Co-funded by the European Union

System of Environmental Economic Accounting

Statistics Netherlands

1926 | 2026 Istat Istituto Nazionale di Statistica

Advancing Connected Values of Ecosystem Services: Integrating Socio-Ecological Context and Economic Dependency

Two complementary extensions to the Connected Values Framework

Kaia Oras[1], Aldo Femia[2], Sjoerd Schenau[3], Aveliina Helm[4], Kalev Sepp[5], Aljona Karlõševa[6], Michelle Steenmeijer [2], Kätlin Aun[1], Grete Luukas[1].

[1] Statistics Estonia; [2] Istat; [3] Statistics Netherlands; [4] University of Tartu; [5] Estonian University of Life Sciences; [6] Tallinn University of Technology

32nd Meeting of the UN London Group on Environmental-Economic Accounting

September 2026

Co-funded by the European Union. Eurostat grant 101262404, 2025-EE-SUSTAINABILITY.

Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

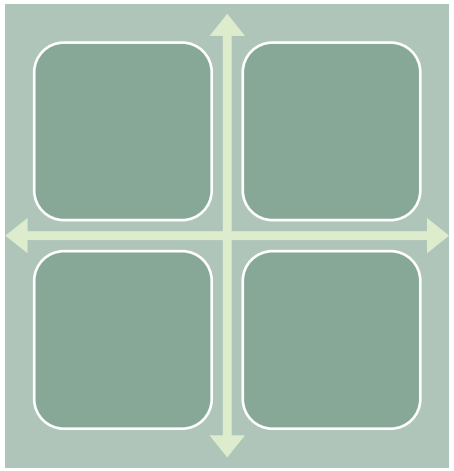
STATISTICS ESTONIA

Bringing together values from different perspectives

Monetary values on ecosystems...

...representing the whole range of actual transactions, embodied values, assets at risk, rents, opportunities...

...are allocated to the double-entry classification table of monetary values connected to ecosystem services



...based on the hypotheses on ecosystem service status (exist/does not exist) and human activities status that are embodied in the **scenarios** under which the values are computed

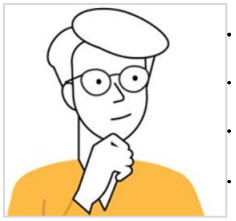
STATISTICS ESTONIA

Understanding the spectrum of connected values

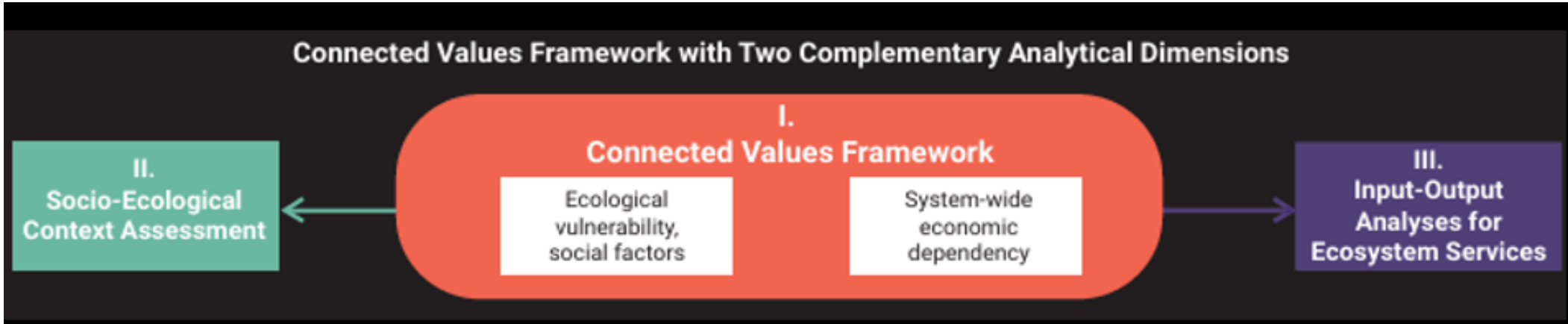
REFERENCE SCHEME FOR THE CLASSIFICATION OF VALUES CONNECTED TO ECOSYSTEM SERVICES

