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“Description of the methodology and methodological issues for forestry account”

Project name: Development of the forestry, environmental subsidies and ecosystem accounts

Project acronym: 2022-EE-EGD, 101113157

Methodological report

December 2024, Tallinn

Contents

1 Introduction and project achievements

This methodological report describes the development work done under Activity 1. Developing forest account in the frame of the work on development of environmental accounts in 2023-2024 under grant "Grant Agreement no 101113157 — 2022-EE-EGD, Development of the forestry, environmental subsidies and ecosystem accounts".

The objective set in the grant agreement was to develop forest accounts in Estonia and provide the deliverables:

- D1.1 – Description of the methodology and methodological issues for forestry account
- D1.2 – Data for the forest accounts module (EFA tables) year 2022

For the development of the methodology and production of the forest accounts, a project team was formed which involved experts from Statistics Estonia, Estonian Environment Agency, Estonian University of Life Sciences, expert from Swiss Statistics and main stakeholders from Ministry of Environment.

Two major methodological seminars in Tallinn (referred to in Annex 1 and Annex 3) and a study visit of Estonia's experts to Swiss Statistics (referred to in Annex 2) were particularly useful. They provided a better understanding of the connections between different EFA tables and allowed to identify which variables and tables could achieve compliance. During the discussions, it was agreed upon what was reasonable to accomplish during the grant project and which variables would need more attention in the future. Insights into the Swiss EFA compilation process also greatly contributed to the development of EFA in Estonia. Work carried out with the assistance of the competent expert (Swiss Statistics) has built the foundation for compilation of excellent EFA account in coming years.

Methodological seminars involved in addition to other experts also major users who acknowledged the good level of methodological work undertaken in Estonia so far. In addition to main project expert on forest accounting from a Swiss Statistics, experts from forest accounts, for example from LUKE Finland and Statistics Finland joined the final methodological seminar in order to discuss implementation and methodological issues of EFA. While the Swiss experts had long-term methodological experience and competence in forest accounting and national accounts, the Finnish experts offered insight to forest accounting from the perspective of similar geographical region.

Due to the need of the analyses of the methodological work finished on June 30th (second phase in 2022 and 2023 (101022852 — 2020-EE-ENVACC) and the questions regarding the approach to be taken, kick of the work was split in two parts: expert kick off meeting was carried out in first order and the planned stakeholder kick off meeting (referred to in Annex 5) was carried out after the analyses of the earlier work was done. This change in the timing of the kick of seminars with stakeholders was adequate in current circumstances, analyses needed and was in the best interests of the project results to be reached and the success of the action.

The overall work on the EFA tables, along with the collaboration between statisticians, forestry scientists, experts, and stakeholders, was deemed a success. The workplan was effectively executed, encompassing planned activities such as data compilation, the development and adaptation of definitions and concepts, and the identification of future development needs.

Proposed reporting tables for the forest accounts module for 2022 data were compiled and the methodology was elevated on a new level.

The EFA methodology itself underwent a significant change during the implementation time of the project. At the start of the project, the methodology for the forest accounts module was largely based on the concepts and methods of the existing EFA questionnaire. During the grant lifetime the guidelines of the European Forest Accounts (EFA) handbook were developed by the Eurostat handbook expert group, Estonia was also part of as well. Statistics Estonia contributed to the development of the common concepts of the EFA guidelines through the work in working groups and written consultations. Methods for compiling of the forest accounts outlined in the guidelines of the European Forest Accounts (EFA) handbook were tested, and the results and observations are outlined in the following subchapters of this report.

Additionally, Estonia has contributed to the development of the handbook with national case examples. It can be concluded that the guidelines in the EFA handbook are generally well described and applicable to Estonia. However, problems arise from national circumstances (data availability, coverage, quality, etc.), mainly regarding physical balance tables (Aa tables), which in certain cases do not allow fully following the preferred approaches suggested in the manual. In addition, some categories of timber and other land with tree cover still have consistency issues. These issues are described in the respective chapters of this report. On the other hand, the EFA guidelines provide rather concise directions for the B and C tables on the current level of application in Estonia.

In a first phase of the project the results of earlier development work (2022-EE-EGD, grant 101113157, Activity 4. "Developing a methodology and compilation of forest accounts") were analysed, open issues from previous work were taken further and the actions for 2023-2024 were agreed. Issues raised in previous work in development of the EFA tables were tackled. The achievements are described in respective chapters.

Compilation of the physical balances (tables) for 2022 year data was successful. Analysis of bottlenecks identified in the previous stages of development work were handled and the options are outlined in respective chapters. Methodological overview of EFA A tables discusses the compilation process, links to international reporting (LULUCF, Forest Europe, FRA), issues with applying EFA definitions of wooded land and timber stock, quality of the data.

Regarding future improvements on physical balances several workstreams were identified: the harmonization regarding the new calculation scheme for calculating opening and closing stocks using greenhouse gas emissions reporting common reporting tables (CRT) tables. This implementation could start from 2025 and will depend on the research project by Tartu University and the Estonian Environment Agency. In long run the further development of the wooded land area estimates is needed and foreseen as well in order to enhance A1a wooded area table estimates, which are linked also for timber stocks and flows calculations. Future long run development in wooded land area and changes will require GIS-based reporting on land use, likely involving multi-source inventory (National Forest Inventory, Earth Observation, etc.). In addition to better data, this future process will bring out probably also revision needs. This process is however costly and time-consuming, requiring collaboration across institutions. Once operational, these results can be used in EFA reporting. Improvement of the national forest inventory gross annual increment and mortality models based on measurement data to reduce estimate fluctuations, is a future research task for national forest inventory team.

Regarding the valuation of wooden land various EFA (manual) approaches were tested. Discussing the advantages and disadvantages of alternative valuation methods, the experts concluded that, considering the quality and availability of input data, it is practical in to use the administratively determined tax value for EFA accounts. Various EFA approaches were tested for valuing timber resources as well. The forestry economics theory was discussed, national and international experts were consulted, approaches were also handled on both methodological seminars. Since timber stock includes forest stands of various ages, income from harvesting is generated over decades and discounting future revenues of young stands would assign them a comparable monetary value to mature stands, it was decided that in order to estimate the monetary value of timber flows (net increment and removals), best option to prefer is to combine Net Present Value (NPV) calculation with stumpage price valuation. The preferred method was discussed in more detail. Methodologies described in the EFA handbook were tested and differences in certain aggregates of EFA and national accounts were investigated based on EFA manual guidance and the input from the Swiss Statistics expert and experts from national accounts.

Examining the results of the B and C tables brought out that depending on the applied methodology results can vary a lot. In order to choose the most suitable methodology, discussions with experts and colleagues from national accounts were needed. The analyses of the consistency between national accounts and EFA tables was very useful and opened the fora for future improvement. Differences are caused by the level of detail that is used in calculations, dependencies in national accounts, system boundaries and routine calculation processes in national accounts. Currently the consistency between A tables was favoured while estimating the output of forest trees, intermediate consumption of the forest trees and work in progress. During the grant project different data sources and detailed information on enterprise level were analysed, consultations with colleagues from national accounts and national and international experts were held, issues that need further attention were agreed on. Investigated details are handled in respective chapters of a report.

It was decided that it is very important to set up workflow extending to several years between national accounts and EFA as the precondition for further integration of NA and EFA will require the timeseries for at least 5 years or even longer (up to 1999). The initial bridge tables which cover the essential linkages between Estonia's monetary EFA tables A1b, A2b, B1, B2, B3a and B3b were developed and analysed. Collaboration between Estonian NA and EFA compilers has been built up during the project for the compilation and cooperation for the full set of EFA tables for the year under review 2022. Tasks division principles have been addressed, and first milestones have been set. Some aspects for the workflow, methods, cooperation, remain to be further agreed and deepened between Estonian NA and EFA compilers. The bridge tables drafted in this work to materialize the interfaces between EFA and NA will be the bases of the work in 2025 and onwards. The compiling sequence must be agreed and later implemented to suit the sustainable routine compilation of EFA table B1 in integrated manner.

The choice of methodologies to be implemented for the compilation of EFA in Estonia depends on several criteria, which are discussed in the chapters describing the different possibilities, advantages and disadvantages per table. The

consistency between monetary and physical tables will be hence analysed further aiming for higher uniformity. The design of a roadmap for the implementation of the European Forest Accounts (EFA) in Estonia was considered to be crucial in process view sense "who is doing what and when" for the development of this module, taken from the pilot results in 2024 to a forthcoming activity of Estonian statistical production in 2025 and later.

Despite the fact that regular data production to the regulation 691/2011 annex VII is foreseen to start in 2025, in sense of integration with national accounts, the period 2025-2026 could be seen as transitional. In this period Estonian EFA is foreseen to be compiled and conciliated and the predesigned workflows with NA will be still tested.

We have let Eurostat know through the partnership portal that on some of the workflows already initiated in previous grant work 101022852 — 2020-EE-ENVACC, partial results have been achieved and methodologies now just have to be adjusted due to the advancements of work on methodological manual of European Forest Accounts. So, some clarification on adjustments in the work description were proposed as some of these methodological issues listed in the current grant agreement (on forest accounts) were partially already tackled in earlier grant work in 2023 (101022852 — 2020-EE-ENVACC) and initial analyses description of these issues were already given also in the earlier methodological report. As second grant project followed immediately but the content of grant was already agreed half a year earlier, so in order to avoid misunderstanding it was clarified that issues which were analysed and some descriptions and conclusions were made already in earlier work, would not be address as the new methodological challenges again. These issues are listed in Annex V and described under respective subchapters as well accordingly.

The acronyms used in current work are listed in Annex VI. Compilation of the list of acronyms was built on materials provided by expert (Swiss Statistics) and was a first attempt to assemble comprehensive material of the terms for EFA account in Estonia to be used in coming years.

Methodological report and the EFA tables are made available via a Statistics Estonia Estonian and English language web site in order to make them easy to find for those interested in the advancement of methodology both in Estonia and among those developing and implementing EFA in other countries.

Thanks!

We would like to thank Eurostat for providing us the grant to develop European Forest Accounts in Estonia and Franz Murbach from Swiss Statistics for assistance and expertise offered.

2 Area of wooded land

2.1 Compilation of the EFA table A1a, methodology for the year 2022 [1]

Current chapter provides an overview of the data sources for the compilation of the tables on wooded land balance (Table A1a) applied methods, overview of the process of the compilation, links to international reporting's (LULUCF, Forest Europe and FRA). The issues related to the application of the EFA definitions of wooded land are highlighted.

Problems arising from the basic characteristics of the used data sources: Variability of estimates acquired with sampling method and differences in definitions are discussed. Detailed overview and feedback are given on the compilation of each variable in a balance.

Issue of the compilation of the balance is handled methodologically as starting and the final assets are independent estimates and not the result of a balance sheet calculations. Estimates of changes added to the initial state do not add up to the final asset. It is described how the situation could be solved: for example, the difference is allocated to the balancing entry in case of the forest land and then the balancing entry is attributed proportionally to forest land subcategories according to the opening area.

Provided approach for wooded land asset account allows the annual reporting on table A1a with actual estimates and do not include any data modelling (forecasting, inter-/extrapolation). To the possible extent the reporting kept coherence with other international reporting routines (FRA, Forest Europe, IPCC LULUCF).

2.2 Data sources for the compilation of the EFA table A1a: Area of wooded land

National Forest Inventory (NFI) is the main data source for the table A1a. NFI is carried out by the Forest Department of the Estonian Environment Agency (EstEA). NFI provides following EFA wooded land related data:

- area of forest land and other wooded land and other land uses (cropland, grassland, wetlands, settlements, and other land).
- dynamics of the area of land-use changes (including afforestation and deforestation).
- designation of forest according to availability for wood supply.

The use of data which are produced based on agreed methodologies continuously is an essential and important precondition for the compilation of forest accounts. The NFI started in 1999 in Estonia. The NFI is a systematic collection of forest, forestry, and land-use information on network of sample plots. NFI is designed as an annual and continuous research effort. Design of the Estonian NFI is a systematic sample without pre-stratification. The network of sample plots covers the whole country (and all land-use categories) and is planned as a five-year cycle. The sampling intensity is the same throughout the whole country. The sampling grid is designed to meet the accuracy requirements at the national level. Approximately 370 clusters (ca 5 500 sample plots) measured each year. An observation unit is an individual field plot that is the centre of sample circles with defined radii. The method of sampling with partial replacement is used. Plots are divided into permanent clusters (plots re-measured in every 5 years) and temporary clusters that form 800-meter squares. All population units have an equal probability of being selected into the sample. The results are point estimates of multiple population parameters based on the measurement data. As all NFI estimates are based on sampling, they are not absolute. Therefore, each estimate of a general parameter is always accompanied with a sampling error. The sampling scheme and design are described in more detail by Adermann (2010)[2].

[1] Some of text of this chapter copies the methodological descriptions given already in the following grant: Grant Agreement no NUMBER — 101022852 — 2020-EE-ENVACC, Development of environmental accounts; *Activity "Developing a methodology and compilation of forest accounts"; D1.12 Description of the methodology and methodological issues for forestry account; Methodological report."* Authors of the text are the same. The reasons to copy also the basic descriptions are:

- These methodological descriptions were well-developed during the previous grant work,,
- Full methodological description is needed to provide the reader with comprehensive approach in single stand-alone document instead of references to other documents.

[2] Adermann, V. (2010). Estonia. *In*: Tomppo, E., Gschwantner, T., Lawrence, M., McRoberts, R. (eds). National forest inventories: Pathways for common reporting. Dordrecht: Springer, pp. 171–184.

NFI statistical estimates are the basis for national[3] and international statistical reporting: e.g., United Nations/FAO Forest Resources Assessment[4], the Ministerial Conference on the Protection of Forests in Europe (Forest Europe aka MCPFE)[5], information on forest carbon pools and changes for the LULUCF sector in the GHG inventory[6]. The usage of NFI as the primary data source guarantees the comparability with already reported estimates to other major international forest related reporting frameworks.

Estimates for "Afforestation and other increase" and "Deforestation and other decrease" of forest land come from GHG reporting CRT tables[7]. Areas in CRT table are based on NFI land-use assessment. Most recent data submission i.e., 2024 was used for 2022 figures, where land-use change data are provided for every single year for 1990–2022.

Data for subcategories of forest land and other wooded land area (available for wood supply (AWS) and not available for wood supply (NAWS)) are based on NFI plot data. Locations of the sample plots are compared to the nature protection GIS layers from the Estonian Nature Information System EELIS[8].

2.3 Methodology for the compilation of EFA table A1a: Area of wooded land

Applicability of the definitions

EFA table A1a compilation is based on FRA definitions.

Forest area and other wooded are estimated according to the FRA (UNFAO – Forest Resources Assessment) definitions[9]:

- **Forest land:** Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.

  All temporarily unstocked forest areas and regeneration areas which have yet to reach a crown density of 10 per cent and a tree height of 5 meters are also included as forest, as are areas which are temporarily unstocked because of human intervention such as harvesting, or natural causes (fires, etc.) but which are expected to revert to the forest. Forest land also includes abandoned shifting cultivation land with a regeneration of trees that have, or are expected to reach, a canopy cover of 10 percent and tree height of 5 meters.

- Other wooded land: Land not classified as "Forest", spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use.

Forest land definition according to the Estonian Forest Act[10] differs slightly compared to FAO definition. FRA forest land covers areas which are reported under other land-use categories according to the national definition (see the Table 1. Forest land and other wooded land area according to national and FRA designation in 2018). Therefore, the estimates of forest area in national and international reporting are not directly comparable. For the reporting on EFA wooded land (A1a) FRA definitions were used.

[3] Yearbook Forest 2021: https://keskkonnaportaal.ee/sites/default/files/Teemad/Mets/Mets2021.pdf ; NFI 2023 estimates: https://keskkonnaportaal.ee/et/teemad/mets/metsastatistika-sh-smi#SMItulemused2023

[4] Forest Resources Assessment, United Nations Food and Agriculture Organisation, https://www.fao.org/forest-resources-assessment/en/

[5] State of Europe's Forests, FOREST EUROPE Ministerial Conference on the Protection of Forests in Europe https://foresteurope.org/state-of-europes-forests/

[6] United Nations Framework Convention on Climate Change, Estonian reports, https://unfccc.int/reports?f%5B0%5D=corporate_author%3A81

[7] Greenhouse gas emissions in Estonia 1990-2022. CRT Table 4.1. Inventory 2022. https://cdr.eionet.europa.eu/ee/eu/govreg/inventory/envzfktlg/

[8] https://infoleht.keskkonnainfo.ee/artikkel/1525036761

[9] FAO (2018). Terms and definitions FRA 2020. Forest resources assessment working paper 118. https://www.fao.org/3/I8661EN/i8661en.pdf

[10] Riigi Teataja, Forest Act , https://www.riigiteataja.ee/en/eli/ee/510022014001/consolide/current ;

§ 3. Forest and forest land

(2) 'Forest land' means land that meets at least one of the following requirements:

1) is entered in the cadastral register as a forest land parcel;

2) is a plot of land with an area of at least 0.1 hectares and woody plants with the height of at least 1.3 metres and with the canopy density of at least 30 per cent grow there.

(3) The land of yards, residential land, parks, cemeteries, green areas, berry gardens, orchards, forest nurseries, gardening centres, arboreta, and plantations of trees and shrubs is not deemed forest land for the purposes of this Act.

(4) For the purposes of this Act, 'tree and shrub plantation' means a site of habitat established for intensive growing of trees and shrubs on non-forest land where trees and shrubs are grown with regular planting spacing and managed uniformly by age.

Table 1. Forest land and other wooded land area according to national and FRA designation in 2018[11]

	Total area of Estonia			of which FRA forest land					of which FRA other wooded land				
							Share from					Share from	
Estonian land category	1000 ha	Share (%)	RE* (%)	1000 ha	Share (%)	RE* (%)	land category	total area	1000 ha	Share (%)	RE* (%)	land category	total area
Forest land	2330.9	51.4	1.1	2330.9	95.3	1.1	100.0	51.4	0				
Bushes	67.6	1.5	9.3	20.8	0.9	16.8	30.8	0.5	41.2	42.1	11.7	60.9	0.9
Natural grassland	237.7	5.2	4.9	34.0	1.4	13.0	14.3	0.7	31.7	32.4	13.0	13.3	0.7
Swamp, bog	222.7	4.9	5.1	57.1	2.3	10.3	25.6	1.3	21.8	22.3	16.9	9.8	0.5
Other	1675.1	36.9	1.2	3.5	0.1	39.8	0.2	0.1	3.1	3.2	43.3	0.2	0.1
Total	4533.9	100.0		2446.3	100.0	1.1		54.0	97.8	100.0	7.7		2.2

There is no need for additional calculations or re-categorization of other land-use classes in compiling EFA table on wooded land A1a. NFI is using next to the Estonian national land-use classification the international wooded land classification (FRA: forest land, other wooded land) since 2005. Relevant land-use categories (both national and international) are attributed to the sample plots and sub-plots during the fieldwork.

FRA forest land area includes areas from other land-use classes by national classification. See Table 2. Matrix of land-categories based on Estonian national classification and LULUCF in 2021 (1000 ha) according to NFI, where IPCC forest land coincides almost fully to the FRA forest land area definition.

There is no uncertainty from the classification of land-use areas in NFI but there exists the uncertainty from the subjectivity of the designation by fieldworkers, as the land category is the assessed not measured attribute. It may add extra variability especially in case of the Other wooded land area (phenomena with the relatively small area). There are some land-use categories where woody vegetation may reach the forest land or other wooded land parameters. In those cases, the trees are not measured e.g., on corridors under powerlines or other infrastructure objects, on slopes of the inland water bodies esp. ditches); land-use is determined on the sample plot according to Estonian land category system but not by the FRA wooded land categories. According to NFI field manual[12] the Other wooded land is assigned to the sample plots in case of the following national land-use categories: bushes, natural grassland, bog/swamp and unusable mineral land (see Table 2).

[11] Statistiline mets 20 aastat statistilist metsainventeerimist Eestis, Keskkonnaagentuur 2019, page 27, https://keskkonnaportaal.ee/sites/default/files/2021-12/Statistiline%20mets%20-%2020%20aastat%20statistilist%20metsainventeerimist%20Eestis.pdf

[12] Keskkonnaportaal, NFI field-work manual, https://keskkonnaportaal.ee/sites/default/files/Teemad/Mets/SMI_valitoode_juhend_2023.pdf

Table 2. Matrix of land-categories based on Estonian national classification and LULUCF in 2022 (1000 ha) according to NFI[13]

Estonian land-category	LULUCF land-category (1000 ha)					
	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land
Forest land (M)	2 111.3					
Unstocked forest land (MM)	213.8					
Arable land (excl. PK, PR) (PM)		670.7				
Permanent crops (PK)		3.7				
Long-term cultural grassland (PR)		307.5				
Bushes (P)	19.4		40.6			
Natural grassland (RM)	34.5		207.9			
Swamp, bog (S)	63.4		25.2	139.4		
Inland water bodies (SV)				263.8		
Peat quarry (KT)				25.8		
Opencast pit (excl. KT) (K)					9.1	
Settlements (excl. T, TR) (A)					196.7	
Roads, railways (T)					66.4	
Lines, power lines etc (TR)					78.1	
Unusable arable land (KK)	4.4		2.3			38.2
Other land (Y)						11.8
Total	2 446.7	982.0	276.0	428.9	350.3	50.0

EFA defines the *other land with tree cover available for wood supply containing agro-forestry, short-rotation forestry and short-rotation coppices on agricultural land*. This is narrow approach (assuming that provided list is exclusive) compared to FAO FRA definition[14]. EFA and FRA approaches for other wooded land with tree cover are different. In case of EFA approach the area of other wooded land with tree cover is almost non-existent in Estonia. In another hand we have the areas of other land with tree cover for which there is no entrance category in EFA.

2.4 Data processing for the compilation of the variables of the table A1a.

NFI provides **annual estimates based on last 5-years' measurement of sample plots for opening and closing stock for forest land and other wooded land area** (Table 3). Every NFI sample plot is assigned with status of land category and the

[13] Yearbook Forest2021, chapter 1. Forest Resources page 94, Estonian Environment Agency 2023, https://keskkonnaportaal.ee/sites/default/files/Teemad/Mets/Mets2021.pdf

[14] FAO FRA definition: OTHER LAND All land that is not classified as "Forest" or "Other wooded land".

Explanatory notes:

1. For the purpose of reporting to FRA, the "Other land" is calculated by subtracting the area of forest and other wooded land from the total land area (as maintained by FAOSTAT).
2. Includes agricultural land, meadows and pastures, built-up areas, barren land, land under permanent ice, etc.
3. Includes all areas classified under the sub-category "Other land with tree cover".

OTHER LAND WITH TREE COVER Land classified as "other land", spanning more than 0.5 hectares with a canopy cover of more than 10 percent of trees able to reach a height of 5 meters at maturity.

Explanatory notes:

1. Land use is the key criteria for distinguishing between forest and other land with tree cover.
2. Specifically includes: palms (oil, coconut, dates, etc.), tree orchards (fruit, nuts, olive, etc.), agroforestry and trees in urban settings.
3. Includes groups of trees and scattered trees (e.g., trees outside forest) in agricultural landscapes, parks, gardens and around buildings, provided that area, height and canopy cover criteria are met.
4. Includes tree stands in agricultural production systems, such as fruit tree plantations/orchards. In these cases, the height threshold can be lower than 5 meters.
5. Includes agroforestry systems when crops are grown under tree cover and tree plantations established mainly for other purposes than wood, such as oil palm plantations.
6. The different sub-categories of "other land with tree cover" are exclusive and area reported under one subcategory should not be reported for any other sub-categories.
7. Excludes scattered trees with a canopy cover less than 10 percent, small groups of trees covering less than 0.5 hectares and tree lines less than 20 meters wide.

designation to FRA forest or other wooded land. Data of sample plots are generalized to the whole territory of Estonia (every sample plot represents ca 156 ha of land).

The breakdown to subcategories by types of forest in EFA tables as area estimates for subcategories of forest land and other wooded land. These categories are based also on NFI plot data. Locations of the sample plots are compared to the nature protection GIS layers from the Estonian Nature Information System EELIS. Every sample plot gets the protection status according to the strictest protection (quite often several different protection statuses overlap). The protection status is converted into 3 main forest categories:

- Unmanaged (Strictly protected) forest/OWL area where no forest management is possible, equals to the "not available for wood supply".
- Protection forests/OWL where forest management is restricted but not forbidden.
- Commercial forests/OWL where forest management is possible according to the rules set in Forest Act.

Protection forests/OWL and commercial forests/OWL together form the area of forest/OWL available for wood supply. Distribution of the forest categories according to the nature protection regimes has been agreed with the Ministry of Environment. For more details see Yearbook Forest 2021, chapter Environment[15]. Data of sample plots are generalized to the whole territory of Estonia (Table 3).

Estimates for "Afforestation and other increase" and "Deforestation and other decrease"

There are no direct measured total area estimates about increase and decrease of wooded land area, not from NFI or other sources. Remote sensing techniques enable to assess better the forest area loss than gain. Remote sensing usually detects the change in forest cover (tree cover) not the change of land-use (forest land area). Indirectly the forest area increase can be detected from changes of land-use. This approach is used in reporting the greenhouse gas (GHG) emissions of land-use, land-use change and forestry (LULUCF) sector (change of land-use on NFI sample plots). Estimates for "Afforestation and other increase" and "Deforestation and other decrease" of forest land come from GHG reporting CRT tables[16]. The present system of calculation of land-use matrix over the time-series in GHG reporting includes the reverse (backward) calculation of land use areas according to land-use changes over the whole period. This causes the situation where closing area will not sum up from the opening area and changes in case of earlier years. This difference (between closing area and opening area and changes) in forest land area in Table A1a is attributed to the "Balancing item" category. Research project in collaboration of Tartu University and Estonian Environment Agency elaborated a new calculation scheme which will avoid the recalculation of full time-series[17]. The implementation of the results will be carried out in 2025.

Afforestation area by the State Forest Management Centre is almost only statistical source on increase of wooded land but it provides only partial coverage and cannot be used for EFA purposes. This figure does not contain natural forestation/expansion. **Estimate of "Afforestation and other increase" of forest land area** in table A1a originates from LULUCF reporting (Table 4). LULUCF reporting framework uses NFI plot data to assess land use and land-use change areas. As the total area of change is small, the estimate has quite high relative error. It must be noted that this is combined estimate of changes of different land-use categories not the independent estimate about forest land increase. This kind of estimate is not available for sub-categories of forest land and for other wooded land area. In case of subcategories of forest land area, the approach is the allocation of the increase proportionally to the share of subcategory from the total forest land area of opening stock in table A1a. There is no data to distribute the increase to subcategories of forest land in another way. It can be assumed that afforestation and other increase takes place mostly on areas available for wood supply. Increase of wooded land can take place also on areas NAWS, but mostly by natural expansion as afforestation component is not possible.

There are different data sources available for **"Deforestation and other decrease" of wooded land**:

- actual deforestation areas in state forests,
- deforestation notifications submitted by landowners/managers to Estonian Environment Board.
- land-use change estimates from LULUCF reporting.

[15] Yearbook Forest2021, chapter 9. Environment, Estonian Environment Agency 2023, https://keskkonnaportaal.ee/sites/default/files/Teemad/Mets/Mets2021.pdf

[16] Greenhouse gas emissions in Estonia 1990-2022. CRT Table 4.1. Inventory 2022. https://cdr.eionet.europa.eu/ee/eu/govreg/inventory/envzfktlg/

[17] Statistilise metsainventuuri (SMI) arendamine, Tartu Ülikooli matemaatika ja statistika instituudi (MSI) lõpparuanne, TÖÖVÕTULEPING nr 4-1/23/52; https://keskkonnaportaal.ee/et/statistilise-metsainventuuri-smi-arendamine

The 2 first sources have their definite disadvantages:

- Information does not include decrease of wooded land area from natural processes.
- There have been cases where other land categories (not forest land) have been reported for deforestation (e.g., in case of big nature restoration areas).
- Forest notifications signal the will of the landowner but there is no data whether the deforestation was carried out.
- State Forest Management Centre reported up to year 2021 under the deforestation also the maintenance (tree felling) on roadsides and ditching systems which is not deforestation as it takes place on other land category than forest land. In 2020 the "deforestation" of roadsides and ditches made up 78% of total reported deforestations by State Forest Management Centre (1580 ha out of 2027 ha). This sort of analysis does not exist for deforestation notifications of other owners. Regular reporting based on this source would require yearly analysis of all deforestation notifications which is laboursome and not cost-effective.

Due to the mentioned reasons the only possible stable and cost-effective source is land-use change approach (based on NFI sample plots). This approach guarantees the compliance with GHG LULUCF sector reporting which is the suggested approach also in Forest Monitoring Regulation legal proposal by the European Commission[18].

Estimate of "Deforestation and other decrease" in reporting table A1a (see Table 4 and Table 5) originates from LULUCF reporting and is identical to the approach used for afforestation (change of forest land area into other land-use categories on NFI sample plots). As the total area of change is small, the estimate has quite high relative error. It must be noted that this is combined estimate of changes of different land-use categories not the independent estimate about forest land decrease. This kind of estimate is not available for sub-categories of forest land and for other wooded land area. There is no data available to distribute the decrease to subcategories of forest land in another way. It can be assumed that deforestation and other decrease takes place mostly on forest area available for wood supply. But there exist cases where nature restoration projects (e.g., restoration of wetlands or meadows) or infrastructure projects (e.g., extension or establishment of military polygons) may use the deforestation measures.

Balancing item The present system of calculation of land-use matrix over the time-series in GHG reporting includes the reverse (backward) calculation of land-use changes and land use areas over the whole period. As mentioned above this causes the situation where closing area will not sum up from the opening area and changes in case of earlier years. The difference in forest land area is attributed to the "Balancing item" category in table A1a. The balancing item of forest land was distributed for subcategories of forest land area proportionally to the share of subcategory from the total forest land area of opening stock in table A1a. There is no data available to distribute the balancing item to subcategories of forest land in another way.

Statistical re-classification (+/-) Re-classification of the total forest land area does not exist on total level but only for subcategories. Changes in total forest land area should be covered by flow items ("Afforestation and other increase" and "Deforestation and other decrease"). In case of the sub-categories of forest land area the re-classification is possible as there exist the opening and closing areas for Forest available for wood supply and Forest not available for wood supply (distribution based on the forest categories according to protection/management status). The reclassification is justified as there is an on-going process of creation of new and re-valuation of existing protection regimes (change in protection status). The area of unmanaged/strictly protected forest land has steadily increased i.e., the areas which formerly belonged to the FAWS category were moved to FNAWS category as a consequence of legal process. The re-classification was calculated as a final step after the opening/closing area, flow items and balancing item were filled in the table.

It is not possible to compile statistics on **"Other land with tree cover available for wood supply"** according to EFA definitions. The EFA definition currently includes agro-forestry, short-rotation forestry and short-rotation coppices on agricultural land. Those land-use types are almost non-existent in Estonia. There have been scientific test trials with the short rotation coppice of willow species. The hybrid aspen plantations have been planted on agricultural lands but those fulfil the forest land definition requirements before being felled. However there exist trees outside the forest land and

[18] Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on a monitoring framework for resilient European forests, https://environment.ec.europa.eu/publications/proposal-regulation-forest-monitoring-framework_en ; *(11) Against that background a forest monitoring system should be established by the Commission in cooperation with Member States, based on three elements that should be gradually made operational: a geographically explicit identification system for forest units, a forest data collection framework and a data sharing framework. The forest monitoring system should allow the collection of data based on Earth observation and georeferenced ground observation and should ensure interoperability with other existing electronic databases and geographic information systems, including those relevant for the monitoring of LULUCF activities and for the tracking of deforestation-free commodities in accordance with the Deforestation Regulation. The forest monitoring system should respect the principles laid down by the latest European Interoperability Framework*

urban settings e.g., inland waterbodies (trees on the slopes and sides of the ditches), infrastructure (trees on the corridor of powerlines) which are not assigned with the forest land or other wooded land label in NFI. There is a reasonable amount of woody biomass removed from outside the wooded land (infrastructure, inland water bodies – slopes of the ditches). This creates the inconsistency between the tables A1a and A2a as ca 8% of timber harvested (removals reported in table A2a) from outside the wooded land categories in table A1a.

