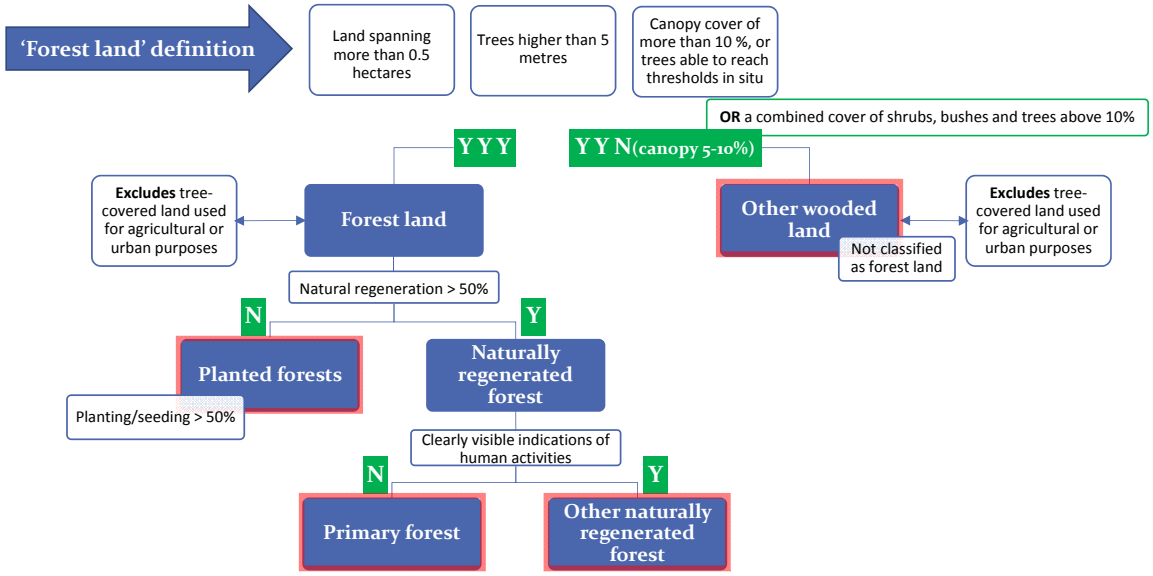
2. Forest Asset Accounts

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

Forest and other wooded land types



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2. Forest Asset Accounts

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

Reasons for additions and reductions

Afforestation

- **increase** in stock of forest and other wooded land
- due to the establishment of new forest on land that was previously not classified as forest land,
- or as a result of silvicultural measures such as planting and seeding.

Natural expansion

- **increase** in area from natural seeding, sprouting, suckering or layering.

Deforestation

- **decrease** in the stock of forest and other wooded land
- due to the complete loss of tree cover and transfer of forest land to other uses (e.g., to agriculture, settlements)

Natural regression

- **decrease** due to natural reasons (e.g., landslide, fire, disease)

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2. Forest asset accounts

Key policy considerations

- Physical asset account for forest and other wooded land (hectares)
  - Is forest area increasing or decreasing?
  - Economic dimension: fewer benefits in future.
  - Environmental dimension: ecosystems, flood control…
  - Social dimensions: population dependence on forests

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Questions/comments?

- Next: Group exercise
  - 20 minutes to prepare
  - 10 minutes to report answers

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Group exercise

- Situation
  - Have 5 years of historical data on forest area, deforestation and natural regression
  - Need to model afforestation, natural expansion, opening and closing stock
  - Need to produce SDG 15.1.1 forest area as a proportion of total land area
- Objective (Groups of 3-5 persons; 20min to prepare)
  - Calculate afforestation, natural expansion, closing stock, opening stock for each year
  - Calculate SDG indicator 15.1.1 for 5 years
- Report & discuss answers (10min)

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Group exercise

- Step 1: Calculate afforestation, natural expansion, opening stock and closing stock for years 2 to 5

Forest asset account (1,000 hectares)					
	Year 1	Year 2	Year 3	Year 4	Year 5
Opening stock	10,500.0				
Additions to stock					
Afforestation	450.0				
Natural expansion	210.0				
Total additions	660.0				
Reductions in stock					
Deforestation	5.0	4.0	2.0	-	-
Natural regression	155.0	80.0	5.0	870.0	7.0
Total reductions	160.0				
Closing stock	11,000.0				