ACCORDING TO THE FEATURES OF THE CALCULATION SCENARIO

Connected monetary value in scenario		Ecosystem service in scenario: Ecosystem service exists	Ecosystem service in scenario: Hypothetical absence of the ecosystem service
Monetary value exists (scenario coincides with reality)	Ecosystem services (ES) are traded as private usage rights	Rent of the land, directly observable prices applied to actually traded volumes, observed value of actually observed transactions in tradable permits	×
	ES are potentially traded as private usage rights	Directly observable prices applied to tradeable rights to use the ES	
	ES are used for producing other goods or services	Resource rent, residual value, hedonic pricing	
	Other (outside or inside of SEEA-EA, within SEEA CF, other satellite accounts or SNA and their analytical extensions)	Subsidies, travel cost, effective carbon rates; Total value of goods and services and primary income whose production depends on the ES	
Monetary value "would appear" (does not exist in reality, does in the scenario)	Economic activity that avoids the need for the ES		Abatement costs, averting behaviour
	Restoration of ES as economic activity		Restoration costs
	Marketisation of the ES (with or without perfect price discrimination)	Prices applied to quantities of ES that are not actually under current institutional arrangements, WTP for maintaining ES	
Monetary value "would disappear" (exists in reality, is lost in the scenario)	Existing economic activities can no longer thrive, and/or assets are damaged («other negative changes in value») because of the lack of the ES		Social cost of lacking ES, expected damages



Advancing connected values of ecosystem services: integrating socio-ecological context and economic dependency



Why do we need context?

Different connected values reflect different stages in socio-ecological pathways.

Their interpretation requires context:

II. Socio-Ecological Context	III. Economic Dependency
Can the service continue to be supplied? How do ecological and social factors shape service realization?	Who depends on the service? How do dependencies propagate through value change and trade?

STATISTICS ESTONIA

Socio-ecological pathways to ecosystem service benefits

Different connected values reflect different stages in the pathways

Ecological fundamentals

extent, condition, thresholds, resilience, dependencies, risks

Social fundamentals

institutions regulating access, needs and preferences, economic structure, budget constraints

Ecological capacity

Actual demand

Realized ecosystem service flow

Societal or economic benefit

=> Not all connected monetary values represent benefits

=> Different connected values answer different policy questions.

STATISTICS ESTONIA

Structure of the standardized socio-ecological context assessment

Dimension	Field
Ecological perspective	1. Ecosystem dependencies and processes
	2. Resilience and recovery potential
	3. Critical thresholds and risks
Socio-institutional perspective	4. Socio-cultural context, diverse values and user dependence
	5. Institutional and governance context
	6. Accessibility, co-production, substitution and other factors ("Technological context")
Interface between ecological status and society benefits	7. Condition–service relationship
Interpretation of values	8. Interpretation of connected values

The concept of the Socio-Ecological Context Assessment developed in this work draws on the IPBES Conceptual Framework, its concept of nature's contributions to people, and the IPBES Assessment of the diverse values and valuation of nature (Diaz et al. 2015, 2018; Pascual et al., 2022).

Different ecosystem services require different interpretations

Ecosystem service	Main ecological dependency/threat	Main social-institutional determinants of connected values	Condition–service relationship	Keywords on monetary values
Crop provision	Soil quality / land use practices	Agricultural policy / land ownership/food systems	Positive non-linear	Loss risk ≠ m-values / co-produced values / subsidies
Wood provision	Forest condition / disturbance	Forest governance	Positive non-linear	Market-oriented
Crop pollination	Pollinator habitats / habitat loss	Landscape-level coordination	Strong positive	Multiple values / partial coverage
Global climate regulation	Carbon stocks / land use practices	Climate policy	Threshold dependent	Non-equivalent values
Local climate regulation	Urban greenery / loss	Urban planning	Context dependent / insufficient evid	Partial coverage
Air filtration	Canopy cover / degradation	Territorial planning	Strong positive	Avoided damage
Nature-based tourism	Landscape quality / decline	Accessibility / tourism promotion	Positive context dependent	Partially captured

EXAMPLE: Crop Provision

1. Ecological Perspective

Dependencies & Processes

- Healthy soils
- Water regulation
- Pollination
- Natural pest control
- Nutrient cycling

Resilience & Recovery

- Moderate recovery potential
- Long recovery for soil
- Vulnerable under monoculture

Critical Risks

- Soil erosion
- Biodiversity loss
- Nutrient depletion
- Climate extremes
- Land use practices

2. Social & Institutional Perspective

Socio-cultural Relevance

- Food security
- Rural livelihoods and agriculture economy

Economic Enabling Factors: Co-production

Ecosystems provide the underlying capacity while human inputs help translate this capacity into realised production.