Due to high variability (high relative error), small area of the phenomenon and lack of data it is not possible to assess properly the **flow items of other wooded land**. The relative error of OWL estimates (phenomenon with relatively small area) is much higher than actual changes. The number of measured OWL sample plots is too small to obtain reasonable estimates. OWL land is not registered as former land-use in case of temporary sample plots (half of measured plots, this limits the number of OWL plots which could be used in increase and decrease estimates of OWL). Analysis showed that those items should not be reported to avoid confusing high fluctuations in stock estimates (mostly caused by extreme stock estimates on single sample plots).

2.5 Results for the EFA table A1a: Area of wooded land and links to other reporting frameworks

Current chapter outlines two additional relevant reporting tables related to the compilation of the table on wooded land assets. The interrelations between the tables are marked in bold in tables and marked with asterisks and explained in chapters above. First one is a timeseries of the statistics on wooded land in Estonia displaying the timeseries available for categories opening and closing stock (Table 3. Area of wooded land in 2006–2022 according to NFI). Compliant data to this table are also reported to international organizations via routine reporting. Second table (Table 4. Increase and decrease of forest land area in 2022 according to GHG reporting) is one of the IPCC reporting tables “Increase and decrease of forest land area in 2022 according to GHG reporting. Areas and changes in areas between the previous and the current inventory year” regarding forest area changes which are referred in previous chapters. Marked with an asterisk are the calculations of the total changes of forest land area (increase and decrease). Third table (Table 5. A1 (a) Area of wooded land, in 1000 ha, Reference year = 2022) displays the EFA table A1a for the year 2022. The interrelations between the tables are marked in bold in both tables and marked with asterisks and explained in chapters above.

Table 3. Area of wooded land in 2006–2022 according to NFI

	Area of wooded land (1000 ha)									
	Forest						Other wooded land			
	Total		available for wood supply		not available for wood supply		Total		available for wood supply	
Year	(1000 ha)	RE95 (%)*	(1000 ha)	RE95 (%)*	(1000 ha)	RE95 (%)*	(1000 ha)	RE95 (%)*	(1000 ha)	RE95 (%)*
2022***	**2446.75**	2.24	**1972.68**	2.83	**474.07**	8.46	**102.84**	9.25	**76.45**	10.53
2021**	**2447.41**	2.24	**1988.90**	2.84	**458.51**	8.77	**101.27**	9.37	**75.50**	10.47
2020	2443.87	2.19	2051.07	2.71	392.80	9.81	100.60	9.50	75.18	10.73
2019	2450.53	2.18	2006.81	2.70	443.72	10.00	100.39	9.75	75.89	10.84
2018	2446.54	2.19	2036.36	2.69	410.18	10.05	97.83	9.90	74.44	10.93
2017	2438.49	2.51	2046.86	3.12	391.63	11.13	97.07	11.29	76.75	12.28
2016	2421.38	2.79	2062.21	3.46	359.17	12.64	96.98	12.08	77.70	13.09
2015	2421.42	2.89	2088.62	3.53	332.79	13.17	101.78	11.89	82.52	13.03
2014	2408.18	2.89	2106.48	3.47	301.70	13.83	103.35	11.56	84.83	12.54
2013	2379.50	2.72	2082.65	3.25	296.85	12.88	106.50	10.98	90.04	11.81
2012	2360.04	2.83	2079.65	3.31	280.39	13.52	108.16	11.39	91.49	12.05
2011	2348.89	2.97	2084.60	3.39	264.29	14.83	118.33	11.23	97.16	12.05
2010	2337.38	3.07	2088.56	3.43	248.82	14.83	127.89	11.36	106.32	11.99
2009	2337.48	2.95	2076.31	3.33	261.17	13.76	108.22	12.17	88.88	12.90
2008	2326.81	2.95	2070.52	3.28	256.29	14.06	87.13	13.67	69.39	14.25
2007	2345.42	2.92	2090.82	3.24	254.59	14.09	63.22	16.76	49.46	17.77
2006	2325.04	2.92	2086.08	3.26	238.96	14.54	35.51	23.61	29.43	24.82

* relative error (%) at 95% confidence level

** 2021 figures were used as opening area for 2022 in table A1a

*** 2022 figures were used as closing area for 2022 in table A1a

Source: Estonian Environment Agency, NFI2022

Table 4. Increase and decrease of forest land area in 2022 according to GHG reporting[19]

TO: / FROM:	Forest land (managed)	Forest land (unmanaged)	Cropland	Grassland (managed)	Grassland (unmanaged)	Wetlands (managed)	Wetlands (unmanaged)	Settlements	Other land	Total unmanaged land	Initial area	Total decrease*
	(kha)											
Forest land (managed) [2]	2 445.40	NO	0.09	NO	NO	0.03	NO	0.53	0.03	NO	2 446.09	**0.69**
Forest land (unmanaged) [2]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Cropland [2]	0.06	NO	981.50	0.09	NO	NO	NO	0.23	NO	NO	981.88	0.39
Grassland (managed) [2]	0.97	NO	0.38	275.87	NO	NO	NO	0.39	NO	NO	277.60	0.00
Grassland (unmanaged) [2]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Wetlands (managed) [2]	NO	NO	NO	NO	NO	36.05	NO	NO	NO	NO	36.05	0.00
Wetlands (unmanaged) [2]	0.14	NO	NO	NO	NO	NO	392.86	NO	NO	NO	392.99	0.14
Settlements [2]	NO	NO	0.03	NO	NO	NO	NO	349.16	NO	NO	349.19	0.03
Other land [2]	0.19	NO	NO	0.03	NO	NO	NO	0.03	49.94	NO	50.19	0.25
Total unmanaged land [3]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Final area	2 446.75	NO	982.00	275.99	NO	36.08	392.86	350.34	49.97	NO	4 533.99	4 533.99
Net change [4]	0.66	NO	0.12	-1.61	NO	0.03	-0.13	1.15	-0.22	NO	0.00	
Total increase*	**1.35**	0.00	0.50	0.12	0.00	0.03	0.00	1.19	0.03	0.00		

[1] For Parties using reporting approach 1 to represent land areas, only data on the initial and final area per land use should be included. "NA" should then be used for the specific land-use transitions, allowing for the formulas in the cells for final and initial areas to be overwritten. Coastal wetlands areas which are not part of the total land area should not be included in this land matrix.
[2] Definitions for the respective land-use categories used by the Party should be provided in the NID, in accordance with the definitions of land use categories in the 2006 IPCC Guidelines (Vol. 4, chap. 3.2).
(3) Parties may report only the total area of unmanaged land area and report "IE" under the individual unmanaged land uses categories. Conversely, if areas are reported under the individual unmanaged land-use categories, Parties should report "IE" for the total area of unmanaged land.

[19] Greenhouse gas emissions in Estonia 1990-2022. CRT Table 4.1. Inventory 2022. https://cdr.eionet.europa.eu/ee/eu/govreg/inventory/envzfktlg/
[4] Net change is the final area minus the initial area for each of the conversion categories shown at the head of the corresponding row. Under the final area row the sum of the net change equals zero. In case of land upheaval from the sea (and other geological processes beyond human control), the "new" area should be reflected. In such cases, the net change would differ from zero. Any such processes should be explained and documented in the NID.

* Calculated for EFA, not a part of submission table; Afforestation and deforestation figures marked with bold were used in table A1a

Table 5. A1 (a) Area of wooded land, in 1000 ha, Reference year = 2022

Assets (stocks and flows)		Opening area (December 2021)	Afforestation and other increase	Deforestation and other decrease	Statistical re-classification (+/-)	Balancing item (+/-)	Closing area (December 2022)
Code	Description						
1	Forest	**2447.41**	**1.35**	**0.69**	0.00	-1.32	**2446.75**
1.1	Forest available for wood supply	**1988.90**	1.10	0.56	-15.68	-1.07	**1972.69**
1.2	Forest not available for wood supply	**458.51**	0.25	0.13	15.68	-0.25	**474.06**
2	Other wooded land	**101.27**				1.58	**102.85**
2.1	Of which available for wood supply	**75.50**				0.95	**76.45**
3	Other land with tree cover available for wood supply						

2.6 Analysis of bottlenecks identified in the previous stages of development work

Table 6. Problems of the compilation of EFA table A1a: Area of wooded land

Description	Possible solution	Time of implementation
Shortcomings related to the application of the NFI methodology:		
Estimates of opening and closing area are based on National Forest Inventory (NFI) where according to the methodology and its application the estimates are for the whole year not for the end or beginning of the calendar year (period of fieldwork measurements is from May to October);	Not possible in case of NFI	
NFI yearly estimates are calculated according to the measurements of the last 5 years and calculated estimate is attributed to the last year of fieldworks	Estimates based on single year can be reported in case of fully GIS based reporting on land-use as multi-source inventory (NFI, EO, etc) as demanded in GHG reporting	Not before 2027 and later than 2030
NFI is a sample-based inventory i.e., all estimates have statistical error which is bigger the smaller is the probability of occurrence of investigated phenomenon (especially in case of other wooded land category and flow items).	Periodic validation of results with other data sources, using the average estimates, modelling in case of need	open
Problems arising from the use of different data sources, or the data processing rules (see for the details Chapter Data sources for the compilation of the EFA table A1a: Area of wooded land):		
Flow estimates for "Afforestation and other increase" and "Deforestation and other decrease" of forest land come from GHG reporting CRT tables. The present system of calculation of land-use matrix over the time-series in GHG reporting includes the reverse (backward) calculation of land use areas according to land-use changes over the whole period. This causes the situation where closing area will not sum up from the opening area and changes in case of earlier years	Calculation procedure described by the Tartu University, implementation with NFI data planned in 2025	2025/26
Flow estimates are combined from changes of different land-use categories and are not the independent estimate about forest land increase/decrease. This kind of estimate is not available for sub-categories of forest land and for other wooded land area. In case of subcategories of forest land area, the approach is the allocation of the increase proportionally to the share of subcategory from the total forest land area of opening stock in table A1a.	Fully GIS based reporting on land-use as multi-source inventory (NFI, EO, etc) as demanded in GHG reporting	Not before 2027 and later than 2030
Distribution of balancing item or reclassification to sub-categories of forest land is based on their relative share not on actual data.	Approach remains same for time being	open

Data scope for "Other land with tree cover available for wood supply" according to EFA definition which includes agro-forestry, short-rotation forestry and short-rotation coppices on agricultural land but does not cover other categories of forest land with tree cover available for wood supply which are relevant in Estonia. There exist trees outside the forest land and urban settings e.g., inland waterbodies (trees on the slopes and sides of the ditches), infrastructure (trees under the corridor of powerlines) which are not assigned with the forestland or other wooded land label in NFI.	Not possible to solve if definition and reporting table remains same.	During the revision of EFA handbook
There is not enough data available now to assess properly the flow items of other wooded land. In another hand this category itself is negligible. The relative error of OWL estimates (phenomenon with relatively small area) is much higher than actual changes. According to the analysis it is not sensible to report the flow estimates on OWL to avoid confusing high fluctuations and very high relative error in area and timber estimates (mostly caused by extreme stock estimates on single sample plots).	No action needed, possible developments do not provide data of good quality and are not cost-effective; it is not sensible to report flow items for OWL	

* Descriptions from the Grant Agreement no NUMBER — 101022852 — 2020-EE-ENVACC, Development of environmental accounts; Activity 4. "Developing a methodology and compilation of forest accounts"; D1.12 Description of the methodology and methodological issues for forestry account; Methodological report

Evaluation of the specific methodological issues regarding wooded land are described also in the respective chapters. Guidance in EFA handbook is generally applicable and approaches well described. Problems arise from the national circumstances (data availability, coverage, quality, etc.) which do not allow to follow fully the preferred approaches in manual. More relevant national detailed approaches could have been described in the description of methodology.

2.6.1 Methodology for the distribution of "Other wooded land" into subcategories

Regarding the distribution of "Other wooded land" into subcategories „OWL available for wood supply" and "OWL not available for wood supply", solution was similar to the distribution into subcategories of forest land: These subcategories are based on NFI sample plot data. Locations of the sample plots are compared to the nature protection GIS layers from the Estonian Nature Information System EELIS. Every sample plot gets the protection status according to the strictest protection (quite often several different protection statuses overlap). The protection status is converted into 3 main forest categories:

- Unmanaged (strictly protected) forest/OWL area where no forest management is possible, equals to the "not available for wood supply".
- Protection forests/OWL where forest management is restricted but not forbidden.
- Commercial forests/OWK where forest management is possible according to the rules set in Forest Act.

Protected forests/OWL and commercial forests/OWL together form the area of forest/OWL available for wood supply. Distribution of the management/protection categories according to the nature protection regimes has been agreed with the Ministry of Environment.

2.7 Methodology for the estimation of the balancing item

The present system of calculation of land-use matrix over the time-series in GHG reporting includes the reverse (backward) calculation of land-use changes and land use areas over the whole period. This causes the situation where closing area will not sum up from the opening area and changes in case of earlier years. The difference in forest land area is attributed to the "Balancing item" category in table A1a. Research project in collaboration of Tartu University and Estonian Environment Agency elaborated a new

calculation scheme which will avoid the recalculation of full time-series. The implementation of the results will be carried out in 2025. The balancing item of forest land is distributed for subcategories of forest land area proportionally to the share of subcategory from the total forest land area of opening stock in table A1a. There is no data available to distribute the balancing item to subcategories of forest land in another way.

2.8 Methodology for the estimation of the category " Other land with tree cover available for wood supply

Methodology for the estimation of the category " Other land with tree cover available for wood supply " according to the EFA manual definition was elaborated. During the grant proposal it was still open how the handbook will treat the coverage of "Other land with tree cover available for wood supply". It is currently yet not possible to compile comprehensive statistics on "Other land with tree cover available for wood supply" based on given the EFA definitions for this category. The EFA definition includes agro-forestry, short-rotation forestry and short-rotation coppices on agricultural land. Those land-use types are almost non-existent in Estonia. There have been scientific test trials with the short rotation coppice of willow species. The hybrid aspen plantations have been planted on agricultural lands but those fulfil the forest land definition requirements before being felled. However there exist trees (which fulfil the requirements of definition of "Other land with tree cover" according to FRA definition) outside the forest land and urban settings e.g., inland waterbodies (trees on the slopes and sides of the ditches), infrastructure (trees on the corridor of power-lines) which are not assigned with the forest-land or other wooded land label in NFI. There is a reasonable amount of woody biomass removed from outside the wooded land (infrastructure, inland water bodies – slopes of the ditches). But these currently do not fall under the classification item " Other land with tree cover available for wood supply " according to the current EFA manual definition. This creates the inconsistency between the tables A1a and A2a as ca 8% of timber harvested (removals reported in table A2a) from outside of wooded land categories in table A1a.

2.9 Assessment and additional analysis of the area of forest land in deforested areas (for example, the choice of assessment method)

There are different data sources available for "Deforestation and other decrease" of wooded land:

- actual deforestation areas in state forests,
- deforestation notifications submitted by landowners/managers to Estonian Environment Board;
- land-use change estimates from LULUCF reporting.

2 first sources have their definite disadvantages:

- Information does not include decrease of wooded land area from natural processes.
- There have been cases where other land categories (not forest land) have been reported for deforestation (e.g., in case of big nature restoration areas).
- Forest notifications signal the will of the landowner but there is no data whether the deforestation was carried out.
- State Forest Management Centre reported up to year 2021 under the deforestation also the maintenance (tree felling) on roadsides and ditching systems which is not deforestation as it takes place on other land category than forest land. In 2020 the "deforestation" of roadsides and ditches made up 78% of total reported deforestations by State Forest Management Centre (1580 ha out of 2027 ha). This sort of analysis does not exist for deforestation notifications of other owners. Regular reporting based on this source would require yearly analysis of all deforestation notifications which is laboursome and not cost-effective.

Due to the mentioned reasons the only possible stable and cost-effective source is land-use change approach (based on NFI sample plots). This approach guarantees the compliance with GHG LULUCF sector reporting which is the suggested approach also in Forest Monitoring Regulation legal proposal by

the European Commission[20]. Future development can be foreseen as fully GIS based reporting on land-use as multi-source inventory (NFI, EO, etc) as demanded by GHG reporting framework. This is costly and time-consuming development process including involvement of different institution, and not possible to solve with present resources. Once operational, then the results can be used in EFA reporting.

Estimate of "Deforestation and other decrease" in table A1a (Table 4 and Table 5) originates from LULUCF reporting and is identical to the approach used for afforestation (change of forest land area into other land-use categories on NFI sample plots). As the total area of change is small, the estimate has quite high relative error. It must be noted that this is combined estimate of changes of different land-use categories not the independent estimate about forest land increase. This kind of estimate is not available for sub-categories of forest land and for other wooded land area. There is no data available to distribute the decrease to subcategories of forest land in another way. It can be assumed that deforestation and other decrease takes place mostly on forest area available for wood supply. But there exist cases where nature restoration projects (e.g., restoration of wetlands or meadows) or infrastructure projects (e.g., extension or establishment of military polygons) may use the deforestation measures.

2.10 Observations from the discussion on consultations of EFA guidelines

The process of EFA handbook/guidelines elaboration was well planned and implemented. The quality of discussions on wooded land area lacked the presence of forest inventory experts from countries. More specific situation could have been described and questions raised. Despite the situation the overall quality of handbook is good (well written and organised document) but needs further revision in coming years after the analysis of country experiences in actual reporting for A1a table.

Future improvements needs:

- Research project in collaboration of Tartu University and Estonian Environment Agency elaborated a new calculation scheme for opening and closing stocks using the increase and decrease estimates from GHG reporting CRT tables, which will avoid the recalculation of full time-series[21]. The implementation of the results will be carried out in 2025.
- Future development can be foreseen for area and changes of wooded land as fully GIS based reporting on land-use (most probably multi-source inventory (NFI, EO, etc)) is demanded in GHG reporting and forest monitoring regulation draft[22]. This is costly and time-consuming development process including involvement of different institution, and not possible to solve with present resources. Once operational, then the results can be used in EFA reporting.

[20] Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on a monitoring framework for resilient European forests, https://environment.ec.europa.eu/publications/proposal-regulation-forest-monitoring-framework_en ; *(11) Against that background a forest monitoring system should be established by the Commission in cooperation with Member States, based on three elements that should be gradually made operational: a geographically explicit identification system for forest units, a forest data collection framework and a data sharing framework. The forest monitoring system should allow the collection of data based on Earth observation and georeferenced ground observation and should ensure interoperability with other existing electronic databases and geographic information systems, including those relevant for the monitoring of LULUCF activities and for the tracking of deforestation-free commodities in accordance with the Deforestation Regulation. The forest monitoring system should respect the principles laid down by the latest European Interoperability Framework*

[21] Statistilise metsainventuuri (SMI) arendamine, Tartu Ülikooli matemaatika ja statistika instituudi (MSI) lõpparuanne, TÖÖVÕTULEPING nr 4-1/23/52; https://keskkonnaportaal.ee/et/statistilise-metsainventuuri-smi-arendamine

[22] Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on a monitoring framework for resilient European forests, https://environment.ec.europa.eu/publications/proposal-regulation-forest-monitoring-framework_en : *Article 3 Forest monitoring system*
1. The Commission shall set up, in cooperation with the Member States in accordance with Article 11, and operate a forest monitoring system comprising the following elements:
(a) a geographically explicit identification system for the mapping and localisation of forest units, as set out in Article 4;
(b) a forest data collection framework, as set out in Articles 5 and 8;
(c) a forest data sharing framework, as set out in Article 7.

2.11 Quality of reported data in tables A1a and A2a

Design of the Estonian NFI is a systematic clusterised sample without pre-stratification. The network of sample plots covers the whole country and is designed as a five-year cycle. The sampling intensity is the same throughout the whole country. The sampling grid is designed to meet the accuracy requirements at the national level and guarantee cost-efficient implementation. Approximately 370 clusters (ca 5 500 sample plots) are measured each year. An observation unit is an individual field plot that is the centre of sample circles with defined radii. The method of sampling with partial replacement is used. Plots are divided into clusters that form 800-meter squares. All population units have an equal probability of being selected into the sample. The results are point estimates of multiple population parameters based on the measurement data. As all NFI estimates are based on sampling, they are not absolute. Therefore, each estimate of a general parameter is always accompanied with a sampling error.

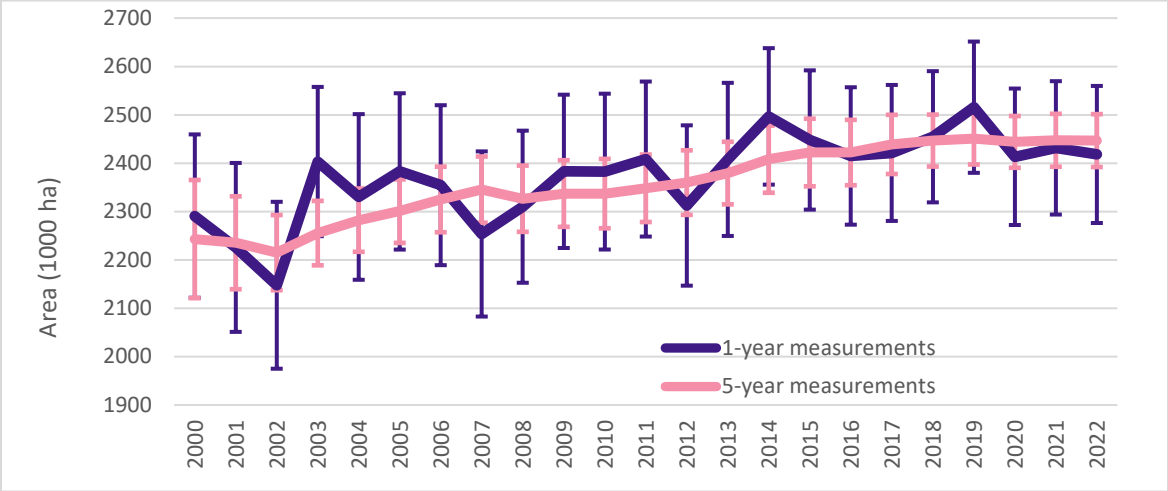
NFI is the major data source for EFA A1a and A2a tables and it is possible to provide relative error estimates for core variables (see Tables 3, 8, 9). NFI error estimation was updated according to the suggestions of scientists from Tartu University Institute of Mathematics and Statistics in 2023. New method takes into account the influence of spatial correlation caused by cluster design of NFI sample plot grid:

As the tracts in close proximity to each other assess approximately the same natural environment, it would make sense to first aggregate these estimates, proposing a regular 5x5 km grid as the basis for aggregation. In this case, all areas with geographically equal size would be equally represented in the final estimate. More precisely, the idea is to divide the relatively irregular tract network into regular 5x5km squares, then average the tract estimates in each square (generally one tract per square) and then use the estimates of squares for further calculations. … Estimation and error calculation using a regular grid is practically feasible, gives approximately the same results compared to tract-based estimation, and allows the use of a method that has been tried and tested in other countries (including Finland) for error calculation. At the same time, it can be said that, unlike the current error estimation, which underestimates uncertainty significantly, the new error estimation is somewhat conservative, i.e. overestimates uncertainty slightly.[23]

All NFI estimates are based on measurements of last 5 years (except fellings which estimates are based on last 3 years) and are assigned to the last measurement year. Estimates from single year measurements have too high variation. To illustrate the situation, see Figure 1 where total forest area is shown according to yearly and 5-year measurements.

[23] Statistilise metsainventuuri (SMI) traktivõrgu analüüs ja arvutusmeetoditega seotud uuring (Research Study for Analysis of NFI cluster network and calculation methods), Tartu University 2023; https://keskkonnaportaal.ee/et/statistilise-metsainventuuri-smi-traktivorgu-analuus-ja-arvutusmeetoditega-seotud-uuring

Figure 1. Total forest land area in 2000-2022 according to 1-year and 5-year measurements with relative error limits at 95% confidence level



Relative error estimates are calculated at 95% confidence level (RE95%) to guarantee that estimate reflects the reality inside the error limits in most cases. Relative error estimates provide the background while interpreting the reporting tables. Year-to-year changes may provide misleading image as the change is much lower than error limits. It is not possible to make far-reaching conclusions from the results of couple of years. It is important to consider while using NFI estimates that different items are independent estimates, and it cannot be expected that opening stock and flow items result in closing stock. Relative error limits are narrower for total phenomenon but become larger when sub-categories are assessed: e.g. RE95% for total forest land area in 2022 was 2.24% and for FAWS 2.84% (FAWS area forms 80.6% from total forest land area), but for FNAWS 8.46% (19.4% of total FL). The smaller is the assessed phenomenon the wider are error limits, e.g. RE95% for total area of OWL in 2022 was 9.3%. It is not sensible to report NFI estimates for the items with small areas like flow items of OWL. Some reported EFA items are expert estimates where it is not possible to provide relative error estimates. E.g. removals' estimate is combined expert estimate without error estimate, but the bulk of the volume is coming from felling volume estimate (RE95% for total felling volume in 2022 was ca 15%). For aggregated figure of timber stock there is no RE estimate available, error estimates are available for the components (growing stock, standing and lying deadwood; growing stock RE estimates are in tables 8 and 9). It is not possible to provide error limits for table-based calculations (balancing item, reclassification of subcategories according to the share of opening stock). A1a and A2a tables are used as bases in monetary valuation in tables A1b and A2b, this means that quality of estimates transfers to the monetary valuation tables. Same is valid for removals' estimate in C-tables.

3 Timber on wooded land in physical units.

3.1 Compilation of the EFA table A2a, methodology for the year 2022 [24].

Current chapter provides an overview of the data sources for the compilation of the tables on timber assets (Table A2a), applied methods, overview of the process of the compilation, links to international reporting's (JFSQ, Forest Europe and FRA). The issues related to the application of the EFA definitions of timber stocks are highlighted.

Predominant issues were related to the internal inconsistencies between the definitions while compiling the balance on timber assets and flows. Problems arising from the basic characteristics of the used data sources and in data processing rules were discussed. Detailed overview and feedback are given on the compilation of each variable in a balance.

The chapter handles in detail the estimation of the of the flow categories ("net annual increment", "removals" and "irretrievable losses") which use different fractions of timber. Net annual increment is calculated only for stemwood; removals and irretrievable losses include stemwood and non-stemwood. The idea of calculation the closing stock from opening stock and flow items is not achievable. Issue of the compilation of the balance is handled methodologically as starting and the final assets are independent estimates and not the result of a balance sheet calculations. Estimates of changes added to the initial state do not add up to the final asset. It is described how the situation could be solved in case of reporting on Estonia: for example, the difference is allocated to the balancing entry and then the balancing entry is attributed proportionally to forest land subcategories according to the opening timber stock distribution. In addition, the question remains about the inclusion into the re-classification category the decrease of the deadwood as a result of the decaying.

Provided approach for timber asset account allows the annual reporting on table A2a with actual estimates for timber on forest land and other wooded land. Simple assumptions were used for distribution of flow items in case of forest land sub-categories. To the possible extent the reporting kept coherence with other international reporting routines (FRA, Forest Europe, JFSQ).

3.2 Data sources for the table A2a: Timber on wooded land in physical units

National Forest Inventory (NFI) is the primary information source for the table A2a. NFI provides following EFA timber related data:

- volume of timber on different categories of wooded land;
- increment of growing stock on forest land;
- felling volumes as a basis for removals' estimates.

Data for timber stocks' subcategories of forest land and other wooded land according to the availability for wood supply are based on NFI plot data as well. Locations of the sample plots are compared to the nature protection GIS layers from the Estonian Nature Information System EELIS (see chapter on table A1a).

Estimate of removals is combined expert estimate based on felling statistics from NFI, expert estimate about the removals from outside the forest land and expert estimate about the removals of non-

[24] The text of this chapter uses extensively the methodological description from the earlier grant: Grant Agreement no NUMBER — 101022852 — 2020-EE-ENVACC, Development of environmental accounts; Activity 4. "Developing a methodology and compilation of forest accounts"; D1.12 Description of the methodology and methodological issues for forestry account; Methodological report. Authors of the text are the same. The reasons to copy also the basic descriptions are:

- These methodological descriptions were well-developed during the previous grant work„
- Full methodological description is needed to provide the reader with comprehensive approach in single stand-alone document instead of references to other documents.

stemwood from forest land. Estimation is based on the approach used in "Wood balance of Estonia"[25]. The expert estimate from Wood Balance is basis for the data reporting on removals in Joint Forest Sector questionnaire.

3.3 Methodology for the table A2a: Timber on wooded land in physical units

3.3.1.1 Definitions applied for the table A2a and source data

This chapter outlines the definitions of the source data (NFI, FRA; JFSQ) and provides the comparison with the definitions applied for the compilation of table A2a: Timber on wooded land in physical units

Timber stocks are reported for forest land and other wooded which follow the FRA (UNFAO – Forest Resources Assessment) definitions. The definition of timber stock in the SEEA Central Framework is as follows*: 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. 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. Excluded are smaller branches, twigs, foliage, flowers, seeds and roots*[26].

According to the SEEA definition the timber stock include:

- growing stock[27]; Note the difference between SEEA and FRA definitions: SEEA asks for big branches, FRA growing stock excludes branches.
- dead standing and lying trees or parts thereof which have utilisation value as timber or fuel[28].

It is important to note that both growing stock and deadwood are reported on a similar basis in the specific reporting frameworks: either only above-ground stemwood (like stemwood volume in FRA or MCPFE reporting) or above-ground and below-ground stem-wood with non-stemwood (like biomass estimates in FRA reporting or GHG LULUCF sector reporting). In forest accounts the usability of timber is in focus, therefore the only stemwood is reported for both growing stock and deadwood. Below-ground woody biomass has almost no use so far. Branches of trees and undergrowth is being used to a limited extent as source of forest chips used in energy sector.

There is only limited data available about the harvested non-stemwood volumes and figures are based on expert estimates and partial statistics. The non-stemwood estimates are based on biomass conversion and expansion factors not on direct measurements. Stock increment figures are also based on stem-wood measurements/calculations, this is another reason to choose the stemwood reporting approach. Single tree volume calculation formulas are based on single stem without branches i.e. no branches reported (as asked by the SEEA) on growing stock, which is approach used by FRA.

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[25] Puidubilanss Ülevaade puidukasutuse mahust 2022. aastal, Keskkonnaagentuur 2024; https://keskkonnaportaal.ee/sites/default/files/Teemad/Mets/Puidubilanss%202022.pdf

[26] System of Environmental Economic Accounting 2012— Central Framework, United Nations, https://unstats.un.org/unsd/envaccounting/seearev/seea_cf_final_en.pdf

[27] FRA process defines growing stock as follows : *Volume over bark of all living trees with a minimum diameter of 10 cm at breast height (or above buttress if these are higher). Includes the stem from ground level up to a top diameter of 0 cm, excluding branches. Explanatory notes:*

1. Diameter breast height refers to diameter over bark measured at a height of 1.3 m above ground level, or above buttresses, if these are higher.

2. Includes lying living trees.

3. Excludes branches, twigs, foliage, flowers, seeds, and roots;

[28] FRA definition for deadwood:

All non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Dead wood includes wood lying on the surface, dead roots, and stumps larger than or equal to 10 cm in diameter or any other diameter used by the country.

Explanatory note: The country may use another threshold value than 10 cm, but in such a case the threshold value used must be documented.

The estimate for the **Net annual increment** follows the approach provided by EFA framework i.e., *the average annual volume growth of live trees (calculated for the stock of live trees i.e. growing stock) less the average annual mortality*.

The estimate for the **Removals** follows the definition[29] of EFA and Joint Forest Sector Questionnaire[30]. Joint Forest Sector Questionnaire includes removals' estimates with and without bark i.e. under- and overbark. It must be noted that forest accounts' framework is meant to capture all harvested woody biomass i.e. stemwood and non-stemwood, including deadwood.

The definition of **Irretrievable losses** according to the SEEA framework *includes felling residues, all fellings from windthrow that cannot be removed from the forest, as well as timber lost through forest fires*. There is no national definition/data for irretrievable losses comparable to EFA definition. Felling residues can be assessed indirectly as a share from total felling volume, comparison of volume of felled trees to the wood removals volume (direct measurements of harvested sortments), theoretical sortmentation of felling volume or simple fixed share. The approach in present study is to provide expert estimate as close as possible to the EFA definition. The general approach to felling residues must be on a similar basis with removals. If removals include the harvest of non-stemwood, then felling residues should account the non-stemwood (mostly branches) left in the forest during the harvest. Relevant woody biomass must be included into the Irretrievable losses' estimate. There is no data available about the timber volume of storm and fire damages which remains in the forests. Provided figure in table A2a is an expert estimate based on knowledge of removed timber on non-forest land (including non-stemwood), total removed stemwood and felling residues on forest land.