- Opening stock for Year 2 is Closing stock for Year 1…
- Afforestation increases 5% more from previous year (if Y1=100, Y2=105)
- Natural expansion is 2% of Opening stock (if OS=100, NE=2)

Group exercise

- Step 2: Calculate
  - SDG indicator 15.1.1 forest area as a proportion of total land area
    - (Forest area/Total land area)*100
  - Total land area = 30,000,000 hectares
  - Use Closing stock of forest area
  - Calculate for 5 years

Group exercise

- Is everyone clear on the objectives?
- 20 minutes group work
- Please ask questions
- Results:
  - Report **SDG indicator 15.1.1**

	Year 1	Year 2	Year 3	Year 4	Year 5
SDG indicator 15.1.1					

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The answers

Forest asset account (1,000 hectares)					
	Year 1	Year 2	Year 3	Year 4	Year 5
Opening stock	10,500.0	11,000.0	11,608.5	12,329.8	12,227.3
Additions to stock					
Afforestation	450.0	472.5	496.1	520.9	547.0
Natural expansion	210.0	220.0	232.2	246.6	244.5
Total additions	660.0	692.5	728.3	767.5	791.5
Reductions in stock					
Deforestation	5.0	4.0	2.0	-	-
Natural regression	155.0	80.0	5.0	870.0	7.0
Total reductions	160.0	84.0	7.0	870.0	7.0
Closing stock	11,000.0	11,608.5	12,329.8	12,227.3	13,011.8

	Year 1	Year 2	Year 3	Year 4	Year 5
SDG indicator 15.1.1	36.7%	38.7%	41.1%	40.8%	43.4%

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2. Forest Asset Accounts

5.19: Physical asset account for timber resources (cubic metres)

Scope

- Timber resources found in areas of forest and other wooded land (and other land, if of interest)

Timber resources

- Volume of trees, living or dead
- 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.

Units of measure

- Thousands of cubic meters over bark (before bark removed)

Depletion of natural timber resources

- Removals less sustainable yield (SY)
- e.g., SY = 90; Removal = 100 → depletion = 100-90 = 10

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	

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2. Forest Asset Accounts

5.19: Physical asset account for timber resources (cubic metres)

Cultivated timber resources

- Under the direct control, responsibility and management of institutional units
- Growth is recorded as an increase in inventories of those enterprises undertaking the cultivation

Natural timber resources (Available for wood supply)

- Accessible and economically viable
- Growth is recorded only at the time the tree is removed (not in inventory of enterprise)

Natural timber resources (Not available for wood supply)

- Protected, inaccessible, not economically viable
- Important for other analysis (e.g., carbon accounting)

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2. Forest Asset Accounts

5.19: Physical asset account for timber resources (cubic metres)

Reasons for additions and reductions

Natural growth	Reclassifications	Removals	Felling residues	Natural losses	Catastrophic losses
The gross annual increment, i.e., of all trees with no minimum diameter	Increases / decreases in the area of forest land	Volume of timber resources removed from forest land, other wooded land and other land areas	Rotten, damaged or in excess in terms of the size requirements	Mortality from causes other than felling (e.g., diseases)	Exceptional and significant losses of timber resources due to natural causes (e.g., fire)
	Changes in management practice that shift timber resources from cultivated to natural or vice versa	Include removals of trees felled in earlier periods and the removal of trees killed or damaged by natural causes	Excludes small branches that are also excluded from the scope of timber resources		Recorded only when there is no possibility that the timber resource can be removed
		Include fellings, silvicultural and pre-commercial thinnings and cleanings			

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2. Forest Asset Accounts

5.20: Monetary asset account for timber (currency units)

- Contribution to national balance sheet (not GDP)
- Monetary value of opening and closing stock of timber and changes in value over the accounting period
  - Based on volume of timber resources that **can be harvested**
  - Reflects changes in stock (additions and reductions) but also changes in timber prices
  - **Resource rent on timber** resources can be derived as the gross operating surplus from the harvest of timber resources (after taking into account specific taxes and subsidies) less the value of the user costs of produced assets used in the harvesting process.
  - Also derived from **stumpage price** (the amount paid per cubic metre of timber by the harvester to the owner of the timber resources)
  - Multiplied by volume of timber resources