Governance Context

- EU Common Agricultural Policy (CAP)
- Agri-environment schemes
- Land and water management regulations

3.Condition–Service Relationship

Ecosystem Condition → Service Supply

Positive, non-linear

Human inputs can mask declining ecological capacity.
Soil degradation and pollinator loss may accumulate long before they become visible in crop output.

STATISTICS ESTONIA

Different connected values illuminate different parts of the socio-ecological system

Rent value	Output value	Policy given value	Hypothetical value	Hypothetical value
€113 M	**€300 M**	**€174 M**	**€41 000 M**	**€1 M**
Rent price – most reliable anchor for pricing	Gross value of crop products	Agricultural subsidies attributable to food and feed production	Soil restoration cost – risk-of-loss signal	WTP for food security – welfare metric
Current economic benefit	Production outcome	Public priorities	Ecological vulnerability	Social welfare

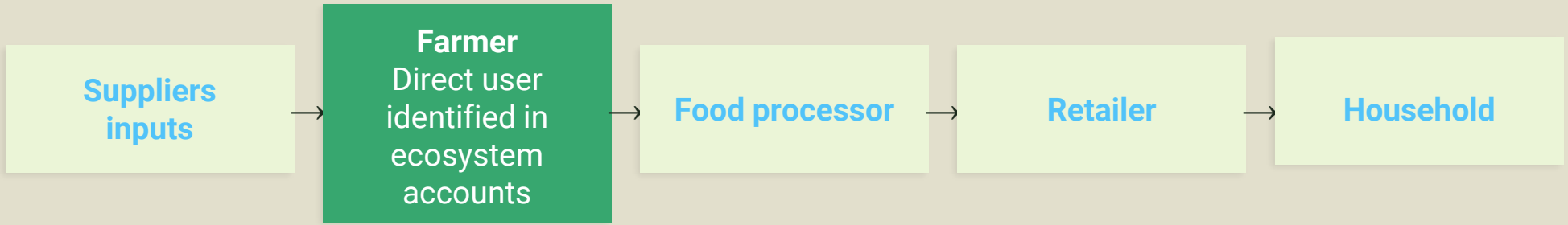
.

Context helps explain what each value represents, why multiple values coexist, and which policy questions they answer.

Extension 2: Who ultimately depends on ecosystem services?

Input-Output analyses: following the benefit and/or value beyond the first user

Standard ecosystem accounts identify who directly uses an ecosystem service.
Input-output analysis reveals who else depends on them.



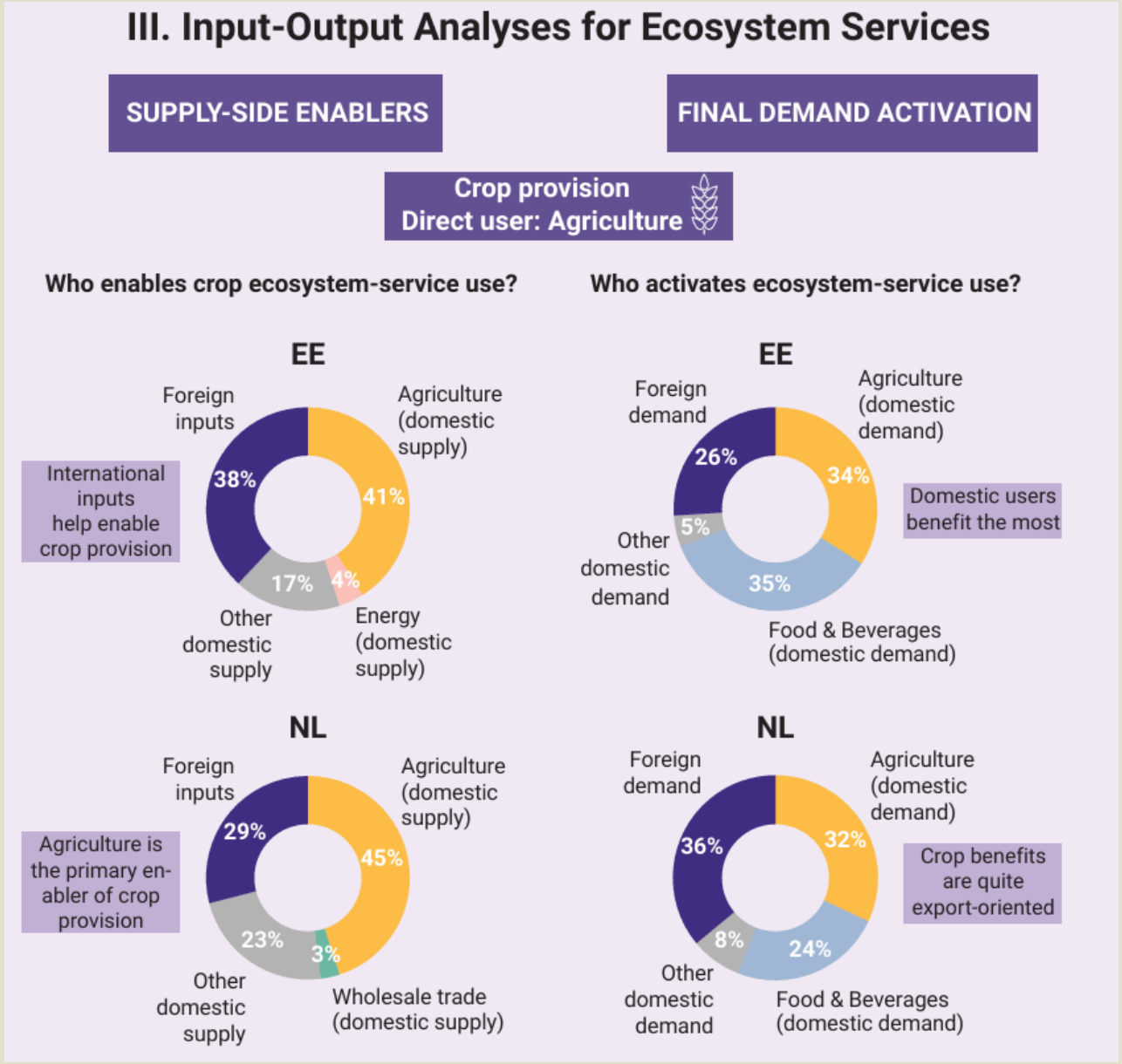
Input-output analysis reveals:

- Who ultimately benefits from ecosystem services
- Which sectors indirectly depend on them

C. Rozendal, S. Schenau, „Structural analysis ecosystem accounting“ Report Eurostat Grant 2023, European Commission

STATISTICS ESTONIA

Crop provision: from ecosystem service to food-system dependency



Supports entire food systems, not only farmers

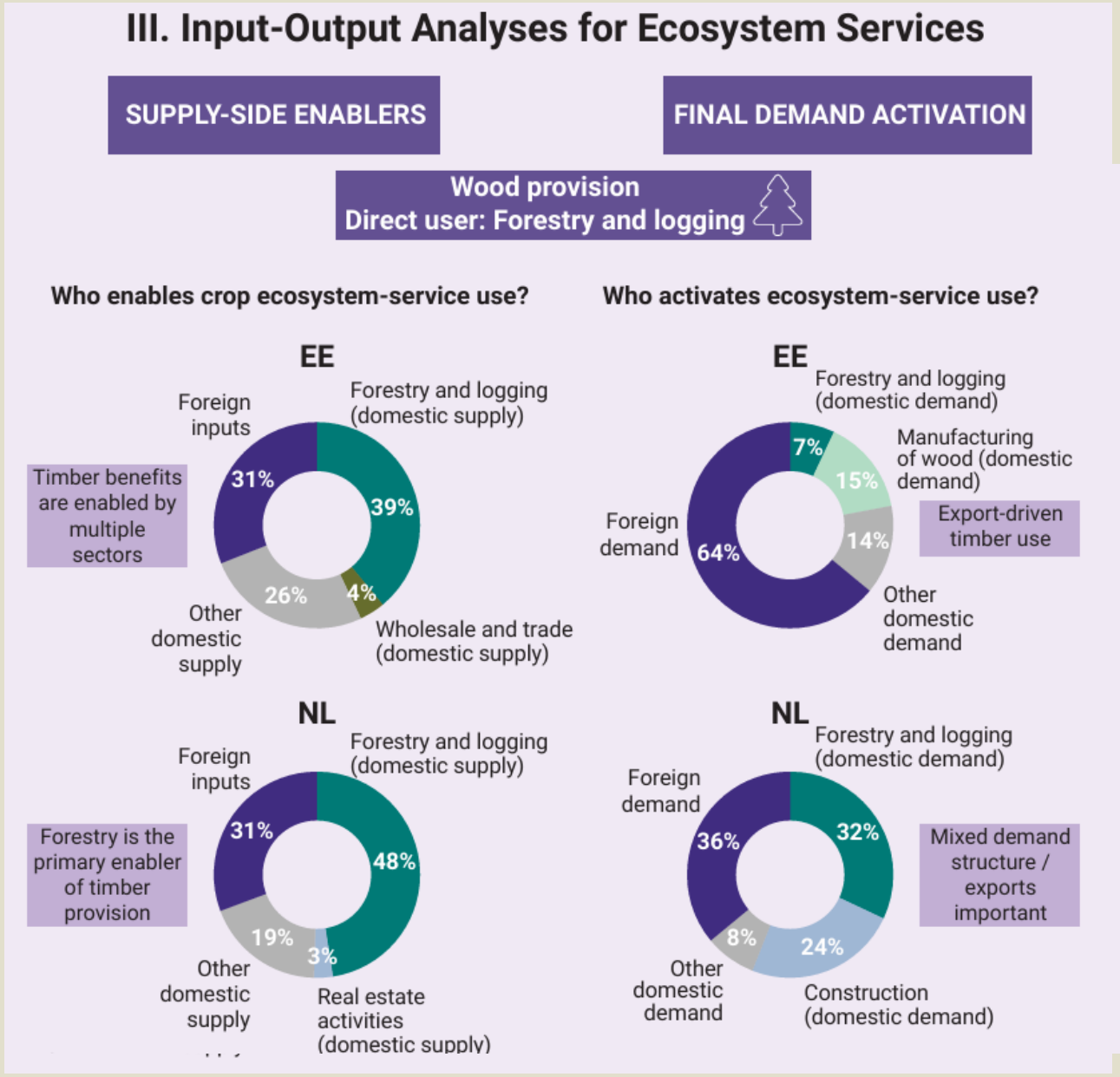
Similar dependency structures in Estonia and the Netherlands