3.4 Data compilation of EFA table A2a, timber on wooded land, in physical units

NFI provides **annual estimates for opening and closing stock for timber on forest land and other wooded land** (see Table 8 and-9). Every NFI sample plot is assigned with status of land category including the designation to FRA forest and other wooded land. Timber volume estimates are based on measurements on sample plots of:

- tree diameters at breast height (1.3 m) and average diameter of lying deadwood;
- tree heights and lengths of deadwood logs;
- assessment of tree species.

Those measurements are converted into volume estimates according to the volume calculation models for each sample plot. Growing stock and deadwood volume estimates are calculated separately. Deadwood volume estimates are calculated separately for standing and lying deadwood. Timber stock estimate is the sum of growing stock and standing and lying deadwood. Forest accounts' approach excludes deadwood which has lost the quality for timber or fuelwood (decayed/rotten snags and notches). Those sortments of deadwood may be reported in the context of ecosystem services having important value for biodiversity. Data of sample plots are generalised to the whole territory of Estonia (every sample plot represents ca 156 ha of land).

There exist also other possibilities to calculate the timber volumes:

[29] *The volume of all trees, living or dead, that are felled and removed from the forest, other wooded land or other felling sites. It includes unsold roundwood stored at the forest roadside. It includes natural losses that are recovered (i.e., harvested), removals during the year of wood felled during an earlier period, removals of non-stem wood such as stumps and branches (where these are harvested) and removal of trees killed or damaged by natural causes (i.e., natural losses), e.g., fire, windblown, insects and diseases. Please note that this includes removals from all sources within the country including public, private, and informal sources. It excludes bark and other nonwoody biomass and any wood that is not removed, e.g., stumps, branches and treetops (where these are not harvested) and felling residues (harvesting waste). It is reported in cubic metres solid volume underbark (i.e., excluding bark). Where it is measured overbark (i.e., including bark), the volume has to be adjusted downwards to convert to an underbark estimate.*

[30] Joint Forest Sector Questionnaire Definitions, United Nations Economic Commission for Europe, https://unece.org/sites/default/files/2022-04/jq2021def-e.pdf

- stand-wise forest inventory data from National Register for Accounting of Forest Resources; this source has no full coverage of forest land (ca 75% of forest land area has valid inventory data i.e. data not older than 10 years), estimates are not based on measurements but on visual assessment (typically this approach underestimates the volume by 15-20%);
- remote sensing data combined with ground measurements may provide possibilities for better temporal or geographic analysis but not the more accurate estimates. Mostly the remote sensing data (ALS, satellite images and other similar) need ground references for the validation and calibration of the system. In Estonia the best ground reference data come from NFI sample plots. Modelling of the ground and remote sensing data adds extra complexity to the process where it is difficult to provide error estimates for the results.

NFI is so far the best continuous and cost-effective timber estimation system available on a national scale.

Timber estimates for **subcategories of forest land and other wooded land according to the availability for wood supply** are based on NFI plot data. Timber volume estimates of sample plots are generalized to the whole territory of Estonia by the management categories of forest land/OWL.

Trees are measured also on the other Estonian land categories on NFI sample plots. This gives the possibility to estimate the volume on **other wooded land** (only on following national land-use categories: swamps/boglands, natural grasslands and areas covered with bushes), which usually remains outside the forest land-use. As FRA forest land and other wooded land categories are assigned to NFI sample plots during the fieldworks there is no need for re-categorization from Estonian land-use categories. That means there is no extra uncertainty from re-categorization of land-use categories. Certain subjectivity exists in the assignment of plots to different wooded land categories. This may add extra uncertainty in case of the phenomena with relatively low occurrence (with small total area) like other wooded land. For example, the single big tree on OWL sample plot may increase substantially the timber volume estimates for 5 years (see Table 7; note the big fluctuation of the average timber stock per ha). Therefore, the estimates of OWL must be treated with care as the relative error level is high. It needs further analysis whether it is meaningful and cost effective to use modelling of the OWL yearly estimates and time-series to avoid big changes due to the high variability. This topic is not the priority in NFI in coming years.

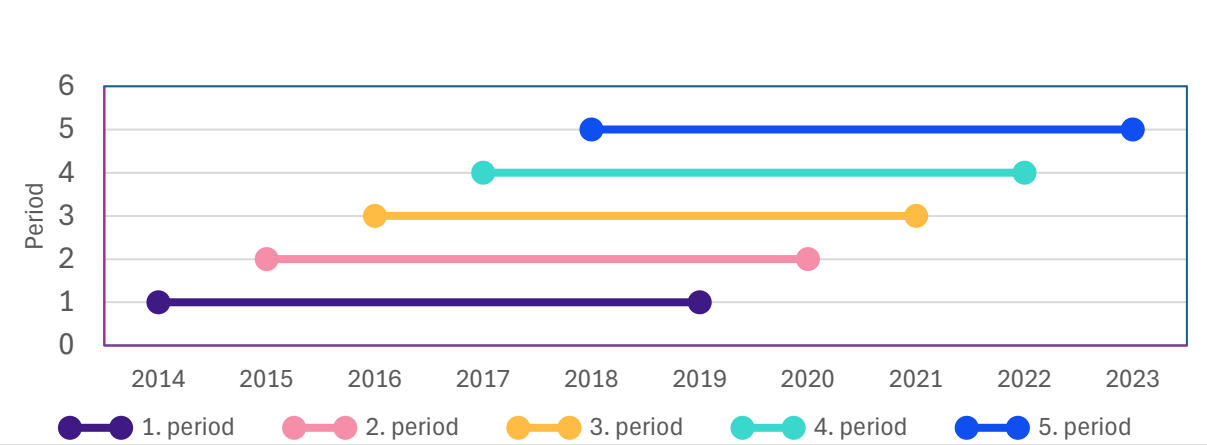
Table 7. Area and timber volume on other wooded land in 2006–2022 according to NFI

	Area (1000 ha)		Timber* (1000 m^3)		Timber* per ha (1000 m^3/ha)	
Year	OWL	OWL_AWS	OWL	OWL_AWS	OWL	OWL_AWS
2022	103	76	2482	2334	24.14	30.53
2021	101	75	2435	2303	24.04	30.50
2020	101	75	2142	2017	21.29	26.83
2019	100	76	1582	1463	15.76	19.28
2018	98	74	1434	1298	14.66	17.43
2017	97	77	1483	1288	15.28	16.78
2016	97	78	1503	1306	15.49	16.81
2015	102	83	1610	1401	15.82	16.98
2014	103	85	1812	1596	17.53	18.81
2013	107	90	1901	1709	17.85	18.98
2012	108	91	2150	2060	19.87	22.51
2011	118	97	2415	2318	20.41	23.86
2010	128	106	3354	3239	26.22	30.46
2009	108	89	2926	2866	27.04	32.25
2008	87	69	2508	2454	28.78	35.37
2007	63	49	1826	1789	28.88	36.17
2006	36	29	1295	1264	36.48	42.94

* Includes growing stock, standing and lying deadwood
OWL – other wooded land, OWL_AWS – other wooded land available for wood supply
Source: Estonian Environment Agency, NFI2022

Net annual increment (NAI) of growing stock was calculated using the annual estimates of gross annual increment (GAI) from NFI up to year 2023. Increment estimates are based on models which rely on periodic re-measurements of permanent sample plots after every 5 years. NAI is calculated subtracting annual mortality from GAI. During the Forest Europe (aka MCPFE) 2020 reporting process the average annual mortality was calculated for the period of 2000-2018: 2,2 million m^3 for FRA forest land and 1,8 million m^3 for FRA forest land available for wood supply. Those mortality rates were used to calculate the NAI up to 2023. Methodological update was made to produce the annual GAI and mortality estimates from NFI for single years. For the first time the annual estimates were produced based on measured increment on permanent volume sample plots of NFI. 5 rounds of measurements provide enough data for increment and mortality calculations. The single year estimate is based on 5-year average (typical approach in NFI) GAI and mortality on re-measured sample plots. Every permanent sample plot is measured after 5 years (on the 6-th year) which provide the opportunity to calculate stemwood volume growth on tree and sample-plot level. Relevant estimate represents average annual volume growth in 5 years. To avoid high fluctuation of estimates caused by variation the 5 most recent re-measurements are included in final estimate (five 5-year periods, Figure 2 for principle and Table 10 for results).

Figure 2. Estimation of GAI and mortality from the NFI tree measurements as the average of five 5-year periods*



*GAI and M estimate on NFI sample-plot network (1/5 measured each year). Every period means measurement of same plots in the beginning and after the end (6th year) of period, which provide average annual GAI and M estimate for the period. Sample plots of different periods do not overlap. Average GAI/M estimate for 10 year period (nt 2014-2023) is calculated from the average yearly GAI/M period estimates.

The new approach is ground-breaking as there has been no yearly mortality rates available so far. This can be considered as major achievement of this grant work. There is a plan to build on measurement data the NFI GAI and mortality models to reduce further the fluctuations of estimates caused by variation. This is a research task of NFI for coming years.

Net annual increment is based on the increase of volume of stemwood of live trees. This is not exactly comparable to opening/closing stock and removals' estimates which include deadwood according to the applied definitions. By the logic of the table A2a the opening stock and flow items must produce the closing stock figure. There is systematic "in-built" methodological discrepancy how the deadwood is accounted in flow items.

Net annual increment indirectly covers the increase of deadwood stock (mortality). Part of the dead trees are being felled during the reporting year and accounted in removals. Those trees may have died in reporting year or earlier years. There is also process of decaying which results in loss of commercial quality of wood (either for timber or fuelwood) and in reduction of deadwood volumes. The present forest accounts' approach does not cover all changes in deadwood. Deadwood inclusion and coverage issue

was raised several times during the negotiation of regulation and compilation of EFA handbook but remained unheard and unsolved. Further work must be done to clarify this issue in reporting and in revising the EFA handbook

Removals' estimates can be used without further calculations from JFSQ reports. JFSQ report is compiled every year by Estonian Environment Agency for 2 previous years (Table 11). Estonian JFSQ report includes timber both under- and overbark. Estonian Wood Balance estimation approach is the basis for removals' estimates. Removals' estimates are expert estimates based on data of felling volumes, estimates of amounts of harvested non-stemwood from forest land and estimates of harvested timber from outside the forest land. Those estimates include unknown uncertainty. Total removals volume is distributed to forest land available for wood supply and other land with tree cover available for wood supply. Removals from FNAWS are considered zero, although it is possible that there may occur small amounts of removals caused by the nature restoration projects or infrastructure/military developments. There is no expert estimate available to report removals on other wooded land. Considering the stock of OWL, the removals' volumes from there are insignificant. There are felling figures for OWL from NFI, but the relative error of the estimate is very high. Removals from other wooded land are a part of the removals estimate on other land with tree cover available for wood supply.

According to the definition **Irretrievable losses** include felling residues, all fellings from windthrow that cannot be removed from the forest, as well as timber lost through forest fires. There is no national definition/data for irretrievable losses comparable to EFA's. Assuming that the general approach to felling residues must be on a similar basis with removals: then if removals include the harvest of non-stem-wood, then felling residues should account the non-stemwood (mostly branches) left in the forest during the harvest. Relevant woody biomass must be included into the Irretrievable losses' estimate. Provided figure in table A2a is an expert estimate based on estimates of total removed timber, total felled stemwood and felling residues. Felling residues are not measured during the NFI fieldworks. It is possible indirectly estimate the non-stemwood of felled trees. 16% of stemwood volume was used to estimate the non-stemwood of felled trees. The removals of branches are recorded on the NFI plot level but not the volume. Irretrievable losses were calculated adding non-forestland removals' volume and total volume of felled trees on forest land (including non-stemwood), then subtracting total removals' volume. It is assumed that non-forestland removals' estimate includes non-stemwood.

There is no data available about the timber volume of storm and fire damages which remains in the forest. Estonian Environment Board carries out assessment of damaged areas after the owner has submitted the forest damage notification. Mostly it is done if there is an interest to harvest the wood from damaged forest areas and forest management regulations prohibit the felling (either the stand is too young for final felling or sanitation felling volume exceeds the limit allowed to harvest without felling notification). Environmental Board specialists assess the damage in forest and give the resolution of possible fellings (relevant data is published in statistical Yearbook Forest[31]). This source underestimates the actual damaged areas and volumes. Often the damaged areas are just harvested if regular felling is possible. Many areas remain without assessment if there is no interest to harvest from the damaged sites. There is also no information about the volume actually cut from the damaged sites. National Forest Inventory provides the estimate about the total damaged areas including the total area affected by the wind damages. Ca 100 000 ha of forest land had wind damages. Unfortunately, it will not give the time of occurrence of the damages (not possible to assign the damage to specific year) and volumes of damaged trees and removals. The volume of burnt timber is also insignificant as the burnt area is small (in average less than 100 ha during the last decade[32]). Mostly those volumes are smaller than general uncertainty level of total removals' estimate. In case of bigger storm damages, it may be necessary to carry out additional research to estimate this fraction. In normal circumstances the provided irretrievable losses' estimate should cover the volume of unharvested storm-felled and burnt trees.

[31] Yearbook Forest 2021, chapter 5. Condition of forests; https://keskkonnaportaal.ee/sites/default/files/Teemad/Mets/Mets2021.pdf
[32] Yearbook Forest 2021, chapter 6. Forest fires; https://keskkonnaportaal.ee/sites/default/files/Teemad/Mets/Mets2021.pdf

Balancing item Opening and closing stock of timber are based on area estimates in table A1a. See relevant section for A1a table for reasons of discrepancy in total forest land area estimates and for need to use the balancing item. The imbalance transfers over to table A2a. Extra discrepancy may arise from the different approach to volume estimates (inclusion of non-stemwood in case of removals and irretrievable loss) and accounting of deadwood. This causes the situation where closing stock will not sum up from the opening stock plus net annual increment minus removals and irretrievable losses. The difference in timber stock is attributed to the "Balancing item" category in table A2a. The balancing item of timber on forest land was distributed into subcategories of forest land proportionally to the share of subcategory from the total opening stock. There is no data available to distribute the balancing item to subcategories of forest land in another way. This situation may change if land-use reporting becomes fully GIS based. The present NFI methodology is not suitable to solve the problem.

Statistical re-classification (+/-) Re-classification of the timber on total forest land area does not have the content already theoretically as the reclassifications should be covered by flow items ("Net annual increment", "Removals" and "Irretrievable losses"). In case of the timber on sub-categories of forest land area the re-classification is possible as there exist the opening and closing timber stocks for Forest available for wood supply (FAWS) and Forest not available for wood supply (FNAWS; distribution based on the forest categories according to protection/management status). The reclassification is justified as there is an on-going process of creation of new and re-valuation of existing protection regimes (change in management/protection status). The area and thereby the timber volume of unmanaged/strictly protected forest land has steadily increased i.e., the areas which formerly belonged to the FAWS category were moved to FNAWS category as a consequence of legal process. The re-classification was calculated as a final step after the opening/closing stock, flow items and balancing item were filled in the table. It is also question whether to include into re-classification category the decrease of the deadwood as a result of the decaying. Handbook does not supply any guidance on this issue despite the raising of issue during the handbook development process.

3.5 Results for the compilation of the table A2a and relations to other reporting

Current chapter outlines five tables related to the compilation of the timber assets in physical units. Table 8 and Table 9 show the timber stock estimates for forest land, its' subcategories and other wooded land by the components of the timber stock i.e., growing stock and deadwood fractions. Table 10 illustrates the net increment calculation according to the gross annual increment and mortality in case of forest land and its' subcategories and other wooded land. Table 11 is a combined table from several JFSQ reports showing the volumes of removals and the breakdown into sortments which have direct connection to supply and use tables (C tables). Table 12 displays the EFA table A2a for the year 2022. The interrelations between the tables are marked in bold in tables and marked with asterisks and explained.

Table 8. Timber on forest land in 1999–2022 according to NFI (1000 m³)

	Timber on forest land																	
	Total forest land					Forest land available for wood supply (FAWS)					Forest land not available for wood supply (FNAWS)					Timber per ha		
	Total	Growing stock		Deadwood		Total	Growing stock		Deadwood		Total	Growing stock		Deadwood		Total	FAWS	FNAWS
				standing	lying				standing	lying				standing	lying			
Year	1000 m3	1000 m3	RE95*** (%)	1000 m3		1000 m3	1000 m3	RE95 (%)	1000 m3		1000 m3	1000 m3	RE95 (%)	1000 m3		m3/ha		
2022*	**504134**	467163	2.9	15169	21802	**387119**	360586	3.2	10742	15790	**117016**	106577	9.3	4427	6012	206	196	247
2021**	**511109**	474526	2.9	14974	21608	**399445**	372646	3.2	10899	15899	**111664**	101880	9.6	4075	5709	209	201	244
2020	519477	482979	2.8	14743	21755	425868	397675	3.2	11322	16872	93609	85304	10.7	3421	4883	213	208	238
2019	528879	492190	2.8	15001	21688	422008	394035	3.1	11349	16625	106870	98155	11.0	3652	5063	216	210	241
2018	530694	494296	2.8	14832	21567	433167	404643	3.1	11484	17040	97527	89653	11.0	3348	4526	217	213	238
2017	536023	499566	3.1	14982	21475	442182	413249	3.6	11578	17355	93841	86317	11.9	3404	4120	220	216	240
2016	534393	497922	3.4	14875	21597	449133	419491	4.0	11832	17810	85260	78431	13.2	3043	3786	221	218	237
2015	534549	497207	3.6	15858	21485	457264	426066	4.1	12840	18358	77285	71140	14.1	3018	3127	221	219	232
2014	530970	493380	3.5	16204	21386	462464	430482	4.0	13381	18602	68506	62899	14.9	2824	2784	220	220	227
2013	525421	488096	3.3	16226	21099	458770	427041	3.8	13480	18249	66650	61055	14.4	2746	2849	221	220	225
2012	514535	478660	3.5	16216	19659	452522	422047	3.8	13601	16873	62012	56613	15.2	2614	2785	218	218	221
2011	505211	470785	3.6	16205	18222	448794	419275	4.0	13732	15787	56417	51509	16.5	2473	2435	215	215	213
2010	493137	461000	3.7	15896	16242	441442	413657	3.9	13712	14073	51695	47342	16.4	2184	2169	211	211	208
2009	485868	454880	3.5	15346	15642	433318	406583	3.8	13189	13546	52550	48297	15.5	2157	2096	208	209	201
2008	478044	448846	3.4	15111	14088	428013	402733	3.7	13002	12278	50031	46112	15.3	2109	1810	205	207	195
2007	476160	447609	3.5	15228	13323	427141	402051	3.7	13298	11791	49019	45558	15.7	1929	1532	203	204	193
2006	470390	442944	3.4	14704	12741	423640	399351	3.7	12929	11360	46749	43593	16.2	1775	1381	202	203	196

* 2022 figures were used as closing stock for 2022 in table A2a
** 2021 figures were used as opening stock for 2022 in table A2a
*** RE95 Relative error (%) at 95% confidence level
Source: Estonian Environment Agency, NFI2022

Table 9. Timber on other wooded land in 2006–2022 according to NFI (1000 m^3)

	Area				Other Wooded Land (OWL)					OWL Available for Wood Supply (OWL AWS)					OWL timber per ha	
	OWL		OWL AWS		Total	Growing stock		Deadwood		Total	Growing stock		Deadwood		Total	AWS
								standing	lying				standing	lying		
Year	1000 ha	RE95*** (%)	1000 ha	RE95 (%)	1000 m3	1000 m3	RE95 (%)	1000 m3		1000 m3	1000 m3	RE95 (%)	1000 m3		m3/ha	
2022*	**103**	9.3	**76**	10.5	**2482**	2287	39.3	35	161	**2334**	2146	42.0	30	157	24	31
2021**	**101**	9.4	**75**	10.5	**2435**	2232	39.0	67	137	**2303**	2107	41.3	62	134	24	31
2020	101	9.5	75	10.7	2142	1926	37.9	85	131	2017	1808	40.4	81	128	21	27
2019	100	9.7	76	10.8	1582	1388	27.7	92	102	1463	1294	29.6	88	81	16	19
2018	98	9.9	74	10.9	1434	1255	25.9	85	94	1298	1143	27.7	82	72	15	17
2017	97	11.3	77	12.3	1483	1237	28.7	74	173	1288	1112	31.4	71	104	15	17
2016	97	12.1	78	13.1	1503	1271	31.3	46	186	1306	1150	33.8	44	112	15	17
2015	102	11.9	83	13.0	1610	1377	31.7	35	199	1401	1253	34.3	33	115	16	17
2014	103	11.6	85	12.5	1812	1583	30.3	47	182	1596	1435	32.6	45	115	18	19
2013	107	11.0	90	11.8	1901	1631	26.0	68	202	1709	1509	27.5	67	133	18	19
2012	108	11.4	91	12.0	2150	1903	27.3	92	155	2060	1816	28.4	91	153	20	23
2011	118	11.2	97	12.1	2415	2109	29.5	94	213	2318	2014	30.7	92	212	20	24
2010	128	11.4	106	12.0	3354	2989	30.7	169	196	3239	2877	31.8	168	194	26	30
2009	108	12.2	89	12.9	2926	2587	34.0	149	191	2866	2528	34.7	147	191	27	32
2008	87	13.7	69	14.2	2508	2207	35.0	131	170	2454	2156	35.7	129	170	29	35
2007	63	16.8	49	17.8	1826	1627	45.1	104	94	1789	1592	46.0	102	94	29	36
2006	36	23.6	29	24.8	1295	1179	52.3	95	20	1264	1150	53.5	94	20	36	43

* 2022 figures were used as closing stock for 2022 in table A2a
** 2021 figures were used as opening stock for 2022 in table A2a
*** RE95 Relative error (%) at 95% confidence level
Source: Estonian Environment Agency, NFI2022

Table 10. Increment and mortality of growing stock on forest land and other wooded land in 2004–2023

Period		Increment and mortality of growing stock on forest land (1000 m^3)									Increment and mortality of growing stock on Other wooded land (1000 m3)		
		Total forest land			Forest available for wood supply			Forest not available for wood supply					
Reporting year	Assess-ment period	GAI	M	NAI	GAI	M	NAI	GAI	M	NAI	GAI	M	NAI
2023	2014/23	13500	4300	9100	11500	3400	8100	2000	900	1000	77	38	40
2022	2013/22	13400	4300	9100	11500	3400	8100	1900	900	1000	83	29	54
2021	2012/21	13500	4000	9500	11700	3200	8600	1800	800	900	78	29	50
2020	2011/20	14500	4100	10400	12900	3400	9600	1600	700	800	71	30	42
2019	2010/19	15500	4200	11300	13900	3500	10400	1600	700	900	65	18	47
2018	2009/18	16700	4300	12400	15100	3700	11400	1600	600	1000	59	21	38
2017	2008/17	17500	4300	13100	15400	3700	11700	2100	600	1400	63	21	42
2016	2007/16	17800	4500	13300	15800	3900	11900	2000	600	1400	61	20	41
2015	2006/15	17600	4600	13000	15900	4000	11900	1700	600	1100	64	20	44
2014	2005/14	16900	4500	12400	15400	4000	11500	1500	500	900	64	14	50
2013	2004/13	16200	4500	11700	14800	3900	10900	1400	600	800	70	5	65
2012	2003/12	15800	4400	11400	14500	3800	10600	1300	600	800	65	5	60
2011	2002/11	15900	4300	11600	14600	3800	10800	1300	500	800	71	10	61
2010	2001/10	16200	4100	12000	14900	3700	11300	1300	400	700	74	n/a	n/a
2009	2000/09	16700	4200	12500	15300	3700	11600	1400	500	900	63	n/a	n/a
2008	1999/08	16800	4200	12600	15300	3700	11600	1500	500	1000	45	n/a	n/a
2007	1999/07	17000	4300	12800	15500	3700	11800	1500	600	1000	27	n/a	n/a
2006	1999/06	16800	4300	12500	15400	3800	11600	1400	500	900	12	n/a	n/a
2005	1999/05	16500	4400	12100	15100	3900	11200	1400	500	900	n/a	n/a	n/a
2004	1999/04	16800	3900	12800	15300	3700	11700	1500	200	1100	n/a	n/a	n/a

GAI - gross annual increment, M - mortality, NAI - net annual increment

Source: Estonian Environment Agency, NFI2023

Table 11. Timber removals in 2020–2022 as reported to Joint UNFAO/ECE/Eurostat/ITTO Forest Sector Questionnaire (JFSQ)

Product code	Product	Timber removals (1000 m^3)					
		overbark			underbark		
		2020	2021	2022	2020	2021	2022
1	ROUNDWOOD (WOOD IN THE ROUGH)	12924	11572	**12813**	11288	10083	11164
1.1	WOOD FUEL (INCLUDING WOOD FOR CHARCOAL)	5117	4523	5012	4390	3888	4308
1.1.C	Coniferous*	1666	1563	1732	1515	1421	1575
1.1.NC	Non-Coniferous*	3451	2960	3280	2876	2467	2733
1.2	INDUSTRIAL ROUNDWOOD*	7807	7049	7801	6898	6195	6856
1.2.C	Coniferous*	5176	4234	4687	4705	3849	4261
1.2.NC	Non-Coniferous*	2631	2815	3114	2193	2346	2595
1.2.NC.T	of which: Tropical*	0	0	0	0	0	0
1.2.1	SAWLOGS AND VENEER LOGS	4919	4608	5105	4387	4088	4529
1.2.1.C	Coniferous	3805	3280	3634	3459	2982	3304
1.2.1.NC	Non-Coniferous	1114	1328	1471	928	1107	1226
1.2.2	PULPWOOD, ROUND AND SPLIT	2828	2381	2638	2458	2054	2276
1.2.2.C	Coniferous	1341	924	1024	1219	840	931
1.2.2.NC	Non-Coniferous	1487	1457	1614	1239	1214	1345
1.2.3	OTHER INDUSTRIAL ROUNDWOOD	60	60	58	52	52	51
1.2.3.C	Coniferous	30	30	29	27	27	26
1.2.3.NC	Non-Coniferous	30	30	29	25	25	24

Source: JFSQ reports 2021, 2022, 2023; Estonian Environment Agency

Table 12. A2 (a) Timber on wooded land, in 1000 m^3 over bark, reference year = 2022

Assets (stocks and flows)		Opening stocks (December t-1)	Net increment	Removals	Irretrievable losses	Statistical re-classification (+/-)	Balancing item (+/-)	Closing stocks (December t)
Code	Description							
1	Forest	**511109.35**	9100	**12013**	1996.32	0	-2065.78	**504134.25**
1.1	Forest available for wood supply	**399445.17**	8100	**12013**	1996.32	-4802.77	-1614.46	**387118.62**
1.2	Forest not available for wood supply	111664.18	1000	0	0	4802.77	-451.32	117015.63
2	Other wooded land	**2434.97**					47.38	**2482.35**
2.1	Of which available for wood supply	2302.92					30.71	2333.63
3	Other land with tree cover available for wood supply			800				-800

3.6 Problems and challenges in the compilation of table A2a: timber on wooded land

Table 13. Problems and challenges in the compilation of table A2a: timber on wooded land

Description	Possible solution	Time of implementation
Shortcomings related to the application of the NFI methodology:		
Estimates of opening and closing area are based on National Forest Inventory (NFI) where according to the methodology and its application the estimates are for the whole year not for the end or beginning of the calendar year (period of fieldwork measurements is from May to October);	Not possible in case of NFI	
NFI yearly estimates are calculated according to the measurements of the last 5 years and calculated estimate is attributed to the last year of field-works	Estimates based on single year can be reported in case of fully GIS based reporting on land-use as multi-source inventory (NFI, EO, etc) as demanded in GHG reporting	Not before 2027 and later than 2030
NFI is a sample-based inventory i.e., all estimates have statistical error which is bigger the smaller is the probability of occurrence of investigated phenomenon (especially in case of other wooded land category and flow items).	Periodic validation of results with other data sources, using the average estimates, modelling in case of need	open
Issues related to the definitions and use of different data sources or the data processing rules:		
- Flow estimates ("net annual increment", "removals" and "irretrievable losses") refer for different fractions of timber. "Net annual increment" is calculated only for stemwood; but "removals" and "irretrievable losses" include stemwood and non-stemwood	Not possible to solve; needs wider agreement between countries and revision of handbook and definitions in regulation	During the revision of EFA handbook
- It is questionable whether the initial idea of calculation the closing stock from opening stock and flow items is achievable based on currently available data and for all categories of wooded land.	Not possible to solve due to different inclusion of timber fractions in stock and flow items (non-stemwood and deadwood); needs wider agreement between countries and revision of handbook and definitions in regulation	During the revision of EFA handbook
- - Inclusion into re-classification category the decrease of the deadwood as a result of the decaying.	This is possible solution but needs wider agreement between countries and revision of handbook	During the revision of EFA handbook
Distribution of balancing item or reclassification to sub-categories of forest land is based on their relative share not on actual data	Approach remains same for time being	open
Data availability for "Other land with tree cover available for wood supply" according to EFA definition. There are removals outside the forest land and urban settings e.g., inland waterbodies (trees on the slopes and sides of the ditches), infrastructure (trees under the corridor of powerlines) which are not assigned with the forest-land or other wooded land label in NFI. The present narrow scope of definition for "Other land with tree cover available for wood supply" would leave ca 0,8 million m3 unaccounted. The approach was taken to report all removed timber from non-forest lands under the "Other land with tree cover available for wood supply"	Not possible to solve if definition and reporting table remains same. Approach remains same for time being until the definitions and reporting table will be revised	During the revision of EFA handbook
There is not enough data available now to assess properly the flow items of other wooded land. The relative error of OWL estimates	No action needed, possible developments do not provide data of good quality	

(phenomenon with relatively small area) may be much higher than actual changes. Further analysis is needed before those items can be reported to avoid confusing high fluctuations in stock estimates (mostly caused by extreme stock estimates on single sample plots). Removals' figures from OWL can be considered insignificant as the total area and stocking level are very low. At the moment the OWL removals are accounted under Other land with tree cover available for wood supply	and are not cost-effective; it is not sensible to report flow items for OWL	

* Descriptions from the Grant Agreement no NUMBER — 101022852 — 2020-EE-ENVACC, Development of environmental accounts; Activity 4. "Developing a methodology and compilation of forest accounts"; D1.12 Description of the methodology and methodological issues for forestry account; Methodological report

Evaluation of the specific methodological issues are described also in the respective chapters regarding timber stock. Feedback on the applicability of the EFA guide for the compilation of table A2a: timber on wooded land is generally positive: guidance in EFA handbook is generally applicable and approaches well described. Problems arise from the national circumstances (data availability, coverage, quality, etc.) which do not allow to follow fully the preferred approaches in manual. More relevant national case examples could have been included into the description of methodology. Some issues cannot be solved at handbook level, as definitions were provided in regulation 691/2011 amendment prior to the work on handbook. This situation necessitates need for several revisions of handbook in coming years (especially the handling of different timber fractions for different balance items). Country experiences and possibilities must be taken into consideration.

3.7 The distribution of the timber stock on "Other wooded land" into subcategories

The distribution of the timber stock on "Other wooded land" into "OWL available for wood supply" and "OWL not available for wood supply" was elaborated. The breakdown to subcategories by types of other wooded land in EFA tables follow the approach of estimates for subcategories of forest land. These subcategories are based on NFI plot data. Locations of the sample plots are compared to the nature protection GIS layers from the Estonian Nature Information System EELIS. Every sample plot gets the protection/management status according to the strictest protection (quite often several different protection statuses overlap). The protection status is converted into 3 main forest categories:

- Unmanaged (Strictly protected) forest/OWL land area where no forest management is possible, equals to the "not available for wood supply";
- Protection forests/OWL where forest management is restricted but not forbidden;
- Commercial forests/OWL where forest management is possible according to the rules set in Forest Act.

Protection forests/OWL and commercial forests/OWL together form the area of forest/OWL available for wood supply. Distribution of the forest/OWL subcategories according to the nature protection regimes has been agreed with the Ministry of Environment. For more details see Yearbook Forest 2021, chapter Environment . Data of sample plots are generalized to the whole territory of Estonia.

3.8 Allocation of the "Other changes in volume, which are not defined elsewhere"

Methodology for the estimation of the timber stock regarding the balancing items "Other changes in volume, which are not defined elsewhere" was described. Due to the different inclusion of timber fractions in definitions at regulation level it is hard to solve the issue on reporting table level. The only practical solution is to properly record different fractions of reporting items in comments and attribute all possible "other reasons for change in stock" to balancing item. For more see below in the section "Analysing under which item the removals of dead wood and non-stemmed wood should be reported".