Table 5.20
Monetary asset account for timber resources *(currency units)*

	Type of timber resource		
	Cultivated timber resources	Natural timber resources (available for wood supply)	Total
Opening stock of timber resources	86 549	82 428	168 977
Additions to stock			
Natural growth	12 364	11 334	23 698
Reclassification	515	1 546	2 061
Total additions to stock	12 879	12 879	25 759
Reductions in stock			
Removals	13 395		
Felling residues	1 752		
Natural losses	309		
Catastrophic losses			
Reclassification	1 546		
Total reductions in stock	17 001	11 849	28 850
Revaluations		16 692	16 692
Closing stock of timber resources	82 428	100 150	182 578

Reclassification = change in status cultivated → natural

Revaluations = changes in price

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2. Forest asset accounts

Key policy considerations

- Physical asset account for timber (cubic metres)
  - Is stock of timber being depleted?
- Monetary asset account for timber (currency units)
  - What is contribution of timber to national wealth?
  - Do benefits of harvesting justify the costs (e.g., concession prices)?

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3. Physical and monetary flows

- Timber is only one product (= goods and services)
  - Other marketed goods (fuelwood, NTFP)
  - Non-market ecosystem services
    - Regulating and maintenance: flood control, habitat,
    - Cultural: recreation, scientific, spiritual
- SNA defines monetary flows of forest products
  - Attributed to supplying sector (*usually* Forestry Industry)
- SEEA-CF defines Material Flow Accounts
  - Physical and monetary supply and use of marketed products
- SEEA-EEA
  - Includes marketed forest products (provisioning services)
  - Also defines **Ecosystem Services**

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3. Physical and monetary flows

Based on SEEA-CF Material Flows

- Physical and monetary supply and use (marketed)

Supply (Million tonnes)		Industry					
		Forest	Other	Households	Import	Environment	Total
Natural Inputs	Timber					100	100
	Fuelwood						
	NTFP (cork, gum, fodder, medicine, peat, food, etc.)					150	150
Products	Lumber	90			10		100
	Furniture		90		15		105
	NTFP (cork, gum, fodder, medicine, peat, food, etc.)		140		5		145
Residuals	Wood waste, etc.	10	20				30
Total		100	250		30	250	630

Use (Million tonnes)		Industry					
		Forest	Other	Households	Export	Environment	Total
Natural Inputs	Timber	100					100
	Fuelwood						
	NTFP (cork, gum, fodder, medicine, peat, food, etc.)		150				150
Products	Lumber		100				100
	Furniture			60	45		105
	NTFP (cork, gum, fodder, medicine, peat, food, etc.)			95	50		145
Residuals	Wood waste, etc.					30	30
Total		100	250	155	95	30	630

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3. Physical and monetary flows

- **Monetary** flows already in SNA
  - Value of timber harvested by timber industry
  - Value of lumber sold and imports (to furniture industry)
  - Value of furniture sold and imports to households and exports
- **Physical** flow accounts
  - Include flows from the environment (natural inputs)
  - Include flows to the environment (residuals)
  - Can be estimated from price/volume (e.g., $/tonne of lumber)

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3. Physical and monetary flows

- Key policy considerations
- The "true" economic value of forests:
  - What is the full economic value of forests, including non-market values, and who are the beneficiaries?
  - Is economic growth based on the depletion of forests? What is the [long-term social] cost of deforestation?
  - Are policy decisions based on the total economic value of forests, taking into account linkages throughout the economy and impacts on all stakeholders?
- The impact on forests of non-forestry policies:
  - What are the economic trade-offs among competing sectors or optimizing forest ecosystems that produce benefits to multiple stakeholders?
  - How will economic growth, macroeconomic and other policies affect forests?

Source: Lange, 2003. in FAO, 2003. *Cross-sectoral policy impacts between forestry and other sectors*

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Forest accounts

Take home points

- Accounts harmonize & validate statistics
- Land Cover Account defines "Tree covered area"
- Land Use defines land designated for Forestry
- Asset Account for Forest Land is a subset of Land Cover
  - Area and value
- Asset Account for Timber includes all exploitable timber
  - Volume and value
- Forests are **ecosystems**, providing timber, NTFP, Regulating & Maintenance and Cultural Services
  - Opportunity to assess trade-offs between economic, environmental and social policies

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