Ecological risks can affect the wider food system

Economic dependency on crop provision extends beyond agriculture into food production, trade and final consumption.

STATISTICS ESTONIA

Wood provision: from forests to value chains



Dependency structures differ markedly between Estonia and the Netherlands

Estonia: dependency extends into wood processing and exports

Netherlands: dependency remains concentrated around forestry

A substantial share of Estonian timber dependency is linked to foreign final demand. Economic significance depends not only on forest ecosystems, but also on value chains, exports and trade structures.

STATISTICS ESTONIA

Synthesis combining socio-ecological context and economic dependency for crops and wood

CROP PROVISION	WOOD PROVISION
Hidden degradation + broad food-system dependency	**Timber supply depends as much on governance as on ecology**
Productive capacity depends on soils, water regulation and biodiversity.	Forest condition determines long-term productive capacity.
Human inputs can temporarily mask declining ecosystem condition.	Realised supply is shaped by governance, ownership and competing forest functions
Benefits extend beyond agriculture into food manufacturing and final demand.	Estonia exhibits strong processing-chain and export dependencies.
Current market values do not reveal long-term ecological risks	A substantial share of timber-related dependency is linked to foreign final demand

STATISTICS ESTONIA

Key messages for London Group

1. Connected values require context

Different values represent different stages of the pathway from ecological and social fundamentals to societal benefits and answer different policy questions.

2. Socio-ecological context matters

Ecological condition-service relationships differ across ecosystem services and influence how connected values should be interpreted.

3. Economic dependency extends beyond direct users

EEIOA reveals who ultimately benefits from ecosystem services and where ecosystem-service dependencies occur in the wider economy.

4. Combining both improves interpretation

Socio-ecological context explains whether services remain viable and how they are managed; dependency analysis shows where their benefits are ultimately used/enjoyed.

London Group questions

How can SEEA EA better link condition, capacity and service flows?

How can SEEA EA capture economy-wide ecosystem dependence?

How can SEEA EA better recognise and interpret multiple connected values?

STATISTICS ESTONIA

Thank you!

This work is supported by the Eurostat grant for environmental-economic accounting „Development of the environmental accounts 2025 – SUSTAINABILITY-EE“
Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them

Contact / materials:

kaia.oras@stat.ee; femia@istat.it

Kaia Oras[1], Aldo Femia[2], Sjoerd Schenau[3], Aveliina Helm[4], Kalev Sepp[5], Aljona Karlõševa[6], Michelle Steenmeijer [2], Kätlin Aun[1], Grete Luukas[1].

[1] Statistics Estonia; [2] Istat; [3] Statistics Netherlands; [4] University of Tartu; [5] Estonian University of Life Sciences; [6] Tallinn University of Technology

STATISTICS ESTONIA

System of Environmental Economic Accounting

Co-funded by the European Union