3.9 Estimation of the timber stock on " Other land with tree cover available for wood supply "

Methodology for the estimation of the timber stock regarding the category "Other land with tree cover available for wood supply" was analysed and elaborated according to the EFA manual definition. During the grant proposal it was still open how the handbook will treat the coverage of Other land with tree cover available for wood supply. It is not

possible to describe the methodology and compile statistics on "Other land with tree cover available for wood supply" according to EFA definitions. The EFA definition includes agro-forestry, short-rotation forestry and short-rotation coppices on agricultural land. Those land-use types are almost non-existent in Estonia. There have been scientific test trials with the short rotation coppice of willow species. The hybrid aspen plantations have been planted on agricultural lands but those fulfil the forest land definition requirements before being felled. However there exist trees (which fulfil the requirements of definition of "Other land with tree cover" according to FRA definition) outside the forest land and urban settings e.g., inland waterbodies (trees on the slopes and sides of the ditches), infrastructure (trees on the corridor of powerlines) which are not assigned with the forest land or other wooded land label in NFI. There is a reasonable amount of woody biomass removed from outside the wooded land (infrastructure, inland water bodies – slopes of the ditches). This creates the inconsistency between the tables A1a and A2a as ca 8% of timber harvested (removals reported in table A2a) outside of woodland categories in table A1a. It was decided to report the removals from non-wooded lands under this category as this is substantial amount which otherwise remains unrecorded in table. Thereby the total timber removals become comparable with the reporting A, B and C tables.

3.10 Analysing the allocation of removals of deadwood and non-stemwood

By the definition of removals, it must include the removals of non-stemwood (mostly branches) and deadwood. Asset account table A2a includes items which inconsistently either include or exclude the non-stemwood and deadwood[33]:

Table 14. Inclusion of timber fractions for different items in reporting table A2a

Item	Inclusion of non-stemwood	Inclusion of deadwood	Inclusion of stemwood
Opening/closing stock	No*	Yes	Yes
Net annual increment	No	No	Yes
Removals	Yes	Yes	Yes
Irretrievable losses	Not defined	Not defined	Yes
Statistical re-classification	Not defined	Not defined	Yes
Balancing item	Not defined	Not defined	Yes

* EFA definition asks for big branches, but FRA definition asks only for stemwood, this is routine approach and executed in volume calculation models (the data of big branches is not available and there are no relevant models available)

It is important to note that both growing stock and deadwood are reported on a similar basis in the specific reporting frameworks: either only above-ground stemwood (like stemwood volume in FRA or MCPFE reporting) or above-ground and below-ground stemwood with non-stemwood (like biomass estimates in FRA reporting or GHG LULUCF sector reporting). In forest accounts the usability of timber is in focus, therefore the only stem-wood is reported for both growing stock and deadwood. Below-ground woody biomass has almost no use so far. Branches of trees and undergrowth is being used to a limited extent as source of forest chips used in energy sector. There is only limited data available about the harvested non-stemwood volumes and figures are based on expert estimates and partial statistics. The non-stemwood estimates are based on biomass conversion and expansion factors not on direct measurements. Stock increment figures are also based on stemwood measurements/calculations, this is another reason to choose the stemwood reporting approach. Single tree volume calculation formulas are based on single stem without branches i.e. no branches reported (as asked by the SEEA) on growing stock, which is approach used by FRA.

The estimate for the Removals follows the definition of EFA and Joint Forest Sector Questionnaire (JFSQ), including non-stemwood and deadwood. It must be noted that forest accounts' framework is meant to capture all harvested woody biomass (i.e. stemwood and non-stemwood, including deadwood) as it is the timber input to economy and must cover the same scope as EFA B and C tables. Therefore, non-stemwood and deadwood should be reported under the removals and not assigned to balancing item (this guarantees the comparability of estimates for timber entering the economy over the A, B and C tables).

The definition of Irretrievable losses according to the EFA framework includes felling residues, all fellings from windthrow that cannot be removed from the forest, as well as timber lost through forest fires. There is no national definition/data for irretrievable losses comparable to EFA definition. Felling residues can be assessed indirectly as a share from total felling volume, comparison of volume of felled trees to the wood removals volume (direct

[33] For definitions see section Definitions applied for the table A2a and source data (NFI, FRA; JFSQ)

measurements of harvested sortments), theoretical sortmentation of felling volume or simple fixed share. The approach in present study is to provide expert estimate as close as possible to the EFA definition. The general approach to felling residues must be on a similar basis with removals. If removals include the harvest of non-stemwood, then felling residues should account the non-stemwood (mostly branches) left in the forest during the harvest. Relevant woody biomass must be included into the Irretrievable losses' estimate.

Statistical re-classification must reflect the timber volume change due to the changes in the status of wooded land (e.g. FAWS to FNAWS), which is based on area change in table A1a. By the logic it must include the same fractions of timber as opening/closing stock (i.e. including deadwood but not the non-stemwood).

Balancing item[34] in addition to balancing out discrepancies may incorporate other reasons for change in the volume of timber stocks that are not captured in other entries.

The described situation provides no chance for actual balance approach in A2a table. Due to the different inclusion of timber fractions in definitions at regulation level it is hard to solve the issue on reporting table level. The only practical solution is to properly record different fractions of reporting items in comments and attribute all possible "other reasons for change in stock" to balancing item. It must be noted that non-stemwood estimates are usually model based averages and do not reflect actual situation. Deadwood is mostly well-covered measurement. Based estimates from NFI.

3.11 Conclusions on the bottlenecks and the needs for improvements

For bottlenecks see Table 13. "Problems and challenges in the compilation of table A2a: timber on wooded land".

Future improvement needs:

- Topics related to A1a table wooded land area estimates, which will be the basis for timber calculations
  - Research project in collaboration of Tartu University and Estonian Environment Agency elaborated a new calculation scheme for opening and closing stocks using the increase and decrease estimates from GHG reporting CRT tables, which will avoid the recalculation of full time-series[35]. The implementation of the results will be carried out in 2025.
  - Future development can be foreseen for area and changes of wooded land as fully GIS based reporting on land-use (most probably multi-source inventory (NFI, EO, etc)) is demanded in GHG reporting and forest monitoring regulation draft[36]. This is costly and time-consuming development process including involvement of different institution, and not possible to solve with present resources. Once operational, then the results can be used in EFA reporting.
- Production of NFI GAI and mortality models based on measurement data to reduce further the fluctuations of estimates caused by variation. This is a research task of NFI in coming years.

[34] From EFA manual: *The entry balancing item should be used to balance out discrepancies between opening and closing stocks after recording the flows explicitly defined in this account (increases, decreases and statistical re-classification) and observed based on the source data. Recording entries under this item is intended to ensure that the accounting identity for asset accounts is applied. In addition to balancing out discrepancies, this entry may incorporate other reasons for change in the volume of timber stocks that are not captured in other entries. This entry should not be used to record the net change in stocks between opening and closing stocks.*

[35] Statistilise metsainventuuri (SMI) arendamine, Tartu Ülikooli matemaatika ja statistika instituudi (MSI) lõpparuanne, TÖÖVÕTULEPING nr 4-1/23/52; https://keskkonnaportaal.ee/et/statistilise-metsainventuuri-smi-arendamine

[36] Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on a monitoring framework for resilient European forests, https://environment.ec.europa.eu/publications/proposal-regulation-forest-monitoring-framework_en : *Article 3 Forest monitoring system*
1. The Commission shall set up, in cooperation with the Member States in accordance with Article 11, and operate a forest monitoring system comprising the following elements:
(a) a geographically explicit identification system for the mapping and localisation of forest units, as set out in Article 4;
(b) a forest data collection framework, as set out in Articles 5 and 8;
(c) a forest data sharing framework, as set out in Article 7.

3.12 Feedback on the participation in international consultations

The process of EFA handbook/guidelines elaboration was well planned and implemented. The quality of discussions on timber lacked the presence of forest inventory experts from countries. Several issues remained without proper interpretation (inclusion of non-stemwood and deadwood in different items, how to report timber on timber outside the wooded land area if EFA narrow definition is used) and description. Those questions were raised several times but were neglected in the process. It is foreseeable that handbook needs revision on mentioned issues. Despite the described situation the overall quality of handbook is good (well written and organised document) but will need revision in coming years after the analysis of country experiences in actual reporting for A2a table.

4 Wooded land in monetary units

4.1 Analysis of the bottlenecks identified in the previous stages of the development work and definition of improvement needs

In the previous stage of the development of forest accounts, which analysed data and results regarding 2020, several challenges were identified in determining the monetary value of forest land.

Valuation methods that take into account the nature of different categories of forest land should be investigated more and developed further in cooperation with the experts of this field.

It was foreseen that the unit value of the transactions could be compared to the estimated productive values of the forest land type and the most suitable one could be chosen.

It was foreseen that methods and the prices for the forest assets not available for wood supply will be discussed and analysed with experts. This comprised the areas of protected forest but also grasslands and bogs. An adjusted market value or taxable value of the land was foreseen as an alternative to an OWL assessment not used for timber supply.

4.2 Monetary value of wooded land based on transaction prices of bare wooded land

Monetary value of wooded land based on transaction prices of bare wooded land rerefers to the direct method in the EFA Handbook 3.111. The monetary value of forest land are compiled based on data regarding the area and changes in physical values of forest land, as detailed in Table A1a “Area of Wooded Land.” Market value data for transactions involving bare wooded land and forest real estate are available from the Land Board (Maa-amet) price statistics database and the annual real estate market reviews.[37]

According to the Land Board's annual real estate review, the median price of transactions with bare (unforested) forest land was €2636 per hectare in 2022. This transaction price is applied to forest land available for wood supply and other wooded land available for wood supply. The median price is multiplied by the physical units presented in EFA Table A1a.

The results of the assessment of the monetary value of forest land based on transaction prices of bare wooded land is presented in Table 15. Monetary value of wooded land based on transaction prices of bare wooded land.

[37] https://maaamet.ee/sites/default/files/documents/2023-02/Eesti%20kinnisvaraturg%202022.pdf

Table 15. Monetary value of wooded land based on transaction prices of bare wooded land, 2022, million EUR

Code	Description	Opening area (December T-1)	Afforestation and other increase	Deforestation and other decrease	Revaluation	Statistical reclassification(+/-)	Balancing Item	Closing area (December T)
1	Forest	4754	3	2	1498	-35	-3	6215
1.1	Forest available for wood supply	4570	3	1	1497	-41	-3	6025
1.2	Forest not available for wood supply	183	0	0	1	6	0	190
2.	Other wooded land	173			0		60	233
2.1	Of which available for wood supply	173	n/a	n/a	0		60	233
3	Other land with tree cover available for wood supply	n/a	n/a	n/a	n/a	n/a	0	n/a

As noted in the EFA manual (3.108), transaction prices are typically averages over the accounting period rather than specific to the beginning or end. Therefore, the prices from two consecutive accounting periods are averaged to estimate the price relevant at the beginning of the second period. The average of the median prices from 2021 and 2022, which is €2298 per hectare, was used to calculate the value of the opening forest land area in 2022. The closing area of 2022 was calculated based on the average of the median prices from 2022 and 2023[38]], which was €3054 per hectare.

The value of the changes in the area of forest land was calculated using the median price of transactions in 2022.

4.3 Monetary value of wooded land based on the taxable value of forest land

Monetary value of wooded land is based on the taxable value of forest land, direct method in the EFA handbook 3.112. According to EFA handbook, the direct method can also be implemented using prices of forest land per hectare determined through administrative processes or collected via surveys of relevant agencies (for example taxation offices) which are then scaled to provide total values for wooded land.

The regular land assessment is carried out by Land Board[39] and is a market-based land valuation that determines an approximate land value, or the taxable value, for each cadastral unit. It is a mass appraisal resulting in a statistical generalization. Only the value of the land was considered without taking into account the trees growing on it. The most recent general land valuation took place in 2022, and the new taxable values were implemented on January 1, 2024.

The taxable value of forest land is the average price of sales transactions of bare forest land. Transactions were verified by comparing satellite images and transaction dates to ensure that the dataset used for analysis consisted only of clear-cut areas. Based on sales transactions, the base taxable value for forest land was determined to be €1883/ha. The "Taxable Value of Land" is the current value used in other land-related operations (e.g., land reform-related procedures).

The value of forest available for wood supply and the value of other wooded land available for wood supply are calculated with the base value for forest land €1883/ha. Forest land with strict nature conservation restrictions is valued at the lowest price level, €400/ha. This price is applied in current development grant to calculate the monetary value of forest land not available for wood supply.

The results of the assessment of the monetary value of forest land based on taxable value is presented in Table 16. Monetary value of wooded land based on taxable value.

[38] https://maaamet.ee/sites/default/files/documents/2024-02/Eesti%20kinnisvaraturg%202023.pdf
[39] https://maaamet.ee/maatoimingud-maakataster/maa-hindamine-ja-tehingud/2022-aasta-maa-korraline-hindamine#metsamaa-hindamismud

Table 16. Monetary value of wooded land based on taxable value, 2022, million EUR

Code	Description	Opening area (December T-1)	Afforestation and other increase	Deforestation and other decrease	Revaluation	Statistical reclassification(+/-)	Balancing Item	Closing area (December T)
1	Forest	3928	2	1		-23	-3	3904
1.1	Forest available for wood supply	3745	2	1		-29	-3	3715
1.2	Forest not available for wood supply	183	0	0		6	0	189
2.	Other wooded land	152	?	?	0		3	155
2.1	Of which available for wood supply	142	n/a	n/a	0		2	144
3	Other land with tree cover available for wood supply	n/a	n/a	n/a	n/a		n/a	n/a

While such taxable value is determined irregularly, it is appropriate to update the prices for the effects of inflation using a forestry related price index. The information provided by Statistics Estonia currently does not include a price index directly related to forestry. For the European Forest Accounts, it is possible to use data from the Land Board and calculate an index based on forest transaction prices, for example. If 2022 is taken as the reference year, when the median price of forest transactions was €7323/ha, then in 2023, the median price was €7358/ha, resulting in a price index of 1.00.

4.4 Monetary value of wooded land based on transaction prices with forests and timber stock value

The monetary value of forest land, based on forest transaction price, i.e. the residual value method as described in paragraph 3.113 of the EFA Handbook, utilizes transaction data of forest properties (including both forest land and standing timber) to determine the average price per hectare, which is then multiplied by the total area of forest land. To isolate the value of wooded land, the value of standing timber is deducted, yielding the residual value.

For this method, the median transaction value of €7323 per hectare of forest in 2022 was used. Species-specific data on managed stands' age classes, provided by the Environment Agency [40] (2023), were used to calculate the NPV of forest management. The NPV calculation used 20-year age classes and harvesting volumes of dominant species at rotation end. A 2.3% interest rate, matching the rate used by the RMK in 2022 [41], was applied to calculate present values.

After deducting the average Net Present Value (NPV) of one hectare of forest (€12 021), the residual value of forest land per hectare is €-4698. Subtracting the value of the timber stock from the value of forest transactions thus results in an estimated negative outcome, which is not appropriate to use as the actual financial value of forest land. In practice, managed forests that supply wood still hold a positive value.

4.5 Monetary value of bare forest land: Faustmann method

Faustmann method for the valuation of land is referred for chapter 3.115 in the EFA handbook. In the report from the previous phase of the forest accounts development project (2022-EE-EGD, grant 101113157, Activity 4. "Developing a methodology and compilation of forest accounts"), was emphasized the need to develop and implement valuation methods that consider the unique characteristics of different categories of forest land. These methods should be

[40] https://keskkonnaportaal.ee/sites/default/files/Teemad/Mets/Mets2021.pdf
[41] https://media.rmk.ee/files/RMK_majandusaasta_aruanne_2022.pdf

designed in collaboration with field experts. Unit transaction values could then be compared to the estimated productive values of various forest land types, allowing the selection of the most appropriate valuation method.

The approach that accounts for forest land productivity is based on the well-known Faustmann formula, which calculates the Land Expectation Value (LEV). This method evaluates the monetary value of land by incorporating all future benefits from timber production, assuming either infinite or long-term asset life. Ideally, this method is applied separately for different tree species to ensure accuracy. By utilizing the Faustmann method, it becomes possible to estimate the monetary value of forest land with varying levels of productivity.

As specified in the EFA Handbook 3.114, the Faustmann method is particularly useful when transaction data for forest land is unavailable.

In Estonia, forest site types are categorized into 27 types, further divided into seven quality classes, resulting in at least 189 distinct land plot categories. Given the labor-intensive nature of calculating LEV for each combination, this project concentrated on five common forest site types: Oxalis, Filipendula, Aegopodium, Rhodococcum, and Transitional bog. For each site type, the LEV was calculated for its most typical quality class using formal forest management rules and established best practice models.

Table 17. The Land Expectation Value (€*ha-1) in most common forest site types in Estonia

Forest site type	Quality class	LEV, €* ha-1
Oxalis	I	6 702
Filipendula	I	5 232
Aegopodium	I	5 392
Rhodococcum	II	4 317
Transistional bog	III	3 703

The results of the sample calculations reflect the varying productivity of stands in different site types. For example, the LEV of a transitional bog is almost half that of forest land in the Oxalis site type. At the same time, the calculated LEV is significantly higher than the average price of transactions involving forest land.

The aspects mentioned above (numerous site types, quality classes, and mixed stands) make the use of the Faustmann method extremely time-consuming, which is why its application for EFA purposes within a limited budget is not realistic.

4.6 Comparison of various applied methods for the estimation of the monetary value of wooded land

The methods and results for the estimation of the monetary value of wooded land were discussed with the Estonian expert team, Swiss Statistics experts Franz Murbach and the Finnish expert from LUKE.

Based on the comparison of various methods described in EFA handbook, at first the suggestion was to select an approach for assessing the monetary value of forest land that applies the median transaction price for forest land used for timber supply and the minimum taxable value for land not used for timber supply. For forest land valuation, the decision was to use the prices from the previous calendar year and the current year for assessments at the beginning of the year (value of the opening area). To account for changes during the evaluation period, the average prices for the same year should be applied. For year-end valuations of closing area, the average prices from the current year and the following year should be utilized. In cases where information on the following year's prices is unavailable, the average transaction prices from the current year under review should be used instead.

The drawback of this approach lies in the lack of representativeness of the sample. In 2022, 36 transactions with total area 179.2 hectares were made. Transactions involving forest lands are predominantly conducted with lands that include average and better growth site types. As a result, the average and median price of clear-cut areas in Estonia reflects the value of average and slightly above-average forest lands.

Discussing the advantages and disadvantages of alternative valuation methods, the experts concluded that, taking into account the availability of data, it is practical to use the administratively determined tax value for EFA accounts. The regular land assessment is carried out by Land Board and is a market-based land valuation that determines an approximate land value, or the taxable value, for each cadastral unit. It is a mass appraisal resulting in a statistical generalization. The most recent general land valuation took place in 2022.

While using the median value of transactions provides a good indication of the dynamics in the monetary value of forest land, it likely overestimates the total value. Since the compilation of the statistics on the monetary value of forest land is not yet mandatory in the frame of European Forest Accounts, this opportunity could be utilized.

Due to the opinion that median value of transactions likely overestimates the total value of the wooded land and based on the methods and the comparison of pros and cons of various methods described in EFA handbook. The decision was made that the way to obtain the most accurate value for forest land would be by using administratively determined forest land values, as applied in countries such as Bulgaria, Czechia, Lithuania, the Netherlands, and Poland. Since Estonia has now established the taxable value of land in 2022, it is appropriate to use the values presented in Table 16. Monetary value of wooded land based on taxable value when reporting the results to EFA.

Question of the price index for future calculations is a matter of discussion to be solved in future. National Accounts will be responsible in future for the value of the forest land. If necessary, appropriate adjustments will be made to National Accounts estimates.

5 Timber stock on forest land, valuation

5.1 Timber stock on forest land, methodology and compilation of the account in monetary units, A2b

5.1.1 Specific methodological developments

In the previous stage of the work, which analysed data and results from 2020, several challenges were identified in determining the monetary value of forest land, timber stock and flows.

A primary challenge in compiling the EFA (European Forestry Accounts) monetary tables on assets and flows was the lack of a universally agreed-upon methodology. However, Estonia’s testing results and discussions contributed to refining the EFA definitions for handbook in written as well as on Eurostat expert group meetings during 2023 and 2024.

Regarding Estonia’s specific issues, previous analyses identified the following issues of concern: for the EFA timber valuation: lot of data from the State Forest Management Centre (RMK) have been used, as it has been collected systematically and consistently, providing a statistically reliable dataset. This data includes the cost and price figures for state forest management. These cost and price figures were also applied for the valuations related to private forests. It is widely known, however, that both timber prices and operational costs are generally lower in private forests compared to the state forest management organization. Consequently, it has been foreseen to specify timber prices and management costs for private forests. However, ideally specification of timber prices and management costs could be achieved through targeted studies.

It was desired that future assessment of timber stock would in future consider different categories of forest land, important characteristics of stands (e.g. age, tree species) and calculation of results. Highlighting the differences in forest timber stock valuation methods and results; In June 2024, the EFA Handbook was finalized, and the alternative monetary valuation methods it presents have been applied. It was communicated with Eurostat that the scope of the

assessment will be linked to the scope of the EFA guidelines. In this chapter the results of the assessments based on the methods of EFA guidelines are described. Also, the solving of Estonia's specific issues is outlined.

Possible solutions related to the aforementioned bottlenecks are presented below in the descriptions of methods for assessing the monetary value of timber stock on forest land. It was communicated with Eurostat during the course of the work that EFA manual definitions, as those have become available, in the duration of the grant, will be applied as a priority option in methodological decisions.

5.2 Timber stock on forest land, testing of the EFA methodologies

The EFA handbook outlines four methods for estimating the financial value of a timber stock: the net income method, age constant method, stumpage value method, and consumption value method.

In this project, several methods have been tested for assessing the timber stock, including one, which is not described in the EFA manual. However, when using any method, it is important to calculate the average stumpage price for the year under observation. The methodology of calculation of the average stumpage prices is described in subchapters below.

5.2.1 EFA principles

Estimating the monetary value of timber stocks (EFA Table A2b) follows some basic principles (see EFA Handbook, chapter 4.4.3). The different valuation methods of standing timber were discussed and tested for Estonian EFA in the following subchapters. Basically, each volume item of the physical timber balance (EFA Table A2a), stock and flow, could be multiplied by a price to obtain a monetary value. Although the principles of National accounts (ESA2010) must be applied, implementation can, depending especially on the available data and statistical resources, need to undergo pragmatic simplifications.

Two perspectives should be and were applied on wooded land and timber stocks: the production border perspective and the availability for wood supply perspective. Combining both perspectives is crucial to calibrate correctly the monetarization process, and the integration of economic values in the production account of EFA (EFA table B1, B2) and National accounts (especially NACE 02 Forestry and logging industry).

Table 18. Combining perspectives on wooded land and timber stocks

			European Forest Accounts perspective on timber stocks available for wood supply (AWS)	European Forest Accounts perspective on timber stocks available for wood supply (AWS)
National accounts perspective on standing timber stocks	On cultivated wooded land	Flows (net annual increment, removals) are inside the production boundary. Changes in inventories of work-in-progress and other flows (revaluation, reclassification, losses, balancing item) are recorded in the accumulation accounts. Stocks are work-in-progress on cultivated biological assets (AN.1221)	Monetarisation of flows and stocks in A2b, net annual increment (NAI) being an output component (P.1) and removals (RMOV) of standing timber an intermediate consumption component (P.2), both recorded in production account. The difference NAI-RMOV = changes in inventories of work-in-progress on cultivated biological assets, is recorded in capital account, the stock to be recorded in balance sheet (AN.1221).	No monetarisation is necessary, as the expected flows are limited (assumption). No monetary recording of standing timber flows and stocks. Removals are recorded as wood in the rough at the time of recording of output.
National accounts perspective on standing timber stocks	On uncultivated wooded land	Flows (net annual increment, removals) are outside the production boundary, stocks are uncultivated biological assets (AN.213)	Monetarisation of flows and stocks is possible in A2b, but no integration in the production account as no managed production process of standing timber takes place. Recording of flows and stocks of uncultivated biological assets in accumulation accounts and balance sheet (under conditions defined by ESA2010). The theoretical possibility was discussed, and it was agreed that in case of Estonia all forest are to be considered cultivated.	

The production border, according to the scope of National accounts, covers the timber stocks of cultivated forests and other wooded land, meaning that uncultivated wooded land lies outside the production border. Furthermore, from the EFA perspective of availability for wood supply, the timber stocks of forests, other wooded land and other land with tree cover not available for wood supply can be assumed as equal to zero (see EFA Handbook, 4.88).

For Estonian realities, a pragmatic simplification was assumed that the combination of "uncultivated wooded land" X "wooded land available for wood supply" is negligeable, so that all the flows and stocks of standing timber of wooded land available for wood supply are taking place within the production boundary of National accounts and are :

- monetarized
- and recorded as a production process of standing timber (product 02.10.30) and therefore recorded in the production account
- and recorded as stocks and flows of work-in-progress of standing timber (cultivated biological assets, AN.1221) in the accumulation.

Furthermore, if only units of the NACE02 Forestry and logging industry manage the production process of standing timber, then a direct offset can be done between the EFA table A2b and B.1. The comparison was performed: forestry activity was analysed: at the current stage the assumption was made that all output of standing timber was managed in NACE 02.

Data availability can be scarce for stocks and flows of standing timber of the wooded land categories "other wooded land" and "other land with tree cover", so that further simplifications may be necessary in matter of assessment of physical and even more monetary values. The table below gives the general frame of the elements to be monetarized or not. The implementation chapters handle this specific situation. The issues have been explained in chapters regarding the physical balance of the timber stock as well.

Table 19. Monetary value of timber stocks, general rules of the elements to be monetarized or not

Code	Description	Opening area (December T-1)	Net increment	Removals	Irretrievable losses	Revaluation	Statistical reclassification(+/-)	Balancing Item	Opening area (December T)
1	Forest	aggregate	aggregate	aggregate	aggregate	aggregate	aggregate	aggregate	aggregate
1.1	Forest available for wood supply	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
1.2	Forest not available for wood supply	no (=0)	no (=0)	no (=0)	no (=0)	no (=0	no (=0)	no (=0)	no (=0)
2.	Other wooded land	aggregate	aggregate	aggregate	aggregate	aggregate	aggregate	aggregate	aggregate
2.1	Of which available for wood supply	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
*2.2**	*Other wooded land not available for wood supply**	*no (=0)*	*no (=0)*	*no (=0)*	*no (=0)*	*no (=0)*	*no (=0)*	*no (=0)*	*no (=0)*
*3+3ad**	*Other land with tree cover*	*aggregate*	*aggregate*	*aggregate*	*aggregate*	*aggregate*	*aggregate*	*aggregate*	*aggregate*
3	Other land with tree cover available for wood supply	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
*3ad**	*Other land with tree cover not available for wood supply**	*no (=0)*	*no (=0)*	*no (=0)*	*no (=0)*	*no (=0)*	*no (=0)*	*no (=0)*	*no (=0)*

.*those wooded land categories are added to the EFA dataset table A* for completeness reasons

In general approach the estimation methodologies to be applied integrate many aspects, e.g. ESA2010 general rules, EFA toolbox, data availability, complexity and compilation costs. A general framework can be sketched which has to be defined depending on the methodology chosen for estimating the value of stocks and specific flows (net annual increment, removals) of standing timber as well as the other flows impacting the total changes in stocks of standing timber (irretrievable losses, revaluation, reclassification, balancing item). The final choice of prices per stock and flow item must be defined for each method. The tried EFA approaches in case of Estonia are outlined in following chapters.

Table 20. General logics for implementing the monetary balance table for standing timber A2b, AWS categories

Code	Stock and flows	Relevant quantities	Prices	Description and assumptions
STK_OP	Opening stocks (December T-1)	Strictly equal to the closing stock of year under review T-1, corresponds to A2a	Strictly equal to the closing stock of year under review T-1. STK Prices according to the chosen method.	The value of the opening stocks of year under review T is strictly equal to the closing stocks of year under review T-1
NAI	Net increment	Corresponds to A2a	NAI prices according to the chosen method	The value of NAI is an output component, so it doesn't contain revaluation aspects (holding gains and losses)
RMOV	Removals	Corresponds to A2a	RMOV prices according to the chosen method	The value of RMOV is an intermediate consumption component
LOSS	Irretrievable losses	Corresponds to A2a	Price can be equal to the price of STK_OP or RMOV price	Assumption: assortment pattern of the irretrievable losses comparable to the opening stock
REVAL	Revaluation	Applies to the constant quantity of the stock (intersect STK_OP and STK_CL)	Price for revaluation = price (STK_CL) - price (STK_OP) STK Prices according to the chosen method	*Gross approach:* Revaluation is done on every assortment sub-category of stocks AWS (intersect STK_OP and STK_CL) *Net approach:* Revaluation is done on the AWS category (e.g. FAWS) as a whole (intersect STK_OP and STK_CL).
RCLAS	Statistical reclassification	Applies to the quantity of the closing stock which was reclassified from AWS to NAWS (-) or NAWS to AWS (+)	Price equal to the STK_OP price	Explains especially the reclassification between the categories FAWS and FNAWS and applies on the relevant opening stock (EFA Handbook 4.66).
BAL	Balancing item	Corresponds to A2a	Price implicit (=value/quantity)	The balancing item serves to capture all other changes not captured by the other flows items (EFAA Handbook 4.21) BAL= STK_CL - STK_OP - (NAI-RMOV-LOSS+REVAL+RCLAS)
STK_CL	Closing stocks (December T)	Corresponds to A2a	Strictly equal to the opening stock of year under review T+1. STK Prices according to the chosen method.	The value of the closing stocks of year under review T is strictly equal to the opening stocks of year under review T+1

In general, the stocks are calculated as a first step and later the flow items are calculated in two stages: at first the flows for which physical data exits. As a second stage to get the balance the revaluations are calculated as residual. The same method is used for the financial assessment of the annual net increment, removals, and other timber flows (losses/reclassification/balancing items), i.e., the average stumpage price applied. For stocks different concepts were tested.

In Estonian case the flows items in all applied methodological approaches rely on stumpage prices, the calculation of stocks however were valued using different methods.

The uncertainty of physical data has been elaborated in chapter on timber stocks in physical volumes and balance. Specificities are handled below for each of the 4 methods.

5.3 Calculation of average stumpage price

Based on the available data, the average stumpage price of wood can be calculated in various ways. In determining the stumpage price, one may rely either on current market information or on modelling approaches to estimate costs. The former approach was applied to EFA table A2b while the latter has been utilized in National Accounts (NA). This report also includes a description of the methodology used by the Statistics Estonia for NA aggregates, along with a balance of wood resources calculated using the stumpage price obtained from the method used in A2b calculation. A comparison of the average stumpage price of wood calculated for the EFA table A2b and that which is used in NA is presented in Table 23. Comparison of calculated stumpage prices by two different approaches.

5.3.1 Calculation of stumpage prices based on timber sales data from RMK

Road-side price data (Table 21. Average road-side prices of wood in the RMK in 2022) and average logging costs in RMK were used to calculate stumpage prices. The proportion of different assortments in the total amount of wood sold was considered when calculating weighted average stumpage price.

Table 21. Average road-side prices of wood in the RMK in 2022

Assortment	Road-side price, €/m3
Pine log 5-9,9cm	44.89
Pine log 10-17,9cm	86.49
Pine log 18+cm	116.22
Spruce log 5-9,9cm	52.56
Spruce log 10-17,9cm	81.25
Spruce log 18+cm	96.67
Birch log 12-15,9cm	73.24
Birch log 16+cm	13.,66
Birch veneer log 24+cm	194.90
Aspen log 16+cm	72.79
Black alder log 16+cm	68.21
Grey alder log 16+cm	56.60
Pine pulpwood	50.46
Spruce pulpwood	57.00
Birch pulpwood	73.06
Aspen pulpwood	43.22
Ash log	138.63
Oak log	158.43
Fuelwood	39.65
Average	74.47

Based on the road-side price data price and the proportion of sold assortments, the weighted average road-side price of the assortment was calculated. From this, the average wood procurement cost was subtracted, resulting in the average stumpage price. Unit price of wood procurement in 2022 was €11.70 per m3 on regeneration felling per m3 and 25.80 € per m3 on thinning. The average unit cost of wood procurement of different types of fellings was €13.95 per m3. In 2022, the weighted average stumpage price was €63.46 per cubic meter (Table 22. Formation of the weighted average stumpage price in 2022).

Table 22. Formation of the weighted average stumpage price in 2022

Assortment	Road-side price, €/m3	Share of assortment, %	Weighted road-side price, €/m3
Pine logs	116.22	12%	13.94
Pine log d<18cm	86.49	3%	2.60
Spruce logs	96.67	13%	12.57
Spruce logs d<18cm	81.25	8%	6.50
Birch veneer logs	194.90	2%	3.90
Birch logs	137.7	4%	5.51
Aspen logs	72.80	9%	6.55
Pine pulpwood	50.46	4%	2.02
Spruce pulpwood	57.00	10%	5.70
Birch pulpwood	73.06	12%	8.77
Aspen pulpwood	43.22	6%	2.59
Fuelwood	39.65	17%	6.75
Total		100	77.41
Timber procurement costs, €/m3			-13.95
Weighted average stumpage price, €/m3			6.46

5.4 Methodology of stumpage price for the changes in inventories of work in progress (NA)

Statistics Estonia has used stumpage price data in National Accounts for the changes in inventories of work in progress. Primary data on forest gross increment, mortality and harvest volumes are sourced from the Estonian Environment Agency.

Gross increment data are provided separately for state and private forests, encompassing only forest land; data for other wooded land are not available. Only commercial forests, including those with economic restrictions, are accounted for in growth and logging volumes, as no commercial activities occur in strictly protected forests. Forests with management restrictions are fully included. To calculate the net growth of forest stands, the volume of dead trees is subtracted from the growth data. It is estimated that 2.2 million m³ of trees die annually in commercial forests, so all species volumes are adjusted for mortality.

The structural breakdown of the “other” tree species is as follows: aspen 27%, ash 25%, linden 14%, oak 6%, maple 3%, and the remaining 25% as fuelwood.

Logging volumes are presented separately for the RMK and private forests, as well as by assortments for both commercial and forests with management restrictions. The “residues” assortment serves as a control measure in calculations: timber material + waste = logging volume. Waste includes portions of the tree trunk not used as timber (e.g., crown and bark). The stumpage revenue calculated in national accounts for changes in inventories does not include the price of residues. Forest growth is categorized by the end-use of the harvested timber into the following assortments: large logs, small logs, pulpwood, fuelwood, and residues.

Net growth is calculated by subtracting the volume of dead trees from the gross increment, distributing the remaining volume into assortments, and then deducting the logging volume by assortment. This approach is an estimation and does not account for the age structure of the forest.

In calculating stumpage prices, RMK’s intermediate storage prices for timber are used. If there is no price for a particular assortment, it indicates that this assortment was not sold that year. Stumpage prices are obtained by deducting timber harvesting costs from intermediate storage prices.

Harvesting costs for timber are calculated according to Annex 6 of Government Regulation No. 242 (RT I, 03.09.2013, 2)[1] [42]on the estimation of costs of wood procurement. For this calculation, primary data from the Environmental Agency are used to determine average stem volume (height and diameter at breast height, based on species age classes), and GIS queries are applied to estimate average hauling distances (distance from the centroid of cadastral units to the nearest road-side storage using ETAK map layers).

The result is a logging cost by timber assortment and species, specified separately for RMK and other owners. Net growth is then multiplied by the stumpage price corresponding to the species and assortment, yielding the monetary value of net growth by species. Summing the values by species provides the total monetary value of net growth.

5.5 Alignment of physical amounts from A2a and price data for calculation of table A2b variables

When seeking the reason for the difference in average stumpage prices calculated with different methods (Table 23. Comparison of calculated stumpage prices by two different approaches), it primarily stems from timber procurement costs. For calculation of table A2b variables, RMK's actual costs were used, whereas in NA, models were applied for calculations. In National Accounts, harvesting costs are calculated using a model that accounts for the average characteristics of stands by tree species and age class, deriving the average stem volume of harvested trees. Geographic Information System (GIS) map layers are used to determine the average skidding distance.

In the logging volume data provided by the Estonian Environment Agency, birch small logs are almost always included, yet there are no corresponding price data. According to RMK, birch small-size logs are rarely sold. Based on RMK's recommendation, an estimated price is applied to birch small-size logs: an average percentage of the price for birch logs.

The logging volume data from the Environmental Agency includes grey alder and black alder pulpwood; however, pulpwood for these species does not exist in practice. Therefore, their volumes are accounted for as fuelwood, with the fuelwood price applied.

For the "Other" species category, the price of fuelwood for hardwood species is used. For aspen small logs, the pulpwood price is applied as the estimated value.

In 2022, the average stumpage price calculated in NA was €60.63/ m3 but average stumpage price calculated based on stumpage prices of the timber sales data from RMK was €63.46/ m3

Table 23. Comparison of calculated stumpage prices by two different approaches

	EFA table A2b	National Accounts
Average stumpage price in 2022, €/m3	63.46	60.63
Stumpage price of fuelwood in 2022, €/m3	25.75	23.95

This report presents the 2022 balance sheets of the monetary value of timber stock with both approaches of average stumpage price calculation; based on RMK market prices (Table 24. Monetary value of timber stock calculated with stumpage price method (A2b initial preferred method), Table 25. Monetary value of timber stock calculated with stumpage price method (based on national accounts preferred method)). In future the detail of the level of the stumpage prices and respective calculations should be harmonized.

[42] https://www.riigiteataja.ee/akt/103092013002

5.6 Description and comparison of the four methods for estimating the monetary value of a timber stock

As EFA handbook outlines four methods for estimating the financial value of a timber stock: the stumpage value method, net income method, age constant method and consumption value method. In this chapter the results of the tested methods for assessing the timber stock are outlined. In addition, one method which is not described in the EFA manual is outlined as well.

5.6.1 Stumpage Value Method

The results of calculating EFA tables by stumpage value methods based on two different approaches for finding of the average stumpage value are presented in tables Table 24. Monetary value of timber stock calculated with stumpage price method (A2b initial preferred method) and Table 25. Monetary value of timber stock calculated with stumpage price method (based on national accounts preferred method). The values of the opening and closing stock and timber flows for the reference year are calculated by multiplying the timber stock volume and physical flows by the average stumpage price per cubic meter. For "Other wooded land", the stumpage price of fuelwood is applied. The methods for calculating the average stumpage price were described in previous subsection above.

Table 24. Monetary value of timber stock calculated with stumpage price method (A2b initial preferred method), 2022, million EUR

Code	Description	Opening stocks (December T-1)	Net incre-ment	Removals	Irretrievable losses	Revaluation	Statistical reclassification (+/-)	Balancing Item	Opening stocks (December T)
1	Forest	25349	514	762	127	0	-305	-102	24567
1.1	Forest available for wood supply	25349	514	762	127	0	-305	-102	24567
1.2	Forest not available for wood supply	0,0	0	0	0	0	0	0	0
2.	Other wooded land	59	n/a	n/a		0		1	60
2.1	Of which available for wood supply	59	n/a	n/a		0		1	60
3	Other land with tree cover available for wood supply	n/a	n/a	n/a	21	n/a		0	n/a

Table 25. Monetary value of timber stock calculated with stumpage price method (based on national accounts preferred method), 2022, million EUR

Code	Description	Opening stocks (December T-1)	Net increm ent	Removals	Irretrievab le losses	Revaluati on	Statistical reclassification (+/-)	Balancing Item	Opening stocks (December T)
1	Forest	24218	491	728	121	5	-291	-103	23471
1.1	Forest available for wood supply	24218	491	728	121	5	-291	-103	23471
1.2	Forest not available for wood supply	0,0	0	0	0	0	0	0	0
2.	Other wooded land	59	n/a	n/a		0		1	56
2.1	Of which available for wood supply	59	n/a	n/a		0		1	56
3	Other land with tree cover available for wood supply	n/a	n/a	19	n/a	n/a	n/a	0,0	n/a

5.6.2 Net Income Method. Net Present Value Method Combined with the Stumpage Price Method

It was decided by the expert team to test the Net Income Method using a combined approach that integrates the Net Present Value (NPV) calculation with the stumpage price valuation method. The reason for combining lies in the time perspective of the assessment. The value of the timber stock is estimated based on cash flows over the coming decades, while the reference year's increment, removals, and other flows represent the values specific to that year. The stumpage price method is the most suitable for assessing the value of timber flows for the current year

The assessment was based on the total area of managed forests, distributed by dominant tree species into 10-year age classes. For simplification, the areas of 10-year age classes were aggregated into 20-year age classes.

The next step involved calculating the future timber stock based on these areas. The timber stock for each 20-year age class at rotation age was forecasted using the average growing stock of mature stands: the area was multiplied by the average growing stock of stands that had reached the rotation age. Both the area of the stands and the data on the average stock of the mature stands were obtained from the NFI.

To calculate the net present value of future income, it was necessary to determine when the cash flows would occur, i.e., when income would be realized. The time until clear-cutting was obtained by subtracting the mean age of the age class from the allowable rotation age of the dominant tree species. For example, in the case of 0–20-year-old spruce stands, the mean stand age of 10 years was subtracted from the rotation age of 70 years, resulting in a time period of 60 years until clear-cutting. This period length was used for discounting. The time until clear-cutting was calculated separately for each age class of each tree species.

The future income was calculated as the product of the total growing stock of stands within an age class and the average stumpage price of the respective tree species. Stumpage prices were determined for each tree species based on the distribution of the growing stock of mature stands into assortments. A specialized program was used for assorting. For the monetary valuation of opening stock, the stumpage price of December 2021 was applied, while for closing stock, the average stumpage price of 2022 was used. E.g. for spruce, the stumpage price was €56.90/m³ in December 2021 and €58.11/m³ in 2022.

An interest rate of 2.3% was used for discounting. A similar rate was applied by the State Forest Management Centre (RMK) in 2022 for the valuation of biological assets.

The net present value of future income was calculated separately for all age classes of each tree species and then aggregated to obtain the net income of the timber stock.

The monetary value of timber flows in 2022 was calculated, multiplying the timber volume by the stumpage price. In 2022, the average stumpage price was €63.46 per cubic meter. Road-side price data from the State Forest Management Centre (RMK) and average logging costs were used to calculate stumpage prices. Data on removals and assortments were sourced from the NFI. For "Other wooded land," the stumpage price of fuelwood is applied due to lower volumes per hectare and specific species composition. The results of calculations are presented in the Table 26. Monetary value of timber stock calculated with the Net Income Method, million euros.

Table 26. Monetary value of timber stock calculated with the Net Income Method, million euros

Code	Description	Opening stocks (December T-1)	Net increment	Removals	Irretrievable losses	Revaluation	Statistical reclassification(+/-)	Balancing Item	Opening stocks (December T)
1	Forest	14861	514	762	127	6561	-305	-102	20639
1.1	Forest available for wood supply	14861	514	762	127	6561	-305	-102	20639
1.2	Forest not available for wood supply	0,0	0	0	0	0	0	0	0
2.	Other wooded land	59	n/a	n/a		0		1	60
2.1	Of which available for wood supply	59	n/a	n/a		0		1	60
3	Other land with tree cover available for wood supply	n/a	n/a	21	n/a	n/a	n/a	n/a	n/a

5.6.3 Resource rent price method

A resource rent price reflects the overall return to the economic owner of a resource per unit of output. Estimating a resource rent price therefore requires deducting all relevant costs from the measure of output, including the user costs of capital. For a forest/timber resource as a whole, the costs will include silvicultural and other management costs.

Data on timber sales revenue and forest management costs from the State Forest Management Centre's 2022 annual report indicate an average forest management income of €80.17 per cubic meter and an estimated average cost of €45.90 per cubic meter. Thus, the resource rent per cubic meter is €34.27. This net income is multiplied by the volume of timber stock and physical flows. For the opening stock, the net income of €18.65 per cubic meter in 2021 is applied. The results of monetary valuation of timber by resource rent price method are presented in Table 27. Monetary value of timber stock calculated with the resource rent method.

Table 27. Monetary value of timber stock calculated with the resource rent method, 2022, million EUR

Code	Description	Opening stocks (December T-1)	Net increment	Removals	Irretrievable losses	Revaluation	Statistical reclassification(+/-)	Balancing Item	Opening stocks (December T)
1	Forest	7450	514	762	127	6599	-305	-102	13267
1.1	Forest available for wood supply	7450	514	762	127	6599	-305	-102	13267
1.2	Forest not available for wood supply	0,0	0	0	0	0	0	0	0
2.	Other wooded land	43	n/a	n/a		0		1	80
2.1	Of which available for wood supply	43	n/a	n/a		0		1	80
3	Other land with tree cover available for wood supply	n/a	n/a	27	n/a	n/a	n/a	n/a	n/a

5.6.4 Age constant method

In this method, the expected felling value for each age class is estimated as in the net income method and then multiplied by an age factor.

Since age class coefficients are absent in forestry practice in Estonia and are not addressed in theoretical works, it is not possible to apply this method for assessing the monetary value of timber resources.

5.6.5 Consumption value method

In this method, as for the stumpage value method no discounting of the stumpage price is applied, but the current volume of the timber stock is split into different age or diameter classes and different stumpage prices are applied for different classes on the assumption that the timber is harvested in the current period.

In Estonia, there are data available regarding the distribution of forest stands by age classes. Such data were used in the net income method. However, in Estonia we don’t have data on the stumpage prices of timber for different age classes. It would be possible to indirectly derive the stumpage prices for trees of various diameters using sorting programmes, but this requires the average diameters of forest stands in different age classes. Since such data are not available in Estonian NFI, it is currently not possible to apply the consumption value method.

5.7 Specific methodological issues: valuation of the timber of private forests

In our 2023 analysis, we identified several concerns regarding the timber valuation. We used cost and price data from the RMK, as it has been systematically and consistently collected. This data includes cost and price figures only for state forest management. Due to the absence of the information for the rest of the forest owners, we also applied these to private forests. However, it is well-known that timber prices and operational costs are generally lower in private forests compared to those managed by the state. Therefore, it was considered useful to investigate further timber prices and management costs for private forests.

5.7.1 Timber prices and management costs in private forests

The Estonian Private Forest Association[2] [43]currently provides private forest owners with overviews of wood market prices, a responsibility previously managed by the Private Forest Centre[3] [44]until 2022. In addition to monthly summaries, the Association also publishes more comprehensive quarterly analyses of wood market conditions. However, the published prices for private forests represent end-user storage prices, which need to be converted to stumpage prices for valuation purposes. Comparability is further complicated by the fact that RMK prices are precisely segmented by assortment volumes, while such volume-based segmentation is not consistently available for private forests.

Although data on wood prices from private forests is regularly collected, there is no systematic data collection on forest management costs. A limited number of studies have explored the profitability and costs of forest management (Kaimre 2022; Kaimre et al. 2023[4]), [45]primarily focusing on private forestry subsidies and maintenance of young forests, rather than on regeneration felling costs. Research results indicate that the costs of forestry operations for corporate forest owners are roughly comparable to the forestry operation expenses of the RMK. For private individual forest owners, the average cost is about 18% higher compared to RMK, primarily because small forest owners cannot deduct VAT from their expenses, as companies do. The National Accounts uses modelled logging operation costs for calculating stumpage fees, and according to their data, in 2022, the costs for other forest owners were 4% lower than those of RMK.

Considering the unsystematic nature of collecting price and cost information related to private forests and the incomplete data, it is recommended to use timber prices and unit costs for forest management as provided by RMK when compiling the EFA tables.

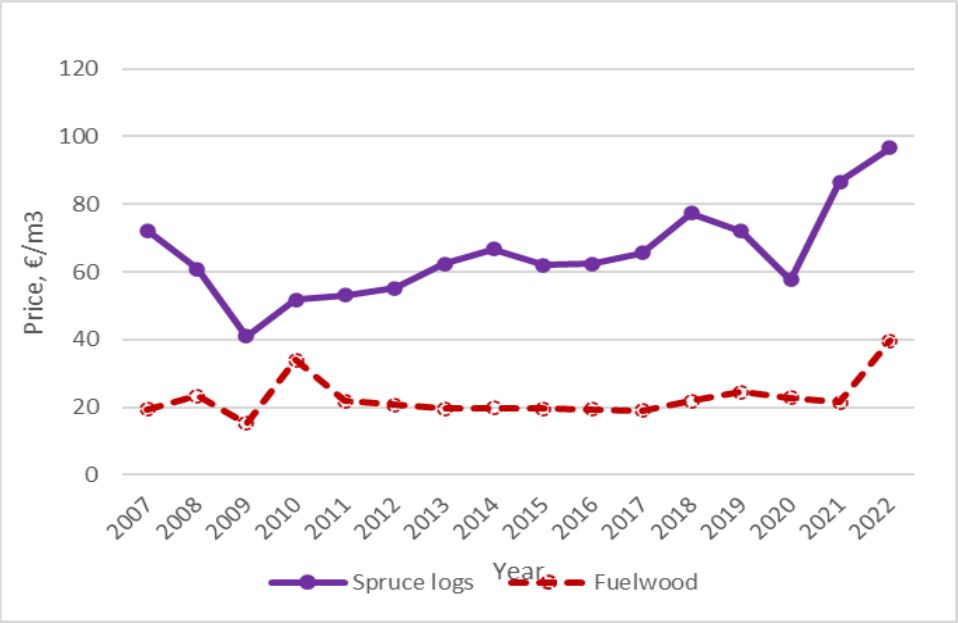
5.7.2 Volatility of timber prices

Another issue of concern was the volatility of timber prices. Since monetary valuation is conducted for a single year, data from that specific year is used for both prices and costs. However, timber market prices fluctuate considerably, which impacts the valuation of timber stocks. To promote valuation stability, the idea of using long-term average prices and costs was discussed in the previous phase of the project (2022-EE-EGD, grant 101113157, Activity 4. "Developing a methodology and compilation of forest accounts"). The main conclusions are also referred to here for the sake of completeness of the discussion.

Figure 3 illustrates price volatility from 2007 to 2022, using RMK roadside prices for spruce logs and fuelwood as examples. The graph shows a significant increase in the price of wood in 2021 and 2022, which is also reflected in the monetary value reports of the timber stock.

[43] https://erametsaliit.ee/puidu-hinnainfo/
[44] https://www.eramets.ee/uuringud-ja-statistika/hinnainfo
[45] https://doi.org/10.15159/eds.rep.23.02

Figure 3. Road-side prices (€/m3) for spruce logs and fuelwood in RMK in 2007-2022



A seminar held on March 26, 2024, accompanied by discussions with an international consultant, explored the appropriateness of various pricing approaches in assessing the financial value of forest resources. The following key insights emerged from these discussions:

The primary objective of data presented by statistical offices is to reflect the conditions and indicators of a specific period. Therefore, when valuing wood resources, it is appropriate to use the average stumpage price for the calendar year. For instance, in presenting the monetary value of timber stock for 2022, it is advisable to use prices from the same year rather than relying on three- or five-year averages from previous years. However, the use of long-term average prices may be relevant in specific contexts, such as compensating for management restrictions on forest land, particularly when current timber prices are lower than the long-term average.

At the seminar held on March 26, 2024, and during discussions with an international consultant, the suitability of using different prices for valuing the monetary value of forest resources was addressed. The following key points emerged from the discussions:

- The objective of EFA balance sheet values is to reflect the conditions and indicators of a specific period (year), rather than the averages of the previous five or three years. Therefore, when assessing the monetary value of timber stocks, it is appropriate to use the average stumpage price for the year under review for both timber flows and stock valuation.

For the valuation of timber flows and stock in 2022, the average stumpage price for 2022 was used. The value of the closing stock calculated using the stumpage price becomes the opening stock value for 2023. For the 2023 balance sheet calculations, the average stumpage price for 2023 is applied.

During the project, a comparative calculation was performed where the Opening Stock value was based on the timber price prevailing in January 2022, and the Closing Stock value was calculated using the December 2022 price. Due to significant differences between the prices at the beginning and end of the year, this approach led to a substantial discrepancy between the Opening and Closing Stock values. However, using average prices over a longer period is appropriate in cases such as compensating for management restrictions imposed on forest land, especially if current timber prices are lower than the longer-term average.

5.8 Comparison of valuation methods

Based on availability of data on Estonia's forest resources and timber market, it was discussed that out of analysed methods either the stumpage price method or the net income method for estimating the monetary value of timber stock in the context of EFA are feasible.

But the Net Income Method using a combined approach that integrates the Net Present Value (NPV) calculation with the stumpage price valuation method was considered most appropriate based.

Since the Timber stock consists of forest stands of various ages, income from their harvesting is generated over decades. Discounting the future revenues of the current young stands allows assigning them a comparable monetary value to that of mature stands. To estimate the monetary value of timber flows (net increment and removals), it is appropriate to use the stumpage prices of the reference year.

In Table 28. Comparison of the monetary value of the stock and flow of timber at the end of 2022 using different methods, the monetary value of the timber stock calculated using different methods at the end of 2022 is presented. The highest value is given by the stumpage method, while the lowest is provided by the resource rent method. The value of timber calculated using the net income method falls between these two extremes.

Table 28. Comparison of the monetary value of the stock and flow of timber at the end of 2022 using different methods

Method	Value of opening stock, million Euros	Value of closing stock, million Euros	Removals	Increment	Comments
Stumpage value method I	25 349	24 567	762	514	Stumpage price is calculated based on market information from RMK
Stumpage value method II	24 218	23 471	728	491	Stumpage price is calculated in NA using timber prices in RMK and modeled costs
Net income method	14 861	20 639	762	514	NPV combined with stumpage value
Resource rent price method	7 450	13 267	762	514	It is based on the methodology for valuing biological assets in state forests. In addition to timber prices, the results are influenced by forest management costs.
Age constant method		-			Age class coefficients are absent in forestry practice in Estonia and are not addressed in theoretical works
Consumption value method		-			Data on the stumpage prices of timber for different age classes are missing

5.9 Improvements and conclusions on timber stock calculation

In the case of Estonia, it might be relevant to consider the different patterns of assortments between increment and removals, which would lead to different average prices for each flow. The feasibility of this differentiated approach depends on the data availability of physical distribution of assortments of increment and removals. The same stumpage prices are applied for each assortment, so the different average stumpage price for increment and removals depends on the different weighting of assortments between increment and removal. If compiling costs must be limited, priority should be given to the elaboration of time series, as for example the retropolation of increment and removals back to 1999 to fit with revised production account of National accounts for the forestry and logging industry (NACE 02).

6 Enhancement of economic aggregates, B tables

6.1 Issues concerning table B1 from the previous grant project

One of the tasks of this grant project was to use the methodologies described in the EFA guidebook to compile the B tables. The biggest concern was with the output of forest trees that was analysed more in depth in the current grant project, also methodologies of output of wood in the rough and forestry services were investigated in more detail.

Other issues from the previous grant were the too high share of other goods and services in total intermediate consumption, quality of the value of own final use estimate and coverage of small forestry enterprises. Results and description of issues tackled and updates to previous methodology used in the last grant project (2022-EE-EGD, grant 101113157, Activity 4. "Developing a methodology and compilation of forest accounts") are described in following chapters.

6.1.1 Assessment of output of forest trees, wood in the rough and changes in inventories of work-in-progress in table B1

One of the biggest focuses in this grant project regarding B tables was on the output of forest trees as the value has not been estimated with the methodology described in the handbook before. Also, the value of wood in the rough and changes in inventories of work in progress relate to the output of forest trees as these should use aligned input data.

The first step regarding this issue was investigating the guidelines from the handbook. EU Forest Accounts Handbook paragraph number 5.22 under chapter 5 gives instructions that "Output of forest trees for forestry activity is equal to the net increment, i.e. gross increment less natural losses." and paragraph 5.36 states that "The value of net increment is typically estimated using stumpage prices for standing timber, which is the value of, or price paid for, timber as it stands uncut in the woods."

The second step was to investigate available physical data. Statistics Estonia receives yearly increment, mortality and harvest physical data from Estonian Environment Agency. The data has since been used in national accounts to estimate changes in inventories of work in progress. Increment has been provided by tree species (spruce, pine, birch, aspen, alder, grey alder and others) and by type of forest (managed forests without restrictions, managed forests with restrictions and strictly protected forests). Harvest is available by tree species (spruce, pine, birch, aspen, alder, grey alder and others), assortment (two different sized logs, pulpwood, fuel wood and waste) and owner (State Forest Management Centre (RMK) and others).

Methodology which physical data should be used in estimates has been developed in national accounts in cooperation with specialists from Estonian Environment Agency many years before work on EFA had begun, for example only increment of managed forests (both with and without restrictions) are included but not increment from strictly protected forests. It was also seen that physical data provided in EFA A tables are generally coherent with physical data used in national accounts. Exception was seen this year as physical increment and mortality data was updated by Environment Agency after it was transmitted to NA therefore estimates of 2022 does not totally align with NA figures, but these should be aligned in the next year when changes have been adopted in NA.

Then it was necessary to analyse possible available prices. Consultations held in the previous grant project revealed that NA uses roadside prices from RMK and uses models to estimate harvest cost. Models for harvest cost consider the breast height and diameter by age class and wood species and average distance from nearest road. Harvest cost is calculated separately for RMK and others. Stumpage price is then calculated by subtracting harvest costs from roadside price. Roadside prices are available by tree species and assortment level and the same detail is available for harvesting costs. More thorough descriptions of used input data are provided in chapter 5.4 Methodology of stumpage price for the changes in inventories of work in progress (NA).

Still some questions on prices aroused:

- It was decided in NA that residuals have a zero price, but it was seen on RMK price data that forest residuals have a price, should waste have a price?
- It was seen that NA includes less assortments than are seen on RMK price data (for example high value of birch veneer is not included in calculations), should all available prices by assortments be included?

- Is the assumption correct that net increment has the same share of assortments as harvest or should weighted average stumpage price be used for total net increment?

For estimating changes in inventories of work in progress NA uses shares of harvest by assortments and uses the same shares for net increment, subtracts harvest by tree species and assortment from net increment by tree species and assortments and multiplies the amount with corresponding stumpage prices. The same logic was tried out also to calculate the output of tree species: first mortality was subtracted from gross increment and then net increment by tree species was divided to assortments using assortment shares of harvest. Then the amounts of net increment by tree species and assortments were multiplied with corresponding stumpage price.

Also, methodology to calculate output of wood in the rough by using physical and price data was tried out. As harvest data and stumpage price are available by tree species and assortments these were multiplied. Different prices were used for fuel wood, logs and pulpwood. As in table B1 are distinguished only logs and fuel wood and not pulpwood then the value of pulpwood was aggregated with logs value.

Changes in inventories of work in progress is regularly calculated in NA but as physical input data was updated during the grant project then the same calculation logic and formulas as are used in NA were used to update the value of work in progress.

6.1.2 Assessment of possible under coverage of forest activity and estimating of missing financial data regarding forestry enterprises

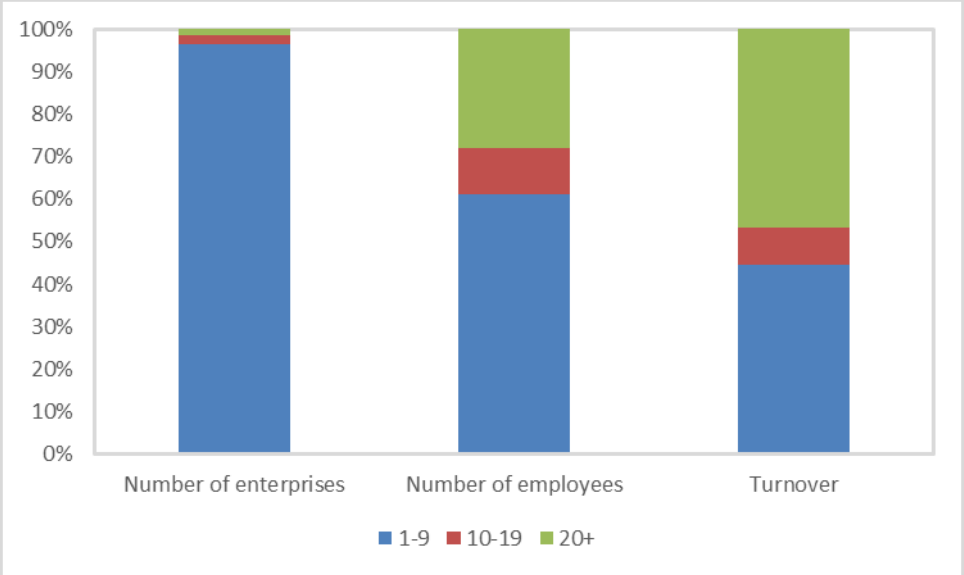
One of the issues that raised concern in the last grant project was possible under coverage of forestry enterprises that were covered in Statistics Estonia. The issue was important as it has a great impact on the results therefore it was important to analyse the coverage of enterprises and estimate missing (if any) part of the activity. To ensure the quality of coverage consultations with colleagues from the enterprise statistics department were held.

Forestry activity involves non-financial corporations and household institutional sectors, depending on the sector different approaches and data sources for estimating economical aggregates are used.

After the consultations with enterprise statistics, it was seen that coverage of forestry activity enterprises in non-financial corporations' sector is quite high.

There were ca 2300 enterprises in 2022 in Estonia that had forestry and logging as their primary activity. 32 enterprises had more than 20 employees and enterprises with less than 9 employees were the majority (96%). 47% of total turnover was produced by enterprises that had more than 20 employees (Figure 4. Structure of forestry enterprises by size of employees, 2022, %).

Figure 4. Structure of forestry enterprises by size of employees, 2022, %



Data of forestry enterprises are collected via following different sources:

- Annual business reports from Business Register
- Enterprises that have more than 20 employees receive and transmit a yearly questionnaire where they fill in their economic information
- If enterprise is not covered with previous two then for all active enterprises data are imputed by using their previous years data or an average of the layer

It was seen that business registry was available for 86% of enterprises and 3% transmitted the yearly questionnaire EKOMAR. Therefore, data can be considered of quality, and all information is available in the source database for further analyses. Also, secondary activity of forest enterprises was looked at and it was seen that forestry activity covers 90% of their total turnover (1 214 million EUR).

Although not necessary for tables B1 and B2 enterprises with secondary forestry activity were investigated to estimate the supply of wood in the rough by other industries for table B3a. To make the analysis of secondary activity first it was necessary to filter out all relevant data. This was done by the business statistics department; they also provided an R code that can be used in the future to get quick extract of secondary activity from the database. Analysis revealed that secondary turnover from forestry activity was almost 99 million euros in 2022.

For table B3a it was necessary to distinguish supply of wood in the rough from other forestry related activities. It was decided that only the biggest enterprises should be investigated as these have the major impact on the results and it was not possible to investigate all forestry activity due to the lack of time available to devote on the topic during the grant project. During the analysis enterprises' business reports were looked into and using the information it was possible to distinguish turnover from wood in the rough from other forestry-related products and services.

Consultations with the business statistics department were also held to ensure that correct variables were used to estimate various categories of intermediate consumption in table B1.

Also, enterprises of the household sector were investigated, and it was found that turnover and expenditure declarations were collected from ca 700 sole proprietors. Calculations of the household sector are done regularly each year by National Accounts and their results were used to fill in EFA tables.

6.1.3 Assessment of output for own final use

Output for own final use is also regularly estimated in NA every year but as the methodology is based on assumptions of average yearly consumption of fuel wood from own forests then the attempt to improve the methodology was made in this grant project. The issue was discussed with colleagues from energy statistics in order to find out if they have information about amounts of households' own consumption of wood to produce heat. During the analysis no more reliable information was found to be used instead of current methodology but it was discussed if more knowledge is available, the solution to this issue would be further developed.

6.1.4 Assessment of intermediate consumption of other goods and services in table B1

Previous grant project revealed that other goods and services used as inputs under intermediate consumption in table B1 should be further analysed as it made up large share of total intermediate consumption. It was hoped that further analysis should reveal if it is possible to separate additional components of intermediate consumption. Also, in the previous grant, the value of consumption of other goods and services was calculated as discrepancy between intermediate consumption calculated in NA and subcomponents that could be distinguished using micro data of enterprises.

During the current grant project detailed economic variables of forestry enterprises from EKOMAR were investigated, also consultations with colleagues from business statistics department were held to distinguish correct values. It was possible to distinguish most of the necessary variables to fill in table B1 and for some variables it was possible to straightforwardly get the value as an exact match was already available. Variables of intermediate consumption and their match from EKOMAR can be seen in Table 29. Variables of intermediate consumption and their data source or formula.

Table 29. Variables of intermediate consumption and their data source or formula

Code	Variables of intermediate consumption	Data source or formula
2.1	Goods input	Sums up from products 2.1.1 - 2.1.4
2.1.1	Trees, tree plants and forest tree seeds	Harvest from table A 2b + 'Raw materials, materials, supplies and intermediate goods: seeds and plants' from EKOMAR
2.1.2	Energy, lubricants	'Raw materials, materials, supplies and intermediate goods: electricity, heat energy and fuels' from EKOMAR
2.1.3	Fertilizers and soil improvers	'Raw materials, materials, supplies and intermediate goods: fertilizers and soil improvers' from EKOMAR
2.1.4	Plant protection products and pesticides	'Raw materials, materials, supplies and intermediate goods: plant protection products' from EKOMAR
2.2	Services input	Sums up from 2.2.1 - 2.2.4
2.2.1	Services characteristic of the forestry and logging activity	Equal with forestry services output
2.2.2	Regular maintenance and repair of equipment	Not separable
2.2.3	Maintenance of buildings	Not separable
2.2.4	Financial services (FISIM) [P.119]	Available from NA
2.3	Other goods and services used as inputs	Total intermediate consumption in NA – subcomponents (except removals from A2b)

Yet as seen from table 29 „Variables of intermediate consumption and their data source or formula", for some aggregates other data sources had to be used. For product "trees, tree plants and forest tree seeds" removals from table A2b should be used in addition to the value from EKOMAR. "Services characteristic of the forestry and logging activity" was assumed to be equal with the output of services characteristic of the forestry and logging activity as it does not distinguish separately from micro data. Services "regular maintenance and repair of equipment" and "maintenance of buildings" were zero in micro data, but suspicion arose that these services could be reported under other categories. Also, consultant from Swiss Federal Statistical Office suggested to derive value for the maintenance services using value of gross fixed capital formation or consumption of fixed capital still this methodology was not developed in this grant project but can be developed further next year. "FISIM" was available from NA and was not separately calculated in this project.

To compare the results with NA it was necessary to see how intermediate consumption is calculated in NA and therefore consultations with colleagues from NA were held. It was seen that in addition to micro data from EKOMAR still some correcting items to ensure balance between supply and use of whole economy was added. These items were included under "other goods and services used as inputs". Other goods and services used as inputs were calculated subtracting subcomponents already filled in the table B1 from total intermediate consumption of NA. Removals from A2b are added to the item of intermediate consumption "trees, tree plants and forest tree seeds" and are not deducted from the NA total intermediate consumption of NACE 02, as those removals of standing timber are not included in the primary NA calculation (before conciliation with EFA).

6.2 Economic aggregates of the forestry and logging industry, table B1

6.2.1 Output of the forestry and logging industry (excluding other industries) Table B1

After tackling the above-mentioned bottlenecks, an attempt to compile table B1 with updated methodology was made. First it was necessary to distinguish various outputs of forestry activity, and the distinction was mostly made using microdata from EKOMAR. Using turnover of enterprises, it was possible to separate some of the required variables. Depending on the data source and calculation methodology used two different results of output are presented in the Table 30.

Method 1 uses input from A2b table and also follows the calculation logic as is used for A2b net increment and removals. Method 2 uses more detailed approach that is also used in national accounts for estimating work in progress (see the description of methodology in chapter 5.4 Methodology of stumpage price for the changes in inventories of work in progress (NA)).

Table 30. Data sources, formulas and results of output variables, 2022, million EUR

	Variable	Methodology or data source	Result of method 1	Result of method 2
1	**Total output (at basic prices) [P.1]**	**Sums up from 1.0+1.1+1.2+1,3+1,4**	**1716**	**1347**
1.0	Of which output for own final use [P.12]	Available from NA	14	14
1.1	Goods characteristic of the forestry and logging activity	**Sums up from 1.1.1 + 1.1.2+1.1.4**	**1451**	**1082**
1.1.1	Trees, tree plants and forest tree seeds	Sums up from 1.1.1.1 + 1.1.1.2	515	379
1.1.1.1	Live forest tree plants (02.10.11) and tree seeds (02.10.12)	Turnover: tree seeds + Turnover: forest tree plants from EKOMAR	1	1
1.1.1.2	Forest trees (02.10.30)	Net increment * stumpage price + Turnover from selling standing timber, included right to harvest from EKOMAR	514	378
1.1.2	Wood in the rough (02.20.1)	**Sums up from logs and fuel wood**	**935**	**702**
1.1.2.1	Logs	Harvest * roadside price	522	559
1.1.2.2	Fuel wood (02.20.14 and 02.20.15)	Harvest * roadside price	412	143
1.1.4	Non-wood products (02.30)	Turnover of NACE 02301 from EKOMAR	1	1
1.2	Services characteristic of the forestry and logging activity	Turnover: forestry services from EKOMAR	118	118
1.3	Other products from connected secondary activities in the local KAU	Sales revenue of forestry enterprise from NACE 16 activity based on EKOMAR	11	11
1.4	Other products (*)	Sales revenue of forestry enterprise from all other activity (secondary activity of forestry enterprises) based on EKOMAR	137	137

For output of logs and fuel wood separate roadside prices from RMK and harvest data from Estonian Environment Agency were used. Still one issue concerning physical amounts remains as it is not possible to identify or distribute increment and harvest physical data by NACE category. Three options were seen:

- Assumption is used that all net increment and harvest comes from NACE 02 entities and the same calculation logic as was used for A2b removals (total physical harvest multiplied with weighted roadside price) was used for the output of wood in the rough.
- Assumption is used that all net increment and harvest comes from NACE 02 entities and the same calculation logic as was used in national accounts was used (assortments were considered separately and were multiplied with corresponding prices)
- Another approach is to use only economic data from EKOMAR to estimate output of wood in the rough, then it would be ensured that output of wood in the rough includes only NACE 02 values. This method would be in line with the approach used in NA as output is calculated using available monetary and not physical data.

All mentioned approaches to estimate output of wood in the rough were tried out in the grant project and results can be seen in table 31. To agree which method should be used further discussions with experts are needed, this is foreseen in the next grant project in 2025. To make the first attempt to transmit EFA tables to Eurostat results of 1. approach was chosen to ensure compliance with A2b table. It was also considered that 3. approach should be compliant with national accounts as it uses the same data source and can be considered the best solution of the three to represent NACE 02 output of wood in the rough as it is not possible to distinguish NACE for physical amounts. Another possibility is to modify calculation methodologies used for A2b, currently the same stumpage price is used for net increment and removals, but it is possible to have different methodologies for the variables. As separate prices for logs and fuel wood

are available it would give more realistic results if these differences were considered. These details has to be argued and agreed on in the beginning of 2025.

It is seen from Table 31. Output of wood in the rough by methodology used, 2022, million EUR below that 2. and 3. approach have rather small difference and it can be assumed that 1. approach might give overestimated result.

Table 31. Output of wood in the rough by methodology used, 2022, million EUR

Methodology	Formula	Result
1. approach	Removals from A2a * weighted average roadside price	934.7
2. approach	Removals by tree species and assortment * corresponding roadside prices	702
3. approach	Turnover of NACE 02 enterprises for wood in the rough (fuel wood and logging)	648.0

To estimate the value of "other products from connected secondary activities in the local KAU" it was necessary to investigate the enterprises as this information was not always easily available. Also, guidelines from Swiss colleague were provided to agree which NACE activity should be included under the aggregate. It was decided that NACE 16 can be considered as connected secondary activity. First it was determined which forestry enterprises provide secondary activity and then information from annual business reports from business registry was used to distinguish turnover from NACE 16.

All other secondary activity of forestry enterprises (except for NACE 02 and 16) was filled under variable "other products".

An issue arose with services characteristic of forestry and logging activity. From EKOMAR the turnover of forestry services was available, but it was also seen that the value could be underestimated as forestry enterprises might show it under some other activity. The value does not distinguish also in the supply table in NA as it is aggregated with tree seeds, plants and wood in the rough (except fuel wood that is a separate product). It was seen that further consultations and cooperation with colleagues from NA is necessary in order to correctly identify output (and also intermediate consumption) of forestry services.

6.2.2 Intermediate consumption of the forestry and logging industry (excluding other industries) Table B1.

After dealing with the issue of intermediate consumption of other goods and services from the previous grant project (2022-EE-EGD, grant 101113157, Activity 4. "Developing a methodology and compilation of forest accounts") (see paragraph 6.1 Issues concerning table B1 from the previous grant project) a table of intermediate consumption with its subcomponents was compiled. Two different methodologies to compile the table were tried out and results can be seen in Table 32. These different methodologies concern only the value of trees used as input by the forestry sector. 1. approach uses the removals value for trees straight from the A2b table, where total amount of harvest has been multiplied with weighted average stumpage price. 2. approach uses more detailed harvest data by tree species and assortments and multiplies the physical amounts with corresponding stumpage price. It has yet to be decided with experts and colleagues from national accounts which methodology would be the best, these discussions will continue next year.

Whatever the methodology chosen, consistent approaches for compiling the values of net increment and removals of standing timber on the one side in A2b, and removals of standing timber and production of wood in the rough in B1 are crucial. For example, generally, the output of wood in the rough must be higher than the intermediate consumption in trees (the difference being the harvest costs, which are deducted from the value of removals of trees but of course included in the inputs of logging activity (energy, maintenance, wages, etc.).

Table 32. Intermediate consumption of forestry and logging industry (excluding other industries) Table B1, 2022, million EUR

	Variable	Method 1	Method 2
2	**Total intermediate consumption [P.2]**	**1261**	**1033**
2.1	Goods input	**856**	**614**
2.1.1	Trees, tree plants and forest tree seeds *6	763	521
2.1.2	Energy, lubricants *7	93	93
2.1.3	Fertilizers and soil improvers	0	0
2.1.4	Plant protection products and pesticides *8	0	0
2.2	Services input	**132**	**132**
2.2.1	Services characteristic of the forestry and logging activity *4	118	118
2.2.2	Regular maintenance and repair of equipment *9		
2.2.3	Maintenance of buildings (*)		
2.2.4	Financial services (FISIM) [P.119]	14	14
2.3	Other goods and services used as inputs (*)	273	273

6.2.3 Gross value added of the forestry and logging industry (excluding other industries) Table B1.

Third part of table B1 is gross value added that can be calculated by subtracting intermediate consumption from output, but it has to also sum up from compensation for employees, consumption of fixed capital and net taxes on production. In this grant project gross value added was not recalculated from its components and national accounts already made calculations were used instead. It was agreed that it is possible to investigate taxes and subsidies on production and compensation for employees of NACE 02 in the next grant project to analyse if the results are similar to when gross value added is calculated with the output and intermediate consumption.

As different methodologies and results were tried out in this grant project it also affects gross value added, if intermediate consumption is larger than output compared to national accounts value then also gross value added is lower. Table 33 shows results of different approaches. All subcomponents except net property income are available from national accounts. Net property income was estimated on micro data of NACE 02 enterprises calculated using rent received minus rent and interest paid minus FISIM. When the value of gross value added is different from national accounts' value then it would affect the value of all subsequent balancing items (factor income, operating surplus and mixed income, entrepreneurial income).

Table 33. Gross value added and its components, 2022, million EUR

	Variable	Method 1	Method 2
3	**Gross value added (at basic prices) [B.1g]**	**315**	**456**
3.1	Consumption of fixed capital [P.51c]	62	62
3.2	**Net value added (at basic prices) [B.1n]**	**253**	**394**
3.2.1	Other taxes on production [D.29]	16	16
3.2.2	Other subsidies on production [D.39]	2	2
4	**Factor income**	**238**	**379**
4.1	Compensation of employees [D.1]	131	131
5	**Net operating surplus [B.2n] and Mixed income [B.3n]**	**107**	**248**
5.1	Net property income [D.4] *10	-15	-15
5.2	**Net entrepreneurial income [B.4n]**	**92**	**233**

6.2.4 Capital transactions, Table B1

Gross fixed capital formation by subcomponents is available from NA, plant resources yielding repeat products seems not to be relevant for Estonia in NACE 02. Other changes in inventories are also available from NA. Changes in inventories in work-in-progress on cultivated biological assets were calculated with two methods: 1. method uses A2b data and is calculated by subtracting removals from net increment. 2. method uses more detailed physical amounts and stumpage prices by tree species and assortments and is regularly calculated in NA. Discussions which method will be chosen in the future will follow in next grant project in addition to previous methodology of forest trees mentioned in previous chapters.

Estonian Environment Agency provided information to estimate capital transfers and for total labour first share of employment of NACE 02 from total NACE A was calculated and then the share was used on employment on full time equivalents that is available for NACE A and not on more detail level. The last item of table B1 - self-employed in 1000 national AWU was not estimated in the grant project as the cell is marked in Eurostat reporting tables as with lower priority and no readily available data source has been found to be used as a basis for estimations. It is a subject of future developments if necessary. Results can be seen in Table 34.

Table 34. Capital transactions, 2022, million EUR

	Variable	Method 1	Method 2
6	**Gross fixed capital formation (excluding deductible VAT) [P.51g]**	**82**	**82**
6.1	Buildings, structures and land improvements	35	35
6.2	Machinery and equipment	46	46
6.3	Plant resources yielding repeat products		
6.4	Other GFCF(*)	1	1
7	**Net fixed capital formation (excluding deductible VAT) [P.51n]**	**20**	**20**
8	**Changes in inventories [P.52]**	**-421**	**-346**
8.1	Work-in-progress on cultivated biological assets [AN.1221]*11	-248	-174
8.2	Other changes in inventories (*)	-172	-172
9	**Capital transfers (net) [D.9]**	7	7
10	Total labor input [L] (in 1000 harmonized AWU) *12	**6**	**6**

6.2.5 Output of the forest and logging industry by type, Table B2

Compared to other EFA monetary tables compilation of table B2 can be considered straightforward. Most of the variables are available from table B1. Households' output is available from NA and can be filled in table B2. Non-market output is zero in Estonia as government and non-profit institutions do not have any activity in NACE 02. Compiled table B2 of 2022 can be seen in Table 35. Depending on the methodology used in B1 the total value and market value in table B2 can be different. Results of both methods are shown in Table 35.

Table 35. Output of the forest and logging industry by type, 2022, million EUR

Code	**Description**	31	32	33	99	41
		Own final use [P.12]	Market	Nonmarket	**Total**	*of which:* Households [S.14]
2	Output (at basic prices) [P.1] Method 1	**14**	**1702**	**0**	**1 716**	62
2	Output (at basic prices) [P.1] Method 2	**14**	**1333**	**0**	**1 347**	62

6.3 Supply and use of wood in the rough by all industries, table B3

In the previous grant project (2022-EE-EGD, grant 101113157, Activity 4. "Developing a methodology and compilation of forest accounts") NA supply and use tables were the main data source to compile Supply and use of wood in the rough by all industries, Table B3, EFA. The main focus was to disaggregate NAs aggregate as it included three separate products. Turnover from micro data was then used to estimate the share of wood in the rough from the aggregated value. As the latest supply and use of NA is available for the year 2020 but EFA for 2022 was compiled in this grant project then it was planned to develop alternative methodology to compile B3 tables by using more recent information. It was also important to ensure consistency between other monetary EFA tables.

First it was analysed which data sources could be used; these are written in Table 36. It was agreed with consultant from Swiss Federal Statistical Office and NA that trade and transport margins and taxes less subsidies on products will be estimated based on most recent NA SUT as the shares would probably not change much. But another approach should be used for foreign trade data as these could have significant yearly changes. For the export and import of wood in the rough foreign trade statistics were used and before that consultation with national accounts was held to ensure that the correct products from trade statistics would be included.

Table 36. Data sources and formulas for compiling tables B3 supply and use of wood in the rough

Variable	Data source/formula
Forestry and logging industry (Division 02), supply	Table B1, output of wood in the rough
Other Industries (if any), supply	EKOMAR
Imports (CIF)	Foreign trade statistics
Trade and transport margins	Shares from NA SUT
Taxes less subsidies on products	Shares from NA SUT
Forestry and logging industry (Division 02) (if any), use	Shares from NA SUT, needs improvement
Other industries, use	Discrepancy between supply and use
Final Consumption	Table B1, own final consumption
Capital formation	Assumed to be zero
Exports (FOB)	Foreign trade statistics

Final consumption is available from B1 and is equal to output for own final use. Capital formation is assumed to be zero. Supply of NACE 02 is available from table B1 and is equal to the output of wood in the rough. To estimate the value of wood in the rough supplied by other industries the biggest enterprises that had forestry as their secondary activity were analysed to distinguish turnover from wood in the rough and other forestry related activities. Only sales revenue from wood in the rough was used to fill in table C3a.

Distribution of use of wood in the rough between NACE 02 and other industries was more complicated as there was no straightforward data source to use except NA use table. Additional consultations with NA are therefore necessary to see how the distribution has been made in NA. In this grants project NA use table was still used as the basis for the distribution. NA use table is also the basis for the distribution between NACE 02 and other industries for table C2. By using shares from NA use table for both B3b and C1b is ensured that EFA tables are aligned. But it has to be considered that NA use table does not have separate value for use of wood in the rough and the value is aggregated with use of the forestry services. Therefore, further methodology development is needed to estimate the use of wood in the rough by NACE 02 and other industries. The use of other industries was calculated as a discrepancy between supply and use.

As it can be seen that NACE 02 has used wood in the rough it has to be checked that it is part of other intermediate consumption goods and services used as inputs (item B1 2.3) and also included on the output side (output of processed wood that used wood in the rough as input). This will remain as a subject for development in 2025.

Filled supply and use of wood in the rough for 2022 can be seen Table 37 and Table 38. As the results are connected to table B1, results of two methodologies are displayed.

Table 37. Supply of wood in the rough, 2022, million EUR

Code	Description	51.0	51.1	51	61	62	63	64	65
		Forestry and logging industry (Division 02)	Other Industries (if any)	Supply of products by industries	Imports (CIF)	Total supply (at basic prices)	Trade and transport margins	Taxes less subsides on products	Total supply (at purchasers' prices)
1.1.3	Wood in the rough method 1	935	107	**1 041**	102	**1 143**	323	56	**1 523**
1.1.3	Wood in the rough method 2	702	107	**809**	102	911	278	56	**1 244**

Table 38. Use of wood in the rough, 2022, million EUR

Forestry and logging industry (Division 02) (if any)	Other industries	Use of products by industries	Final Consumption	Capital formation	Exports (FOB)	Total use (at purchasers' prices)		
1.1.3.20	Wood in the rough method 1	167	1 152	**1 319**	14	0	189	**1 523**
1.1.3.20	Wood in the rough method 2	132	908	**1 040**	14	0	189	**1 244**

6.4 Conclusion regarding B tables

B tables of 2022 were filled as one of the results of this grant project and the issues brought out in the previous grant project (2022-EE-EGD, grant 101113157, Activity 4. "Developing a methodology and compilation of forest accounts") were discussed and analysed. Still some issues (own final consumption of wood in the rough) remained unsolved and need further methodology improvement in the future. The most important issue that will continue next year is the discussions on which method should be chosen to estimate the value of net increment (in tables A2b and B1), removals (in tables A2b and B1) and work in progress (table B1). As the chosen methodology can have a big impact on gross value added value it is important to include colleagues from national accounts also in next rounds of discussion. Calculation methodologies differ on the level of detail, and it has to be analysed to see which methodology gives more realistic results that are aligned with other data sources (e.g. EKOMAR). Regarding table B1 following tasks are seen to be tackled on in the next grant project:

- Discussions on and analyse of different calculation results of net increment, removals and work in progress estimations.
- Calculation of gross value added components - taxes and subsidies on production and compensation of employees.
- Agree on the workflow with NA, suggestions of Swiss Statistics consultant follow in chapter 8.1.1.

Also, it was seen that the methodology to estimate the value of use of wood in the rough needs improvement and the discussions with national accounts colleagues are planned for the year 2025.

6.5 Comparison of the main economic aggregates and results (EFA and SNA)

Comparison of the main economic aggregates and results based on the methods of the definitions of European forest accounts (revised EFA guide definitions) and national accounts (SNA) was analysed.

An attempt to compile EFA B tables using the methodology from the handbook was made. Still many questions arose during the process. The handbook gives instructions, descriptions and examples how to estimate various variables, yet it was seen (and provided in the handbook) that cooperations with NA is essential. Although most of the variables could be calculated using micro data it still is necessary to have a macro view to ensure balanced flows of the whole economy.

Concerning table B1, it was seen that the most significant difference between EFA and NA came from the output of forest trees but also output of wood in the rough could have large impact depending on the methodology.

Output of forest trees has not been estimated with the methodology described in the EFA handbook in NA before and it was done during the grant project. Adding the output of forest trees increases the value of total output of forestry activity as an additional value would be added. On the other hand, also additional product “trees” should be added to intermediate consumption as an input used by the forestry enterprises, this product also has not been included to NA.

By using the NA formulas and data sources for estimating the output of forest trees and wood in the rough but removals from table A2b it was seen that this can cause a negative gross value added. This is due to inconsistency of stumpage price use, in NA more detailed prices and physical amounts are used and an average weighted prices are used for total physical amounts to estimate removals value in table A2b. It has to be decided which methodology should be used in the future. And when the most suitable methodology is chosen then the differences with NA and impacts of EFA results to NA could be analysed better.

It was difficult to estimate the output of forestry services as it is not distinguished in National Accounts. First turnover of forestry services from micro data EKOMAR was used but it was suspected that using the value from micro data might give underestimation. The first analysis of forestry enterprises was made, and it was seen that some of the enterprises that reported their output under wood in the rough also provide forestry services, but it might be difficult to separate. So further cooperation with NA is very needed to agree on correct methodology to estimate the output of forestry services. Possible estimation formulas were tried out during the grant project and also presented in the final seminar, but it was discussed that the methodology needs further improvements and therefore these experimental results are not provided in the final tables.

Another possibility to give input to NA was discussed and it was decided that some components of gross value added could be investigated and estimations of these variables could give knowledge to adjust some categories of output or intermediate consumption. This issue concerns other taxes on production, other subsidies on production and compensation for employees. This issue could be handled with in the next grant project.

It was also discussed in the last seminar that in order to integrate EFA figures to national accounts it is necessary to provide time series for at least 5 years to see how it impacts the whole economy. But in order to compile time series it is very important to agree on the reasonable workflow between EFA and NA compilers to avoid double work. Suggestion on how to set up the workflow and possible procedure is suggested in following paragraph XX (link to paragraph written by France).

6.6 Enhancement of physical supply and use of wood in the rough in C tables

6.6.1 Issues from previous grant project: estimation of the timber final consumption

In the last grant project (2022-EE-EGD, grant 101113157, Activity 4. “Developing a methodology and compilation of forest accounts”), it was discussed that there might be probable under coverage of the timber final consumption by households due to current possible undervaluation in national accounts. The estimation of households’ timber use (mainly fuelwood) for own consumption of households, in addition to currently accounted agricultural holdings, is topic for future development needed for both monetary and physical use tables. This issue was also discussed under table B1 and is described in chapter 6.1.3 Assessment of output for own final use.

6.6.2 Issues from previous grant project: estimation of the physical quantity of foreign trade of wood in rough

A major issue with C tables from the previous grant project (2022-EE-EGD, grant 101113157, Activity 4. "Developing a methodology and compilation of forest accounts") was the probable case that the estimation of the physical quantity of foreign trade of wood in rough may vary in sense of reflecting the timber under bark or over bark. It was suggested that future analyses are needed as probably enterprises indicate their production and export not uniformly. At first it was planned to interview the enterprises exporting the wood in rough and this topic was also discussed in the study visit to Switzerland. After the study visit and discussions with colleagues from foreign trade statistics it was agreed that that the amounts that could be filled in C tables cannot be ideally separated in trade statistics and C tables should be filled using the information that is available from trade statistics as:

- there is no easy solution for the distribution
- other European countries also use the same nomenclature
- C tables are not mandatory, and more attention should be paid to problematic mandatory variables first

Expert observation confirmed that the pragmatic approach based on Estonian expert's knowledge of the traded wood in rough is right to apply: if for example 60% of a given imported assortment is without bark, then to add bark according to the relevant correction factor.

6.7 Compilation of C tables

C tables were compiled using the same methodology that was developed in the last grant project. Still an issue arose that affects also B tables and should be worked on in the next year – distribution of use to different NACE categories was done using supply and use tables of national accounts, but it was revealed that it might give an overestimation as NA aggregates three different products under one. Results can be seen in Table 39. Supply of wood in the rough, 2022, 1000 m3 over bark and Table 40. Use of wood in the rough, 2022, 1000 m3 over bark.

Table 39. Supply of wood in the rough, 2022, 1000 m3 over bark

		Forestry and logging industry (Division 02)	Other industries (if any)	**Supply of products by industries**	Imports	**Total supply**
1.1.3	Wood in the rough (02.20.1)	11 109	989	**12 098**	1 004	**13 102**
1.1.3.1	Logs	6 737	630	**7 367**	965	**8 332**
1.1.3.1.1	Coniferous wood (02.20.11)	4 047	378	**4 425**	726	**5 151**
1.1.3.1.2	Non-coniferous wood, except tropical wood (02.20.12)	2 690	252	**2 942**	239	**3 181**
1.1.3.1.3	Tropical wood (02.20.13)	0	0	**0**	0	**0**
1.1.3.2	Fuel wood	4 373	358	**4 731**	39	**4 770**
1.1.3.2.1	Fuel wood of coniferous wood (02.20.14)	1 511	124	**1 635**	18	**1 653**
1.1.3.2.2	Fuel wood of non-coniferous wood (02.20.15)	2 861	235	**3 096**	21	**3 117**

Table 40. Use of wood in the rough, 2022, 1000 m3 over bark

		Forestry and logging industry (Division 02) (if any)	Other industries	**Use of products by industries**	Final consumption and capital formation	Exports	**Total use**
1.1.3.20	Wood in the rough (02.20.1)	1 086	7 473	**8 559**	2 386	2 156	13 102
1.1.3.1.20	Logs	1 084	5 321	**6 406**	0	1 926	8 332
1.1.3.1.1.20	Coniferous wood (02.20.11)	764	3 752	**4 517**	0	634	**5 151**
1.1.3.1.2.20	Non-coniferous wood, except tropical wood (02.20.12)	320	1 569	**1 889**	0	1 292	**3 181**
1.1.3.1.3.20	Tropical wood (02.20.13)	0	0	**0**	0	0	**0**
1.1.3.2.20	Fuel wood	2	2 151	**2 154**	2 386	230	4 770
1.1.3.2.20.1	Fuel wood of coniferous wood (02.20.14)	1	757	**758**	840	54	**1 653**
1.1.3.2.20.2	Fuel wood of non-coniferous wood (02.20.15)	1	1 394	**1 395**	1 546	176	**3 117**

7 Bridges between EFA and National Accounts

7.1 Principles, common concepts and standards

Common concepts and standards which exist between EFA and NA were elaborated using EFA guidelines and the expert input from Franz Murbach. In Swiss Statistics EFA applies the concepts and standards of ESA2010 where relevant, especially regarding the production border (cultivated and uncultivated forests), measurement of current transactions (production process, generation of primary income), accumulation (gross formation of fixed capital, consumption of fixed capital, changes in inventories, capital transfers), balance sheet (forest land, work-in-progress on cultivated biological assets) and labour input. Wood in the rough elements of supply and use tables are compiled. Output is distributed between the relevant types (market, own final use, non-market) and institutional sectors are a topic, as the output of the private households is put forward. These numerous points of contact between the central framework of National accounts (current transactions, accumulation, balance sheet), NA IOT and EFA were discussed.

8 Implementation, compilation and interfaces

8.1 Degree of detail for implementation of EFA

The EFA dataset defined in the EFA data collection program of Eurostat is in many aspects a condensed list of items to be reported. For the compilation of the EFA a multipurpose forest accounts related dataset which should have a level of detail which is sufficient for a comprehensive compilation process of the European Forest Accounts by Statistics Estonia and also for the input to accounts is suggested to be designed. In addition, in order to ensure a proper interface between JFSQ and Table C1a (supply of wood in the rough), more detail will be necessary than the mentioned C1a items of the EFA dataset. These aspects are also crucial when considering the distribution between institutional sectors and the possible compilation of the forest accounts to the prices of previous year. After analyses of the compiled accounts for 2022 with the help of Franz Murbach the tool for further improvements was proposed, designed and discussed. Project team analysed a summary check list of the elements and agreed to consider the tool as one of the first quality checks to perform in a development work starting in 2025. As this kind of checklist is not available for the use publicly it could be foreseen as a useful toolbox for other countries as well. This could be taken further after the checking all the connections in next round of work (in 2025). Toolbox potential is high considering future compilation of the monetary tables of EFA but also for a wider integrated production process with national accounts but also other reporting like JFSQ, EGSS, etc. The text in italics are the suggestions for the future improvements on coming years, being mainly subjects of the revision under ESA 2025 (assets of national resourced).

Table 41. Conceptual breakdowns of EFA items and additional information for consistent compilation in Estonia

EFA Item (Eurostat dataset)	Description	Breakdown for enabling double entries and offsetting (EFA, bridge NA)	Institutional sector breakdown for enabling bridge with NA, additional breakdown	Breakdown for enabling interface / mapping with other data collections, data sources	Additional info: prices, price index, subsidies and taxes	Additional info: quantities, volume	Other elements (consistency)
A1, A2	All items	Flows: B1, bridge NA (production and accumulation accounts), stocks: bridge NA (balance sheet, AN.1221)	distribute S.1 in S.11, S.14	National Forest Inventory. RMOV: Harvest and/or removal statistics (JFSQ)	Prices per ha, prices per m3	ha, m3 (stemwood OB, roundwood OB...)	Distribution amongst industries (B1=NACE02) *Consider in future bridge stocks FNAWS with balance sheet of NA, asset AN.213 Non-cultivated biological resources*
A1, A2: 2.2	Other wooded land NAWS	Consistency and exhaustivity	distribute S.1 in S.11, S.14	National Forest Inventory, JFSQ	Prices per ha, prices per m3	ha, m3 (stemwood OB, roundwood OB...)	Distribution amongst industries (B1=NACE02)
A1, A2: 3.x	Other land with tree cover, AWS and NAWS	Consistency exhaustivity (B1, B2, B3a, C1a)	distribute S.1 in S.11, S.14	RMOV: Harvest and/or removal statistics (JFSQ)	Prices per ha, prices per m3	ha, m3 (stemwood OB, roundwood OB...)	Distribution amongst industries (B1=NACE02)
B1: 1.1.1.2 2.1.1	Forest trees	Explicit offsetting from A2b (NACE02): NAI, RMOV; bridge NA, SUT of NA	Component of P.1, P.2, D.52 (AN.1221), distribute P.1 in P.11, P.12, P.13;	-	Prices per m3, stock, flows	m3 (stemwood OB, roundwood OB...)	B1=NACE02

			distribute S.1 in S.11, S.14				
B1: 1.1.2	Wood in the rough	Explicit offsetting B3a (NACE02), bridge NA, SUT of NA	Component of P.1, P.2, D.52 (AN.121, AN.123), distribute P.1 in P.11, P.12, P.13; distribute S.1 in S.11, S.14	Harvest and/or removal statistics (JFSQ)	Prices, price index, subsidies and taxes on products	m3 (stemwood OB, roundwood OB...)	B1=NACE02
B1: 1.1.4, 1.3, 1.4	Non-wood, wood processing and other products	Wood processing products, SUT of NA	dito	JFSQ elements, SUT of NA	Prices, price index, subsidies and taxes on products	-	B1=NACE02, consider wood chips production
B1: 1.2	Forestry services	B1: 2.2.1; SUT of NA	dito		Price index	Volume index	dito
B1: 2	Intermediate consumption		distribute S.1 in S.11, S.14	Mapping B1 with EKOMAR	Price index	Volume index	Distribution amongst industries (B1=NACE02)
B1: 2.1.1	Trees, tree plants, forest seeds	B1: 1.1.1: detailed offsetting for subitems, SUT of NA, subitem “trees”= RMOV component of P.52 (AN.1221) (P52_PRO)	dito	Subitems “tree plants and forest seeds” (EKOMAR)	Price per m3 (trees), price index for other elements	m3 of removals, volume index for other elements	dito
B1: 2.2.1	Forestry services	B1: 1.2; SUT of NA	dito	EKOMAR	Price index	Volume index	dito
B1: 2.2.4	FISIM	Consistent with B1 5.1 (no double counting of FISIM)	S.1 distributed by NA in S.11, S.14		Price index delivered by NA	Volume index delivered by NA	Distributed by NA amongst industries, especially here NACE02
B1: 2.3	Other goods and services	SUT of NA	distribute S.1 in S.11, S.14	Detailed mapping with EKOMAR and JFSQ (wood input)	Price index	Volume index	Consider use of wood in the rough for wood chips production
B1: 3.1	Consumption of fixed capital	Asset categories as detail of GFCF(B1,6)	distribute S.1 in S.11, S.14	-	Price index	Volume index	-
B1: 3.2.1	Other taxes on production	Under-compensation VAT, others	distribute S.1 in S.11, S.14	Production table, NA; GDP production side	-	-	Consider ESA2010 rule 4.23 g), listing of types of taxes
B1: 3.2.2	Other subsidies on production	Over-compensation VAT, others	distribute S.1 in S.11, S.14	Production table, NA; GDP production side	-	-	Consider ESA2010 rule 4.37 d), listing of types of subsidies
B1: 4.1	Compensation of employees	-	distribute S.1 in S.11, S.14	Labour and Business surveys	-	-	Mapping labour input, B1-4.1 and B1-(10-10.1)
B1: 5.1	Net property income	Property income, receivables: D.41, D.42, D.43, D.44, D.45	S.1 distributed by NA in S.11, S.14	EKOMAR; Delivered by NA (together with FISIM) to			D.41 receivable and payable do not include FISIM

		Property income, payables: D.41, D.45		ensure consistency and no double counting of FISIM			
B1: 5.2	Net entrepreneurial income	-	distribute S.1 in S.11, S.14	-	-	-	B1-5.2 (S.14) consistent with B1-10.1 and with B2-41
B1: 6	Gross fixed capital formation	consistent with B1-3.1	distribute S.1 in S.11, S.14	-	Price index	Volume index	Consider details ESA2010 assets
B1: 8.1	Work in progress on cultivated biological assets (changes in inventories of standing timber)	Corresponds to A2b (NAI-RMOV) for NACE02 and B1(1.1.1.2) - B1(2.1.1) for trees; SUT of NA (CPA 02.10.30)	distribute S.1 in S.11, S.14	-	Prices per m3, stock, flows	m3 (stemwood OB, roundwood OB...)	B1=NACE02
B1: 8.2	Other changes in inventories	Consistency with output B1-1 and with SUT of NA	distribute S.1 in S.11, S.14	-	Price index	Volume index	Consider mapping with CPA to ensure consistency
B1: 9	Capital transfers	Consistency with B1-6	distribute S.1 in S.11, S.14	Environmental Investment Centre, The Agricultural Registers and Information Board	-	-	Consider listing of types of transfers
B1: 10	Total labour input	Breakdown between 10.1 self-employed and 10.2 salaried labour (10.2=10-10.1)	distribute S.1 in S.11, S.14	Labour and business surveys	-	-	Consistence between B1-5.2 and B1-10.1 and B2-41 Consistence between B1-4.1 and B1-10.2 (=10-10.1)
B2	All items	Consistency with B1-1, distributed P.1 in P.11, P.12, P.13, Bridge NA	distribute S.1 in S.11, S.14	National accounts	Price index	Volume index	Mirror of complete distribution of B1-1 (production and sectors)
B3a, 51.0	Supply of NACE02	SUT of NA, offset of B1(1.1.2)	-	National accounts, JFSQ	-	-	See B3a, 51
B3a, 51.1	Supply by non NACE02 industries	SUT of NA	-	National accounts, JFSQ	-	-	See B3a, 51
B3a, 51	Domestic supply	SUT of NA	-	National accounts, JFSQ	-	-	A2b (RMOV) is consistent with B3a (51) and vice-versa
B3a, 61 to 65	Imports and total supply	SUT of NA	-	Foreign trade	-	-	Consistency with JFSQ and NA SUT
B3b, 51.0	Use by NACE02	Offset of B1(subitem of 2.3)	-	National accounts, JFSQ	-	-	Investigation of the plausibility, production of

							wood chips and other wood processing by NACE02
B3b, 51.1 to 74	Uses by non NACE02 industries, exports and total uses	SUT of NA	-	National accounts, JFSQ, foreign trade	-	-	Total uses = Total supply Consistency with JFSQ and NA SUT
C1a, 51.0	Supply of NACE02	Offset of B1 (1.1.2) physical component, consistent with B3a-51.0	-	JFSQ	-	-	See C1a, 51
C1a, 51.1	Supply by non NACE02 industries	Consistent with B3a-51.1	-	JFSQ	-	-	See C1a, 51
C1a, 51	Domestic use	Consistent with B3a-51	-	JFSQ	-	-	A2a (RMOV) is consistent with B3a (51) and vice-versa
C1b, all	All items	Consistent with B3b	-	JFSQ	-	-	-

8.1.1 Data exchange and tasks division between EFA and NA

The bridge tables drafted in this report aim to materialize the interfaces between EFA and NA. The compiling sequence still need to be implemented to suit the specificities of Statistics Estonia, although the EFA Handbook can give general indications for the compilation sequence of EFA table B1 (see chapter 5 of the handbook).

The conceptual bridge tables below cover the monetary EFA tables A1b, A2b, B1, B2, B3a and B3b. Collaboration between Estonian NA and EFA compilers has been built up during the pilot project elaborating a first full set of EFA tables for the year under review 2022. Tasks division principles have been addressed. First milestones have been set. Some interface aspects remain to be further deepened between Estonian NA and EFA compilers (those aspects are mentioned in the bridge tables below).

The compilation of the monetary tables of EFA in Estonia is closely linked with the compilation of National accounts (NA). One scheme in future might be that within Statistics Estonia, NA delivers to the EFA compilers the aggregates for the forestry and logging industry (B1, NACE 02). The EFA compilers add the specific items concerning the production process of standing timber (product 02.10.30), as output (net annual increment) and input (removals), which are additions to the other production processes of forestry and logging industry (wood in the rough, other forestry products, forestry services, inseparable non-forestry secondary activities including wood processing and the production of other goods and services.

The EFA compilers compile the sub-items of output and intermediate consumption, using principally EKOMAR data, JFSQ data, wood harvest and prices statistics and scaling it up to the output and intermediate consumption level (without the standing timber flows) delivered by NA. Offsetting technics are applied where relevant (e.g. forestry services).

National accounts deliver the other transactions to EFA, which are integrated into EFA tables B1 and B2. National accounts deliver the aggregate monetary components of the Supply and Use Tables for the wood in the rough (product group 02.20.1), and EFA compilers elaborate the detailed breakdown of the wood in the rough for EFA tables B3a and B3b, using especially JFSQ data together with the offsetting of B1. Possible conceptual bridge from NA to EFA can be seen in Table 42.

Table 42. Analysed draft conceptual bridge from NA to EFA in Estonia for future compilation to be considered

Item	Description	From NA towards EFA	to current prices	To previous year prices	Industries	Institutional sectors
A1b, all items	Wooded land	NA delivers no monetary data on stocks and flows of wooded land to EFA	-	-	-	-
A2b, all items	Timber	NA delivers no monetary data on stocks and flows of standing timber to EFA	-	-	-	-
B1, 1 P1 (without NAI)	Output without net annual increment of standing timber	P.1 Output (without 02.10.30 component) Inclusion in P1 Output of EFA	yes	yes	NACE02	S.11, S.14
B1, 2 P2 (without RMOV)	Intermediate consumption without removals of standing timber	P.2 Intermediate consumption Output (without 02.10.30 component) Inclusion in P2 Intermediate consumption of EFA	yes	yes	NACE02	S.11, S.14
B1, 2.2.4 FISIM	FISIM	P.2 FISIM Takeover in 2.2.4 P2_FISIM	yes	yes	NACE02	S.11, S.14
B1, 3 B1B	Gross value added without production process of standing timber	B.1b Gross value added (without 02.10.30 process = P.52 AN.1221), for consistency quality check	yes	yes	NACE02	S.11, S.14
B1, 3.1 P51C	Consumption of fixed capital	P.51c Consumption of fixed capital Takeover in P51C *If possible, NA delivers detailed CFC (4 assets categories analogue to P.51g GFCF)**	yes	yes	NACE02	S.11, S.14
B1, 3.2 B1N	Net added value without production process of standing timber	B.1n Net value added (without 02.10.30 process = P.52 AN.1221), for consistency quality check	yes	yes	NACE02	S.11, S.14
B1, 3.2.1 D29	Other taxes on production	Takeover in D29	yes	yes	NACE02	S.11, S.14
B1, 3.2.2 D39	Other subsidies on production	Takeover in D39	yes	yes	NACE02	S.11, S.14
B1, 4 FI	Factor income	FI factor income (without 02.10.30 process = P.52 AN.1221), for consistency quality check	yes	-	NACE02	S.11, S.14
B1, 4.1 D1	Compensation of employees	Takeover in D1	yes	-	NACE02	S.11, S.14
B1, 5 B2NAB3N	Net operating surplus and mixed income	B2NAB3N Net operating surplus and mixed income (without 02.10.30 process = P.52 AN.1221), for consistency quality check	yes	-	NACE02	S.11, S.14
B1, 5.1 D4	Property income	Takeover in D4 *If possible, NA delivers detailed D4 (payables: D41, D45; receivables: D41 to D45)**	yes	-	NACE02	S.11, S.14
B1, 5.2 B4N	Net entrepreneurial income	B4N Net entrepreneurial income (without 02.10.30 process = P.52 AN.1221), for consistency quality check	yes	-	NACE02	S.11, S.14
B1, 6 GFCF	Gross fixed capital formation	Takeover in P51G and subitems NA delivers detailed CFC (4 assets categories)	yes	yes	NACE02	S.11, S.14
B1, 7 P51N	NFCF	For consistency check	yes	yes	NACE02	S.11, S.14

B1, 8.2 P52_O	Other changes in inventories	Takeover in P52_O	yes	yes	NACE02	S.11, S.14
B1, 9 D9	Capital transfers	Takeover in D9	yes	-	NACE02	S.11, S.14
B2, all items	Output per types and sectors	Inclusion in B2 all items (standing timber process to be added)	yes	yes	NACE02	S.11, S.14
B3a	Supply of wood in the rough, components	Takeover of all components in B3a total line 1.1.3 *(detail of wood in the rough to be added if relevant for national users*)*	yes	-	NACE02, other industries	-
B3b	Use of wood in the rough, components	Takeover of all components in B3b total line 1.1.3.20 *(detail of wood in the rough to be added if relevant for national users*)*	yes	-	NACE02, other industries	-

Table 43. Analysed conceptual bridge from EFA to NA

Item	Description	From EFA towards NA	to current prices	To previous year prices	Industries	Institutional sectors
*Optional** A1b, INCR (AWS)	Increase of wooded land	Inclusion in K.1 Economic appearance or K.5 Other changes in volume not elsewhere classified	yes	*optional**	NACE02, other industries	S.11, S.14
*Optional** A1b, DECR (AWS)	Decrease of wooded land	Inclusion in K.2 Economic disappearance or K.5 Other changes in volume not elsewhere classified	yes	*optional**	NACE02, other industries	S.11, S.14
*Optional** A1b, REVAL (AWS)	Revaluation	Inclusion of (+) revaluation in K.7 Nominal holding gains Inclusion of (-) revaluation in K.7 Nominal holding losses	yes	*optional**	NACE02, other industries	S.11, S.14
*Optional** A1b, RECLAS (AWS)	Statistical reclassification	Inclusion on K.62 Changes in classification of assets and liabilities *Especially for uncultivated biological assets, to be considered if linked with*:* *- afforestation: K.1 Economic appearance* *- deforestation: K.2 Economic disappearance*	yes	*optional**	NACE02, other industries	S.11, S.14
*Optional** A1b, BAL (AWS)	Balancing item	K.5 Other changes in volume not elsewhere classified	yes	*optional**	NACE02, other industries	S.11, S.14
*Optional** A1b, STK_OP (AWS)	Opening stocks 01.01	Cultivated forests, OWL, OLTC: Opening balance sheet, AN.2112 *Uncultivated forests, OWL, OLTC: Opening balance sheet, AN.213 (together with timber component of A2b STK_OP)**	yes	*optional**	NACE02, other industries	S.11, S.14
*Optional** A1b, STK_CL (AWS)	Closing stocks 31.12	Cultivated forests, OWL, OLTC: Closing balance sheet, AN.2112 *Uncultivated forests, OWL, OLTC: Closing balance sheet, AN.213 (together with timber component of A2b STK_CL)**	yes	*optional**	NACE02, other industries	S.11, S.14
A2b, NAI (AWS)	Net annual increment of standing timber	Inclusion in P.1 Output (=P.11), P.12=0, P.13=0	yes	yes	NACE02, other industries	S.11, S.14

A2b, RMOV (AWS)	Removals of standing timber	Inclusion in P.2	yes	yes	NACE02, other industries	S.11, S.14
A2b, NAI-RMOV =P52_PRO (AWS)	Changes in inventories of work in progress on cultivated biological assets	Inclusion in P.52 (AN.1221)	yes	yes	NACE02, other industries	S.11, S.14
A2b, LOSS (AWS)	Irretrievable losses of standing timber	Inclusion in K.3 Catastrophic losses (ESA2010 6.09 b)) or in K.5 Other changes in volume not elsewhere classified (ESA2010 6.13 e)), depending on the extent	yes	*optional**	NACE02, other industries	S.11, S.14
A2b, REVAL (AWS)	Revaluation	Inclusion of (+) revaluation in K.7 Nominal holding gains Inclusion of (-) revaluation in K.7 Nominal holding losses	yes	*optional**	NACE02, other industries	S.11, S.14
A2b, RECLAS (AWS)	Statistical reclassification	Inclusion on K.62 Changes in classification of assets and liabilities *Especially for uncultivated biological assets, to be considered if linked with*:* *- afforestation: K.1 Economic appearance* *- deforestation: K.2 Economic disappearance*	yes	*optional**	NACE02, other industries	S.11, S.14
A2b, BAL (AWS)	Balancing item	K.5 Other changes in volume not elsewhere classified	yes	*optional**	NACE02, other industries	S.11, S.14
A2b, STK_OP (AWS)	Opening stocks 01.01	Cultivated forests, OWL, OLTC: Opening balance sheet, AN.1221 *Uncultivated forests, OWL, OLTC: Opening balance sheet, AN.213 (together with bare land component of A1b STK_OP)**	yes	*optional**	NACE02, other industries	S.11, S.14
A2b, STK_CL (AWS)	Closing stocks 31.12	Cultivated forests, OWL, OLTC: Closing balance sheet, AN.1221 *Uncultivated forests, OWL, OLTC: Closing balance sheet, AN.213 (together with bare land component of A1b STK_CL)**	yes	*optional**	NACE02, other industries	S.11, S.14
B1, 1.1.1.2 subitem "trees" (02.10.30)	Net annual increment of standing timber	Inclusion in P.1 Output (=P.11) *Inclusion in Supply table of NA, product 02.10.30** P.12=0, P.13=0	yes	yes	NACE02	S.11, S.14
B1, 2.1.1 subitem "trees" (02.10.30)	Removals of standing timber	Inclusion in P.2 *Inclusion in Use table of NA, product 02.10.30**	yes	yes	NACE02	S.11, S.14
B1, 8.1 (P52_PRO)	Changes in inventories of work in progress on cultivated biological assets	Inclusion in P.52 (AN.1221)	yes	yes	NACE02	S.11, S.14
B1, 1 (P1) B2 (all items)	Total Output	Inclusion in P1 Output (with subitems P.11, P.12, P.13), net annual increment of standing timber (02.10.30) is comprised.	yes	yes	NACE02	S.11, S.14

		*Details of Output (products): depending on tasks division between EFA and NA compilers**				
B1, 2 (P2)	Total intermediate consumption	Inclusion in P2 Intermediate consumption, removals of standing timber (02.10.30) are comprised. *Details of Intermediate consumption (products): depending on tasks division between EFA and NA compilers**	yes	yes	NACE02	S.11, S.14
B1, accounting balances (B1G, B1N, FI, B2NA3N, B4N)	Gross value added, net value added, factor income, net operating surplus and mixed income, net entrepreneurial income	Delivered for quality control reasons (checking consistency of accounting sequence of NACE02 on NA-side), the difference with "GVA without flows of standing timber 02.10.30" being equal to P.52 AN.1221 (P52_PRO)	yes	Only for B1G and B1N	NACE02	S.11, S.14

**to be considered as a possibility by Statistics Estonia*

8.1.2 Other bridging aspects

The routine yearly statistical production process of EFA is linked with bridges to modules of SEEA, e.g. MFA, ecosystem services, and EGSS (see EFA Handbook Chapter 7). The implementation of those bridges will be done in due time, during the consolidation process of EFA by Statistics Estonia.

8.1.3 Streamlining of the reporting on climate change LULUCF, environmental goods and services sector

The workstreams related to the linkages between EFA and various reporting's (climate change LULUCF Mati, environmental goods and services sector will contribute to long-term streamlining of these lines of reporting.

8.2 Consistency analyses

Consistency between of EFA and national accounts needs to be further analysed. The handling of the forest(timber) as an asset according to the definitions of European Forest Accounts and national accounts (SNA) definitions was done and the results discussed further as much relevant in the context of forestry accounts.

9 Issues to be addressed in 2025

9.1 Definition of a roadmap for the implementation of EFA in Estonia

9.1.1 Main elements for a roadmap for the implementation of EFA in Estonia

After that EFA will be consolidated as a hybrid module, covering physical and monetary aspects of Estonian forests, forestry & logging industry and supply and use of wood in the rough. As EFA is a module with numerous bridges to other statistics which were revealed with high level of clarity by the end of this work. A roadmap for the implementation was considered to be useful and it was decided to be tested. See the roadmap as it is outlined below.

The tables on the Conceptual bridge from EFA to NA and opposite EFA to NA provide the bases for the compilation of the production cycle. This work still needs to be done now and it is foreseen to be handled in 2025. As regards to the production schedule: when EFA is estimating some time period, NA would like to have it set up so that they can incorporate it into NA. NA initial estimates would definitely be some aggregate from quarterly estimates and EFA would have any use of those. Quarterly estimates should not feed into EFA annual calculations as if annual starts using quarterly estimates, it would become some kind of self-generating loop. They have to be independent.

The consistency between monetary and physical tables will be hence analysed aiming for higher uniformity.

The design of a roadmap for the implementation of the European Forest Accounts (EFA) in Estonia is crucial in process view sense “who is doing what and when” for the development of this module, taken from the pilot results in 2024 to a forthcoming activity of Estonian statistical production in 2025.

Despite the fact that regular data production to the regulation 691/2011 annex VII is foreseen to start in 2025, in sense of integration with national accounts, the period 2025-2026 could be seen as transitional. In this period Estonian EFA is foreseen to be compiled and conciliated and workflows with NA will be still tested.

Table 44. Roadmap for the integration of the EFA with national accounts in Estonia Item

Calendar	Methodology	Data sources	Consolidation steps	Years under review	Pilot EFA	Experimentally integrated EFA	Integrated EFA
2024-2025	Experimenting further the feasibility of EFA handbook methods, knowledge input from inland and other countries	Testing all available data sources	Decision of implementation of methods, establishing the routine cooperation with NA, NFI, Environmental Agency, RMK, etc.	2022	X		
2025-2026	Consolidating implementation methodology and institutional foundation, governance, review with panel of experts (forests, SEEA, NA, Eurostat)	Data sources sustainable (statistical program) and where relevant consistent with NA	Documentation, testing with Eurostat, data processing routines, consolidating bridges with NA, quality reporting	2022-2024, (1999) - 2025		X	
2027-2028		Consistent with NA	Consolidated bridges with NA	(1999) - 2027			X
2029	Benchmark and methodological revision coordinated with revision 2029 of NA	NFI, revised NA, revised EKOMAR (NACE Rev.2.1)	EFA time series revised with NFI data and revised NA and EKOMAR data	(1999) - 2028			X
2030-	SNA2025, ESA2029, SEEA/EFA????	Labour and business statistics NACE Rev.2.1					X

9.2 Implementing EFA methodologies and timeseries

The choice of methodologies to be implemented for the compilation of EFA in Estonia depends on several criteria, which are discussed in the chapters describing the different possibilities, advantages and disadvantages per table. Following criteria are particularly important to consider for deciding the methodology set to be applied:

- The method is mentioned in the European Forest Accounts Handbook. The fact that the method is applied by other countries is a key point.
- The data needed is available. The fact that the data complies with the European Statistics Code of Practice is a key point. The available timeseries match with the needs in matter of EFA timeseries to be compiled, and/or coefficients and/or other retropolation – interpolation technics can be applied to fill spatial and time gaps. At that stage of the pilot project, three perspectives impacting the needed time series were defined.
- From the National accounts' perspective, time series from 1999 upwards would be mandatory for the core bridge with National accounts (output, intermediate consumption, gross value added of NACE02 Forestry and logging) if the production process of standing timber must be introduced.
- From Eurostat's perspective, data series from 2022 upwards for tables A1b, A2a, A2b, B1 and B2 would be mandatory (Regulation - 2024/3024 - EN - EUR-Lex), first delivery being expected for September 2025.
- From Statistics Estonia's perspective, time series from 2015 upwards would underpin the feasibility test and trigger the consolidation process with national accounts during the years 2025-2029.

- The compilation process is feasible within the institutional setup of statistical production in Estonia. The expertise, know-how and human resources availability within Statistics Estonia and contracted partner institutions (e.g. Environment Agency) and data producers (e.g. Environment Agency, RMK) is guaranteed or in the process to be acquired. In 2025 still the grant work under the EGD 2024 is foreseen. The expected costs for development, consolidation, ordinary production and revision are foreseen in the limits of the available state budget for the compilation of EFA in Estonia starting from 2026.

- The EFA statistics elaborated by the methodology set applied are comprehensive, complies quality expectations of official statistics (Code of Practice), is consistent with connected statistics (Environmental accounts, National accounts, Forest Resource Assessments, National Forest Inventory, business statistics, trade statistics, forestry statistics, JFSQ, etc.) and is realistically explainable for the stakeholders, as well in levels than in yearly variations.

Table 45. Implementing EFA in Estonia: methodology set and feasibility description

EFA table	Expected time series (*option*)	Methodology set (stand of December 2024) *Main open issues if relevant, in Italics*	EFA Handbook countries' practices	Data availability	Know-how, HR, budget	Compliance with statistical program
A1a, Wooded land, physical	2022- (*1999-*)	National Forest Inventory. Data available from 1999.	Yes	Yes	Yes	Yes
A1b, Wooded land, monetary	2022- (*1999-*)	Taxable values for forest land by categories available for 2022. *Open issue: choice of coefficient (price index) for following years.*	Yes	Yes	Yes	To be clarified by NA
A2a, Timber, physical	2022- (*1999-*)	National Forest Inventory, Forest growth and logging volumes (Environment Agency). Data available from 1999. *Open issue: Removals of deadwood*	Yes *(deadwood to be clarified in EFA)*	Yes	Yes	Yes
A2b, Timber, monetary, NAI, RMOV	1999-	Stumpage prices (based on road-side prices and logging costs, RMK). Timeseries available from Y1998.	Yes	Yes	Yes	Yes
A2b, Timber, monetary, complete	2022- (*1999-*)	Net present value for valuation of timber stocks, stumpage prices for NAI and RMOV. Add losses, revaluation, balancing.	Yes	Yes	Yes	Yes
B1, NACE02 production account	1999-	Aggregates from National accounts, adding/replacing standing timber process and details of output (goods and services), replacing Gross value added.	Yes	Yes	Yes	Yes
B1, NACE02 complete	2022- (*1999-*)	Aggregates from National accounts, adding/replacing standing timber process and details of output (goods and services), replacing balancing items, adding labour volume input. *Open issue: Self-employed labour input*	Yes	Yes	Yes	Yes
B2, NACE02 output types	1999-	Aggregates and output types from National accounts, adding/replacing standing timber process	Yes	Yes	Yes	Yes
C1a, Supply of wood, physical	2022- (*1999-*)	JFSQ. *Open issue: wood supply by households*	Yes	Yes	Yes	Yes
B3a, Supply of wood, monetary	2022- (*1999-*)	Supply and Use Table of National accounts, offsetting B1 (output). *Open issue: wood supply by households*	Yes	Yes	Yes	Yes
C1b, Use of wood, physical	2022- (*1999-*)	JFSQ. *Open issues:* *- Use of wood in the rough by NACE02 remains to be described (wood chips?).* *- Open issue: wood use by households*	Yes	Yes	Yes	Yes
B3b, Use of wood, monetary	2022- (*1999-*)	Supply and Use Table of National accounts. *Open issues:* *- Use of wood in the rough by NACE02 remains to be described (wood chips?).* *- Open issue: wood use by households*	Yes	Yes	Yes	Yes

9.2.1 Timeline: major milestones of a routine statistical production year of EFA

The routine yearly statistical production process of EFA can be defined as follows (revising years under review n-1 and n-2 and compiling first estimate for year n 1), regarding the different exogenous milestones (SEEA modules, National accounts, Eurostat EFA data collection, etc.) and the availability of data sources. The routine production will be tested and consolidated during 2025-2026.

Table 46. Timeline routine statistical production of EFA

Calendar year n	Milestone year n	Data source	Task	Year under review n+1, prov	Year under review n,	Year under review n-1.	Year under review n-2
Jan n							
Feb n							
Mar n							
Apr n	NFI results	National Forest Inventory	Compile physical tables A1a, A2a	-	X	X	
Mai n	Forest statistics	Wood harvest Land prices Wood prices Harvest costs	Compile monetary tables A1b, A2b	-	X	X	X
Jun n		Labour statistics EKOMAR JFSQ data	Standing timber components, table B1 before NA conciliation	-	X	X	X
Jul n	EFA delivery to NA	EFA (components, EFA2NA bridge)	Delivery to NA	-	X	X	X
Aug n	NA delivery to EFA	National accounts (components, NA2EFA bridge, EFA2NA bridge)	FISIM, supply and use monetary data, table B1-B2-B3 NA conciliation	-	X	X	X
Sep n	EFA delivery to Eurostat	EFA dataset	Finalize datasets n-1, n-2, and deliver to Eurostat	-	X	X	X
Oct n	EFA delivery to SEEA	EGSS, MFA, other modules	Finalize bridges to EGSS, MFA and other downstream statistics	-	X	X	X
Nov n				X	-	-	-
Dec n							

9.2.2 EFA and quarterly estimates of current year of National accounts

It was discussed with national accounts that for the integration also quarterly estimates are needed to be compiled. NA would make quarterly estimates based on annual data and indicators. And revise these later based on EFA annual estimates.

9.2.3 Routine revision, scheduled benchmark or methodological revisions and unscheduled revisions of EFA

At the latest when EFA is in a routine statistical production process, a specific EFA revision policy must be applied. The connections between EFA and NA are dense. The most appropriate is to comply EFA revision policy with the principles, frequency and time coverage of the revision policy of the Estonian National accounts. Generally, the NA complies with an internationally defined roadmap of benchmark and methodological revisions. EFA will also have to take on board specific revision policies of SEEA, although it's advisable that SEEA revision policies remain congruent with the revision policies of NA. EFA revision policy must be transparent and openly communicated.

Following principles can be defined at this stage of development of Estonian EFA:

The routine revisions take place each year together with the compilation of the first estimates for EFA (year under review n-1) and cover a limited period of years under review (e.g. n-3, n-2), as provisional data and estimates are

replaced by final data. It is to be noted that in principle no new data source is introduced in the compilation procedure, and no methodological revision takes place.

The benchmark and methodological revisions take place every 4-5 years, at scheduled periods (e.g. 2024, 2029). Those revisions are the opportunity to revise and improve measurement and valuation methods, introduce new data sources, change definitions, introduce new international standards (e.g. the next major methodological revision of NA will take place in 2029, introducing the new System of National Accounts). Crucial is the necessity to revise in general all the time series to avoid breaks in the time series, as chronological and spatial comparability are fundamental for official statistics.

If necessary, unscheduled benchmark revisions can be introduced. This would be the case for example if Statistics Estonia decides to upgrade EFA from experimental to current statistics and therefor introduce in NA outside of a scheduled benchmark or methodological revision year the complete timeseries of the standing timber monetary components (output, intermediate consumption, changes in inventories, stocks).

ANNEX 1. Minutes of the methodological seminar 1

Seminar on the application of the methods of European Forest Accounts 1.

26.03.2024

Minutes

Tallinn, Tatari 51/virtual

Participants:

Kaia Oras, Statistics Estonia

Grete Luukas, Statistics Estonia

Robert Müürsepp Statistics Estonia

Mati Valgepea, Madis Raudsaar, Feliks Sirkas Estonian Environment Agency

Franz Murbach, Swiss Federal Statistical Office

Meelis Seedre, Ministry of Climate

Tanel Niklus, Ministry of Climate

Paavo Kaimre, expert

Ketli Lindus, Irje Mõldre Ministry of Economic Affairs

Enterprises representatives: Hendrik Välja, Margus Kohava Mait Kaup

Veiko.Eltermann RMK

arpo.kullerkupp Private Forest Association

Natalja Rüütel Land Board

Julie Hass, BEA expert

1. Introduction was done by Kaia Oras. Reporting planned within the framework of regulation 691/2011 (Annex VII) on environmental economic accounting was outlined. Overview of forest accounts legal process was given as well. Activities which have been carried out so far regarding the compilation of forest accounts were described. The preparation for implementation were described. The importance of the manual was outlined as there will be from now onwards more clarity in definitions. Workplan was outlined and the roles of the meeting experts were outlined. Need to develop in future regular workflow was discussed as a long-term goal.

2. Accounts of wooded land and timber stock in physical units were presented by Mati Valgepea. Planned methods for Estonia for the compilation of European forest accounts table A1a regarding wooded land balance were discussed. Methods for the calculation of the timber on wooded land, European forest accounts table A2a, planned methods in Estonia. National Forest Inventory (NFI) as the primary information source for the tables A1a and A2a. NFI is carried out by the Forest Department of the Estonian Environment Agency (EstEA) was acknowledged. Mati discussed the methods and the issues arising while compiling the EFA tables. Stock change method is applied in Estonia and not gain and loss method. Closing area will not sum up from the opening area and changes in case of earlier years.

It was discussed that each country has to find the best way for the compilation of the balances depending on the data available.

Problems arising from NFI methodology were discussed. The root problem is that is NFI estimates have high statistical error in case of small-scale phenomena. The deviation is also caused by the fact that yearly estimates are calculated from measurements of the last 5 years not just one single last available year. Also flow estimates do not become available for sub-categories of forest land and for other wooded land area. The relative error of other wooded land estimates (phenomenon with relatively small area) may be much higher than actual changes. The difference in forest land area is attributed to the “Balancing item” category in table A1a. The balancing item of forest land was distributed for subcategories of forest land area proportionally to the share of subcategory from the total forest land area of

opening stock in table A1a. There is no data to distribute the balancing item to subcategories of forest land in another way. Distribution of balancing item to sub-categories proportionally not on actual data. Solution will be only if in future SMI will apply mapping-based approach. According to forest monitoring regulation the detailed maps 10x10 metres precision scale need to be produced every year (in 2-3 years' time from now). This brings the data quality which will allow the compilation of the accounts and application of the definitions in a way that balancing for the beginning and end of the year would be done without the allocation a discrepancy to balancing item.

Regarding smaller categories it was discussed that data sources are currently not available for the estimation of the stocks of the "Other land with tree cover available for wood supply": there exist trees outside the forest land and urban settings e.g. inland water-bodies (trees on the slopes and sides of the ditches), infrastructure (trees under the corridor of power-lines) which are not assigned with the forest-land or other wooded land label in NFI. The fellings from these areas have been estimated based on other data sources. But the data about the areas of these categories are not available. During current study there will be the small try to estimate the areas balance also for these stock and balance items.

In general data for timber stocks' subcategories of forest land and other wooded land according to the availability for wood supply are based on NFI plot data. Locations of the sample plots are compared to the nature protection GIS layers from the Estonian Nature Information System EELIS. For other categories the estimates of removals quantities the combined expert estimates are done based on felling statistics from NFI, expert estimate about the removals from outside the forest land and expert estimate about the removals of non-stemwood from forest land. Estimation is based on the approach used in "Wood balance of Estonia" . These expert estimates are also the basis for the data reporting on removals in Joint Forest Sector questionnaire.

Regarding timber stock there are problems with definitions and models. NFI specific issues are the same as the ones which are relevant for the estimation of forest areas: low number of sample plots: statistical error is big especially in case of other wooded land category and flow items. So estimates from the measurements of the last 5 years, for felling figures are 3-year averages are used. Mati Valgepea described how currently flow estimates "net annual increment", "removals" and "irretrievable losses" use different fractions of timber (inclusion of non-stemwood, deadwood accounting). He questioned how to take a balance approach? Mati Valgepea also noted that it is also question whether to include into re-classification category the decrease of the deadwood as a result of the decaying. As regards the distribution of balancing item or reclassification to sub-categories of forest land, this also has the same reasons on not knowing important input values for more detailed categories.

Narrow scope of "Other land with tree cover available for wood supply" in EFA does not allow the place for reporting of the timber from non-forest lands under the "Other land with tree cover available for wood supply". Mati Valgepea also noted that there not enough data available for flow items of other wooded land. Both removals' figures can be considered insignificant and also total area and stocking level are very low. Mati Valgepea also indicated that at the moment the OWL removals are most probably accounted under other land with tree cover available for wood supply. The next steps were discussed as follows: further development of methodology, consultations bilaterally, EFA manual consideration and continuation of the debate on the coverage and inconsistency on definitions.

Area of deforestation will be tackled on the light of new information. Distribution of balancing item and flow items to forest land categories will be revisited. Other land with tree cover and other wooded land (AWS) stock and flow data will be tackled based on available data.

Analysis of quality (error estimates) will be done subsequent work. Reporting of removals of deadwood and non-stem wood will be analysed further. Connections to other reporting frameworks is also important to describe.

Regarding the definitions: There is a need for better data and statistical skills for estimation of the categories as non-retrievable losses. However probably the data reflect the quality rather well. The issue of the deadwood was tackled, and stock change method was discussed.

The Swiss experience on the compilation of the accounts of wooded land and timber stock in physical units: overview of principles and methods for European forest accounts tables A1a and A2a and work in progress was presented by Franz Murbach. Franz Murbach discussed balances from the viewpoint of categorization of the forests. Franz indicated that data available for the balances differ from country to country.

3. Monetary valuation methods were presented by Paavo Kaimre. Planned methods for European forest accounts table A1b for wooded land balance calculations in monetary units were discussed and the comparison of alternatives

was discussed. Discussion regarding the methods of monetary valuation of wooded land was carried out based on Estonia's earlier experience.

Swiss experience and plans: accounting of timber assets in monetary units, table A2b of the European forest accounts were presented by Franz Murbach.

Discussion on the monetary valuation methods brought out that application of the principle of the EFA () manual and respective screening of the valuation of the timber stock is one centre focuses of the attention in current project. Comparison of alternatives will be done for the calculations in monetary units based on planned methods for implementation European forest accounts table A2b in Estonia.

Julie Hass informed that in US the timber stock valuation is underway. Stumpage prices are available in every quarter. Multipurpose data system is in creation, it is not just for the statistical information.

4. Forestry and logging activity economic accounts plus supply and use tables for the wood in the rough- Planned methods in Estonia for the compilation of European forest accounts tables B1, B2 for forestry and logging activity economic accounting were presented by Grete Luukas. Statistics Estonia's methods has been based on the existing aggregates in national accounts and as these are too aggregated, available data from micro level will be further used. It was discussed that from now onwards the EFA manual methods (as manual has become available) will be applied, microlevel data coverage and quality will be analysed.

It was agreed that different prices and cost data are still issued to consider, as now EFA manual gives more guidelines for doing so. Regarding table B2 on types of the output, the improvements are planned.

Differences between EFA and national accounts was questioned and its was explained that as the output calculation differs, this will be explained and discussed during the cause of the project. Franz explained the different valuation methods and accounts related to forestry applied in Switzerland. will be analysed.

Swiss experience and plans regarding the compilation of forestry and logging activity economic accounts: European forest accounts tables B1, B2 sources and methods were presented by Franz Murbach. Statistics Switzerland described the need to map the sector structure in forestry. Franz Murbach. presented the mapping of the actors in forest activity. It was discussed that it is useful to start to map the transactions between the actors: who is doing what in forestry. It provides the data structure for supply and use. This provides the bases for the model where the producers and service providers are mapped and linked. This would be the bases for the supply and use.

Franz Murbach described also the mapping between the type of producers and institutional units. In addition the mapping of the types of production (market output, own final use , non-market output) by the institutional sector.

Franz Murbach described the datasources (Statistical Forest Inventory, forestry statistical survey and panel of forestry enterprises network data). Public sector enterprises data provides the data structure (costs etc) what is applied also with some reservation to private sector.

Due to the detailed nature of the compilation of the economic tables of EFA accounts, it was discussed that a separate work is needed to look at the mappings and methods of the compilation of accounts. It was suggested that Statistics Estonia analyses the forest sector, equivalent of the Swiss mapping methods in order to ensure the proper allocation of the flows.

Discussion:

Estonia acknowledges the efforts taken in Statistics Switzerland. EFA compilers in Estonia want to get acquainted with the Swiss data model. Currently the economic structure of the private forest operators and small forest enterprises is not well known. Hence basic data and proportions of the forestry sector needs to be assessed. There is a need for further consultation and learning in order to progress with the check the quality of the data of small companies in Estonia. There is a suspicion that the data is fragmented in many respects for small companies/private forests. The service providers are the ones from whom the price data are obtained, and in Estonia there are broadly two different categories of costs.

Questions and answers

Compilation of the supply and use tables for wood in the rough in monetary units. European forest accounts tables B3a and B3b, planned methods in Estonia, Grete Luukas. Compilation of the supply and use tables for wood in the

rough in physical units. European forest accounts tables C1a ja C1b, planned methods in Estonia were presented by Grete Luukas.

5. Franz Murbach introduced the forest accounting methodology of the Swiss Statistical Office - the Statistical Office receives microdata on felling costs from the institute for each individual plot. When estimating logging costs, the technology, logging method, distance from the road, machine hours and labor hours are taken into account. The Statistical Office adds price statistics, Franz uses the price index to calculate the cost of machines and labor. With a negative value, it equates the value of this plot to zero.

Since Estonian forest management practices are different, it is not possible to calculate individual plots, but aggregated or Estonian average values could be used. Assortment distribution is estimated based on actual usage. The Estonian SMI does have height and diameter, but there are no direct assortments that arise. At the same time, the so-called "third" level assortments have been evaluated. Assortments are derived from the use side and later applied to the supply side.

he data also contain a statistical error, if the size of the error can be estimated for physical data (errors are only calculated for the property in SMI), then this cannot be done for price data. In order that the error does not become too big, the Swiss Statistics make calculations for 5 regions and distinguish between two forest owners - state and private forest. Errors handling for the physical stocks and flows is not the focus of current grant (as this).

In Estonia, price data is available for the main tree species, which is a good basis for making financial calculations. Is there also an age structure of forests. Franz Murbach suggested that the choice of methodology should be based on available data. Franz Murbach thinks it's important to show annual volatility in prices. In the grant work, Estonia may test whether the average values of the last 5 years should be taken to reduce price volatility or other feasible approach. It was agreed that the plan would be to test the EFA methodology proposed by Eurostat.

Regarding the inclusion of over and under bark wood in the calculations, the situation of Estonia and Switzerland was discussed. In Estonia's foreign trade, it is not clear whether the data is presented with or without bark. In Switzerland, another institution deals with foreign trade, with whom Franz promised to contact and familiarize Statistics Estonia with respective methods. The possibility of looking at Swiss foreign trade was discussed to get ideas on how to resolve the inconsistencies in the data. Franz suggested that the C table should be done in both units. In addition, it is important to take into account whether it is wet or dry wood and also focus on units and transition.

A separate topic is the balancing of the tables, in which branches are included in balance categories. It is also useful to see whether the input microdata match the EFA definitions, how dead trees are reported, etc. This is a separate area that can be looked and analyzed further. Forest accounting cooperation and further actions were discussed.

Conclusions:

Connection in the tables are vital. The elements in different tables need to be compared.

Work will continue in bilateral settings. Environmental Agency and Statistics Estonia will distribute calculations for the EFA tables in September 2024

Final seminar will be held in November 2024.

Ministry of Climate representatives acknowledged the remarkable amount and high complexity of work that has been carried out.

3. Mati Valgepea, outside experts inputs are increasingly important and these help to enhance the transparency of the data and statistics.

4. Paavo Kaimre concluded that it is easy to ask what monetary value of Estonian forest is but fortunately we have lot of basic data and the methods now available and the semantics of different results need explanations

5. Also the grants enhance the cooperation between countries.

April, 6. 2024

Kaia Oras

Powerpoint presentations are available on demand.

ANNEX 2. Minutes of the study visit to Swiss Statistics

Study visit on the development of the methods for Estonian forest accounts in Swiss Federal Statistical Office 17-18 June 2024

Study visit was held in a frame of Eurostat Grant „Development of the forestry, environmental subsidies and ecosystem accounts, 101113157 - 2022-EE-EGD".

Participants:

Kaia Oras, Statistics Estonia

Grete Luukas, Statistics Estonia

Mati Valgepea, Estonian Environment Agency (online in Teams)

Franz Murbach, Federal Statistical Office

Isabelle Gambetta, Federal Statistical Office

Achim Schafer, Federal Office for Environment

17 – 18 June

Estonian forestry activity was discussed during first and also second day of the study visit. Statistics Estonia gave general overview of available data sources and material in Estonia. It was seen that Estonia has quite detailed information about forestry enterprises and prices for timber (by wood species and assortments). It was agreed that the biggest attention would be on the B and C tables during the study visit and following topics and questions were discussed:

Draw the model of Estonian forestry (actors and transactions) – discussion how to create a model of Estonian forestry enterprises was held. It was agreed that Grete (Statistics Estonia, SE) will make a model of enterprises with transactions and products/services they are producing. Enterprises are allocated to 5 bigger groups according to their NACE activity. Following activities could be distinguished: production of fuel wood, gathering of wild growing non-wood products, silviculture and other forestry activities, support services to forestry, logging. It would be helpful to identify also nurseries that provide tree plants and seeds, right now these are not separated from other activities.

Secondary activity of forestry - as there is also secondary forestry activity it would be helpful to make a B1 table for secondary activity and then can be seen how things sum up. But secondary activity figures shouldn't be filled in EFA B1 table as it is meant for primary forestry activity and local KAUs. Secondary activity should also be included in B3 tables (other industries).

In order to identify/ estimate output value of Live forest tree plants (02.10.11) and tree seeds (02.10.12) that is not readily available yet it was suggested to look up business reports of bigger enterprises. Mati Valgepea recommended to investigate organization of nurseries – union of licenced activity.

Wood in the rough has two subcategories in B table - logs and fuel wood; where should we include value of pulpwood? – Swiss Federal Statistical Office includes pulpwood under logs and SE plans to do the same.

If a subsidiary company of NACE 02 sells timber plants but is active in NACE 01, should it be also included in B tables? Under which category? - Should check if the primary activity is selling tree plants or something else. If it is important activity for forestry should be included to forestry and table B1 but if small, then the enterprise should not be included. Possible changes should be coordinated with agricultural statistics.

Secondary activity of NACE 02 enterprises – if NACE 02 enterprises have output from non- forestry activity, then it should be shown in table B1 under Other products from connected secondary activities in the local KAU.

Output of forest trees – SE has the physical amounts of increment by wood species and also roadside prices and harvesting cost. First the stumpage price can be calculated by subtracting harvesting cost from roadside price. Then net increment can be calculated by subtracting dead wood from increment. Output of forest trees can be calculated by multiplying stumpage price with net forest increment. SE will make the calculations for Estonia and will then present the results to National Accounts and agree on future cooperation and workflow.

Should the work-in-progress value be added to output? - it should not. It shows changes in inventories and is not a component of output.

Calculation of output for own final use [P.12] – Statistics Estonia uses assumption that the average amount of wood used for own final use is 13 m3/year in an agricultural household. Total physical amount of wood used for own final use is calculated by multiplying total number of agricultural households from agricultural statistics with 13 m3. Monetary price is calculated using market price of previous period and price index of wood and to estimate the monetary value of own final use monetary price is multiplied with total physical amount. Swiss uses indirectly energy statistics (coefficients for private use, enterprise statistics have under coverage and is supplemented with information from energy statistic - energy produced from wood by households, but they also have a limit set how much wood can be harvested, rules may differ between cantons.

Net property income [D.4] is not readily available, is SE calculation formula correct? – SE used data from business statistics and following formula: interest income - rent expense - interest expense. Formula is correct but it has to be checked if FISIM is included in enterprise statistics that is used as input and if yes then it has to be subtracted to avoid double counting of FISIM.

Employment - SE introduced methodology (the share of employment (NACE 02 from NACE A) to estimate the labour in FTE (is available only for NACE a)) and data sources and the logic and calculation seem correct.

Prices – SE uses roadside prices from State Forest Management Centre, it was discussed that it is important to check if the prices are over/under bark. If roadside prices are for standing timber equivalents then it is over bark and doesn't match physical harvest amounts and correction factors are needed. SE will discuss the topic with local experts.

Franz also showed how they publish EFA tables in Swiss Federal Statistical Office and discussion what and how should be published was held.

Workshop 2: Trade statistics, wood in the rough

Achim Schafer from Federal Office for Environment gave very comprehensive overview of trade statistics (wood in the rough) and JFSQ of Switzerland: handling of the under and over bark issue in JFSQ and EFA/C Tables (incl. the discrepancy between foreign trade statistics and JFSQ). The information was necessary for compiling EFA C tables. The biggest SE concern about mixed information of under/over bark of wood in the rough in trade statistics was discussed and it was agreed that the amounts that could be filled in C tables cannot be ideally separated in trade statistics and C tables should be filled using the information that is available from trade statistics. It might be that different restrictions have been agreed on (e.g. trees must be pest free) and it would give information about under/over bark of the timber. Also methodology for households final consumption of wood in the rough was discussed.

Follow up meeting

Agenda:

Forestry accounting consultation meeting (study visit after-session 5) regarding A tables, overview of applied methods for 2022 data and expert agreements

Participants: Kaia Oras Grete Luukas ; Paavo Kaimre; Mati Valgepea; Franz Murbach

Forestry accounting consultation meeting was dedicated to the overview of applied methods for 2022 data on timber stocks and flows A2b tables and expert agreements.

Short overview of Swiss and Estonian methods was given.

Analyses of the Estonian methods: A tables in monetary units were analysed.

Feedback on the data and methodology submitted and further tasks:

- Two methods have been applied from the EFA guide:

1.Net income method/Estonian name: NPV/combined stumpage

2.Stumpage prices

Observations:

1.Net income method/Estonian name: NPV/combined stumpage: improvements regarding age classes and description on the input data needs to be compiled.

2.Stumpage prices: Done

3. Using the age constant method: still needs to be compiled

4. Consumption value; still needs to be compiled

Conclusions and agreements:

1.Regarding the tables in financial units:

it is necessary to specify the calculation of the net present value of the timber stock tables

supplement the descriptions with meta information in order to allow full transparency

prepare calculations for the implementation of the remaining two EFA methods as well.

2. For the tables in physical units, it is necessary to also address those categories of lesser importance that we allowed to be evaluated experimentally (OWL). It is also important to create an initial calculation methodology file fr the higher transparency. Question is, which part us feasible/ could be done in 2024

3. For the cost calculations regarding non state forest, i.e private sector companies, Paavo finds studies. Grete does not assemble submit revenue/cost data

The next meeting is scheduled on August 26.

In agenda:

- the review the applied financial valuation methods for timber stock(Paavo submits in good time before the meeting) and wooded land values.

-SA presents B tables for 2022.

Further activities:

The plan is to submit the experimental EFA data for 2022 at the end of September.

ANNEX 3. Minutes of the methodological seminar 2

Seminar on the application of the methods of European Forest Accounts , 2.

26.11.2024

Minutes

Tallinn, Tatari 51/virtual

Participants:

Kaia Oras, Statistics Estonia

Grete Luukas, Statistics Estonia

Mati Valgepea, Estonian Environment Agency

Franz Murbach, Federal Statistical Office

Paavo Kaimre, expert, Estonian University of Life Sciences

Tanel Niklus, Ministry of Climate

Felix Sirkas, Estonian Environment Agency

Aarre Peltola Swen Peterson

Aki Kadulin, Statistics Estonia

Kätlin Aun, Statistics Estonia

Jennifer-Chelsea Laanet, Statistics Estonia

Marku Lamp, Estonian University of Life Sciences

Arpo Kullerkupp; Union of Private Forestry

Peltola Aarre (LUKE), Forest Resource Institute

Annemari Muru, Statistics Estonia

Rudolf Halapuu, Land Board

Natalja Rüütel, Land Board

Taivo Denks, Estonian Environment Agency

Robert Müürsepp, Statistics Estonia

Helmi Polmio, Statistics Finland

Introduction was done by Kaia Oras. Reporting planned within the framework of regulation 691/2011 (Annex VII) on environmental economic accounting was outlined. Overview of forest accounts legal process was given as well. Activities which have been carried out regarding the compilation of forest accounts were briefly described and the preparation for the implementation were explained. The importance of the new EFA manual was outlined as there will be from now onwards more clarity in definitions. Work schedule of the day was outlined, and the roles of the meeting experts were introduced. Need to develop the details of the future regular workflow as a medium-term goal was discussed.

Wooded land balance. European forest accounts table A1a, used methods in Estonia, project results, Mati Valgepea

Accounts of wooded land and timber stock in physical units for the year 2022 were presented by Mati Valgepea. Tables were compiled based on EFA methodology.

If in general EFA methods application was considered feasible, the issues which raised in application were discussed.

1. Methodological problems arising from NFI (National Forest Inventory (NFI) as the primary information source for the tables A1a and A2a) methodology:

NFI estimates have high statistical error in case of small-scale phenomena.

yearly estimates are calculated from measurements of the last 5 years.

estimates for the whole year not for the end or beginning of the calendar year.

Franz Murbach commented that all three issues depend on national available data.

2. Flow estimates from GHG reporting CRF tables: closing area will not sum up from the opening area and changes in case of earlier years. There is a solution provided by the Tartu University Institute of Mathematics and Statistics. Implementation of the proposed solution will be tested and if possible, implemented in 2025.

3. As there are no NFI data on flow estimates for sub-categories of forest land and for other wooded land area the allocation of the increase was done proportionally to the share of subcategory from the total forest land area of opening stock in table A1a.

4. As there are no NFI data to distribute the balancing item to subcategories of forest land in another way the distribution of balancing item to sub-categories was done proportionally to main categories.

5. Current scope of EFA definition for "Other land with tree cover available for wood supply" leaves out certain areas with tree cover. There exist trees outside the forest land and urban settings e.g. inland waterbodies (trees on the slopes and sides of the ditches), infrastructure (trees under the corridor of power-lines) which are not assigned with the forest-land or other wooded land label in NFI. There are no area or stock estimates available for this category but substantial amount of removals (ca 8% in 2022) come from those areas. By the definition those removals remain out of the scope of reporting table A2a

Conclusion: Data availability for the stock variables of "Other land with tree cover available for wood supply" was discussed and it was explained that it is not available via forest inventory.

6. Not enough data available assess properly the flow items of other wooded land. The relative error of OWL estimates (phenomenon with relatively small area) is much higher than actual changes.

Timber on wooded land, European forest accounts table A2a, used methods in Estonia, project results, Mati Valgepea

Results of the calculation of the timber on wooded land, European forest accounts table A2a, for the year 2022 were presented. Used methods for the calculation on wooded land, European forest accounts table A2a discussed. The issues which raised and tackled in a compilation together with the solutions were discussed.

1.NFI specific issues are the same as for the estimation of the wooded land:

estimate in NFI which Estonia's only data source refer for the year not the end of year;

estimates from the measurements refer for the last 5 years; felling figures are 3-year averages;

statistical error is large in case of small items of other wooded land category and flow items.

2.Flow estimates "net annual increment", "removals" and "irretrievable losses" use different fractions of timber (inclusion of non-stem wood, deadwood accounting).

Solution: As the issue is not yet clearly solved by EFA handbook the method of allocating the removals and irretrievable losses with non-stem wood and stock and NAI without non-stem wood was applied.

3.It is also question whether to include into re-classification category the decrease of the deadwood as a result of the decaying. This aspect was not considered by Estonia. This issue is also open in EFA handbook.

4.Distribution of balancing item to sub-categories of forest land is based on distribution of opening stock into forest land subcategories.

5. Narrow scope of "Other land with tree cover available for wood supply". The approach was taken to report all removed timber from non-forest lands under the "Other land with tree cover available for wood supply". It was discussed that data sources are currently not available for the estimation of the stocks of the "Other land with tree cover available for wood supply": there exist trees outside the forest land and urban settings e.g. inland water-bodies (trees on the slopes and sides of the ditches), infrastructure (trees under the corridor of power-lines) which are not assigned with the forest-land or other wooded land label in NFI. The felling's from these areas could be up to 7-8% of total removals. These data have been estimated based on other data-sources. But the data about the areas and stocks of these categories are not available and estimation is difficult.

As in case of the other wooded land, there are not enough NFI based data available for flow items of smaller categories like other wooded land. Removals' figures can be considered insignificant as the total area and stock level are very low. At the moment the OWL removals are most probably accounted under "Other land with tree cover available for wood supply".

Franz Murbach (Swiss Statistics) gave an opinion that provided Estonian experimental data for 2022 is consistent, as combining the physical balances land (A1a) and timber (A2a) give plausible volumes/hectare. Regarding the methodological issues raised, Franz emphasised that the coherence of estimation of stocks in EFA with NFI is the most important, and the flow items estimations are the subject of the implementing of feasible national approaches based on data sources available on national level. Removals in EFA should be coherent with harvest statistics, whereas the differences should be explained (production for own consumption, harvest outside forest or OWL, change of volume unit between removals and wood in the rough, etc.). Franz suggested that the question of removals done on areas not covered by the EFA land balance (A1a) respectively from stocks not covered by the EFA timber balance (A2a) should be described (suggestion has to be made to Eurostat to consider a methodological change in EFA in coming years) in the methodological report, as this supply of wood is economically significant for Estonia. Basically, Franz suggested to "add lines" in the balance tables (other land with tree cover not available for wood supply or "other land with trees not elsewhere comprised") so at least the removals can be recorded in volume and be coherent with the harvest of wood in the rough supplied. The topic should be taken on board of the next revision of the EFA methodology and dataset. Possibly the elements "area", "stock" and "increment" of those other lands providing timber are unknown. It's to be mentioned here that the EFA Handbook mentions in Table 7.3 that the SEEA CF definition of standing timber (SEEA CF 5.349) is broader than the EFA A2a scope, as "SEEA CF includes all possible sources of timber (...).".

Luke (Finland, Aarre Peltola) representative acknowledged the work done in Estonia and referred for the same application issues also in Finland regarding the high relative error of the estimates gave feedback that they have same problems as Estonia: they have only one year inventory data to calculate the results, which is a problem. And as inventory system in is not designed to produce estimates based on one year inventory data. So, the data will be less reliable if only one year data and will be used. Same solutions that Estonia is using are applied in Finland. The changes are the most difficult, small and difficult variables had to be estimated. So, this is the case where for example greenhouse gas inventory has been used, like in Estonia. But not only. In addition to field sample plots satellite data are used for example, so the taken approach is also multi source like in case of Estonia. Aarre Peltola described that removals estimates comes from additional data source which is the removal statistics and removals Statistics in Finland is not major problem. Also, regarding forest fires and wind losses administrative data are available. Luke (Aarre Peltola) representative concluded that work done in Estonia is excellent and that Finland has now same kind of solutions to the problems described as Estonia has found currently and LUKE is in following the same methodological path as Estonia has taken.

Several of the raised methodological issues have been discussed throughout a year. Now the results of the development of methodology and continuation of the debate on the coverage and consistency on definitions was outlined. Methods and the detailed descriptions regarding the referred application issues will be described in a report.

Mati discussed the methods and the issues arising while compiling the EFA tables. Mix of stock change method and gain-loss method is applied in Estonia. Closing area will not sum up from the opening area and changes in case of earlier years.

Valuation of wooded land, calculations in monetary units. Used methods for European forest accounts table A1b, used methods in Estonia. Comparison of alternatives, project results, - Paavo Kaimre

Monetary valuation methods were presented by Paavo Kaimre. Alternative methods for European forest accounts table A1a for wooded land balance calculations in monetary units were presented and the comparison of alternatives was discussed.

The improvements regarding development of the methodology to consider different categories of forest land (protected forests, other forested land) and the productivity of forest types were discussed. Results of the calculations based on three methods described in the EFA handbook were presented: direct method (transaction price method), residual method and Faustmann method.

It was discussed that all three approaches are associated with certain challenges and thus there currently not fully agreed upon method for routinely calculating the monetary value of forest land. Transaction price methods was

considered the most feasible but to obtain statistically more reliable results on total value of wooded land, significantly larger sample size, i.e., the volume of transactions would be needed in future. Residual method gives us negative (i.e. zero) land values and for the application of Faustmann method: a special stream of work needs to be initiated in country to calculate LEV for all forest site types, quality classes and tree species. Results will be sensitive to interest rates as well.

Lack of a universally agreed-upon methodology among the alternatives were discussed and the variety of the methods applied by EU countries was also viewed. Based on the comparison of various methods, Prof Paavo Kaimre suggested to select in the EFA context an approach for assessing the monetary value of forest land that applies the median transaction price for forest land used for timber supply and the minimum taxable value for land not used for timber supply. The drawback of this approach lies in the lack of representativeness of the sample. Transactions involving forest lands are predominantly conducted with lands that include average and better growth site types. As a result, the average and median price of clear-cut areas in Estonia reflects the value of average and slightly above-average forest lands.

According to EFA handbook, the direct method can also be implemented using prices of forest land per hectare determined through administrative processes or collected via surveys of relevant agencies (for example taxation offices) which are then scaled to provide total values for wooded land.

Discussing the advantages and disadvantages of alternative valuation methods, the experts concluded that, taking into account the availability of data, it is practical to use the administratively determined tax value for EFA accounts. The regular land assessment is carried out by Land Board and is a market-based land valuation that determines an approximate land value, or the taxable value, for each cadastral unit. It is a mass appraisal resulting in a statistical generalization. The most recent general land valuation took place in 2022.

There isn't yet built-up expertise in the forest land valuation in the Swiss EFA. The transaction method seems the most promising, eventually by pooled data from several years (3?) to increase observations. The value of standing timber would be deducted (if possible, a regional or forest type value). In the case of Estonia, the transaction price method seems the most promising (consider pooling together 3 years for example to reduce variability). The absolute level is an aspect (price per hectare, value of land), but the variations in volume and prices from one year to another is perhaps even more important. Finally, the value of land (A1b) of cultivated forests should not include the value of standing timber (and other resources) but gives a reflection of the potential of the given land (situation, exposition, soil quality, accessibility, etc.) (ESA2010, Annex 7.1, Land (AN.211): "The ground, including the soil covering and any associated surface waters, over which ownership rights are enforced. Excluded are any buildings or other structures situated on it or running through it, cultivated crops, trees and animals; subsoil assets, non-cultivated biological resources and water resources below the ground.)." Please see below some considerations regarding cultivated and non-cultivated forests connected to the balance sheet of National accounts.

The inclusion of forest land in National accounts balance sheets and the conformity between these estimates was discussed with the representatives of national accounts. Currently the value includes timber value as well. The methodological developments in national accounts could take into consideration one of the three methods proposed by forest accounts project in long run.

Franz Murbach commented that for cultivated forests, you cannot have the standing timber once in the value of land (AN.211) and once again in the inventories of stocks of work-in-progress on cultivated biological assets (AN.1221). it will be a double counting in National accounts.

Franz Murbach gave further suggestions: On the other hand (addendum to the discussion), the valuation of non-cultivated forests is done in the asset AN.213 Non-cultivated biological resources, and in this case the value of the trees is included (condition for valuation in the balance sheet according to ESA2010 would be that only those resources that are currently, or are likely soon to be, exploitable for economic purposes should be included).

To be discussed in the implementation of EFA remains the mapping between the different land and stock categories according to EFA and the differentiation between managed (cultivated) and non-managed (natural, non-cultivated) growth of timber stocks. Depending on the national forest realities (e.g. Estonian forests, OWL and other land with tree cover), a simplification can be to map FAWS with cultivated forests and FNAWS with non-cultivated forests.

The implications for national accounts would be following:

net annual increment of cultivated forests (NAI of FAWS) would be monetarised (A2b all suppliers, B1 only NACE02) and be a component of output; removals of cultivated forests (REM of FAWS) would be monetarised (A2b all users, B1 only NACE02) and be a component of intermediate consumption; the difference between NAI (FAWS) and REM (FAWS) in monetary terms would be equal to P.52 (AN.1221) and be recorded as changes in inventories in work-in-progress of cultivated biological assets (standing timber);the monetary value of the stock of standing timber (FAWS, A2b) would correspond to the value of asset AN.1221 work-in-progress of cultivated biological assets (standing timber), opening or closing stock.

For non-cultivated forests (corresponding to FNAWS in Estonia? To be noted: lies at the margins or outside the production scope), no flows would be monetarised, and in a separate bridge table between EFA and NA a compound monetary value for land together with the standing timber stock could be compiled and included in the asset value AN.213 Non-cultivated biological resources. This inclusion will have to be discussed with Estonian National accounts and could remain outside EFA data collection for Eurostat.

If necessary due to chosen methodology. NA would adjust the forest land estimates, in order to have land value without forests.

National accounts representative Robert Müürsepp agreed on the made suggestions and outlined implications.

Timber on wooded land, calculations in monetary units. Used methods for European forest accounts table A2b, used methods in Estonia. Comparison of alternatives, project results Paavo Kaimre

The results of the application of the methods outlined in EFA manuals for assessing the timber stock were presented and discussed on a seminar. The range of the methods also included one, which is not described in the EFA manual. Results of the calculations and comparison of applicability of the alternatives provided in the EFA handbook were presented by Paavo Kaimre. Feasibility of application of the principles presented in the EFA handbook and respective screening of the valuation of the timber stock were explored. Application of several EFA methods was considered feasible. Regarding the results of the calculation for estimating the financial value of a timber stock: the net income method, age constant method, stumpage value method, and consumption value method were analysed in more detail on a seminar.

The Net Income Method using a combined approach that integrates the Net Present Value (NPV) calculation with the stumpage price valuation method where the NPV of future costs and revenues of the existing stock is used to calculate the monetary value of the opening and closing stock was looked in more detail. Expected timber volumes at harvesting age were estimated by age classes and dominant tree species. Future net income flows were calculated by multiplying the average 2022 stumpage price by the final expected volume for each age class. These values were then discounted using a 2.3% rate over the remaining years until clear-cutting. The monetary value of timber flows in 2022 were calculated, multiplying the timber volume by the stumpage price (average stumpage price was €63.46 per cubic meter).

Based on availability of data on Estonia's forest resources and timber market, it was discussed that out of analysed methods either the stumpage method or the net income method for estimating the monetary value of timber stock in the context of EFA are feasible. But the Net Income Method using a combined approach that integrates the Net Present Value (NPV) calculation with the stumpage price valuation method was considered most appropriate based. Since the Timber stock consists of forest stands of various ages, income from their harvesting is generated over decades. Discounting the future revenues of the current young stands allows assigning them a comparable and adequate monetary value to that of mature stands. To estimate the monetary value of timber flows (net increment and removals), it is appropriate to use the stumpage prices of the reference year.

The semantics of the different results was analysed and discussed by Franz Murbach. Franz concluded that the most important in his eyes is to have a consistent monetary valuation of the net annual increment (NAI, output component) with the monetary valuation of the removals (REM, intermediate consumption component), as the difference between both components is the changes in inventories in work in progress of cultivated biological assets, which measures directly the Gross Value Added (GVA, respectively GDP) effect of forestry or, in other words, the production process of standing timber (as NAI adds to the stock of standing timber while REM retrieves from the stock of standing timber, REM being itself an input for the production of wood in the rough, which is supplied by logging). If the available data makes it possible (volumes or quantities, prices of wood in the rough, harvest costs, stumpage prices), the NAI should be monetary valuated on species/assortment level, as should be the removals (consistently to the pattern of wood in the rough). The pricing pattern could even be adapted to the institutional structure of the NACE02 units (non-financial

corporations, private households) as it seems that as well assortments as prices could diverge in Estonia between those two characteristic institutional sectors.

Pros and cons of the methods regarding the calculations in monetary values based on proposed methods for implementation European forest accounts table A2b in Estonia were discussed as in this phase of the work several methods have been tested for assessing the timber stock, including one, which is not described in the EFA manual. However, when using any method, it is important to calculate stumpage for the year under observation.

As mentioned above, Franz discussed that increment and removals affect GDP calculation. In Swiss system, the satellite account for forestry compiled net annual increment, removals and changes in inventories of work in progress of standing timber as pilot (experimental data) for 4 years, consolidating time series and methodology. Then, during the benchmark revision 2020 of the Swiss National Accounts (NA), the production process of standing timber was introduced in the central framework of NA and is ever since compiled by the Economic Accounts for Forestry and delivered to the NA (bridge between the branch accounts for the primary sector and the NA).

Discussion on the monetary valuation methods brought out and it was agreed that that despite the general methodological flexibility/recommendation of EFA to apply average prices, in future in the next work foreseen in 2025 and onwards could be the integration of an optimal detailed level for the calculation of the flow items (especially NAI and REM) in the next phase of the methodological development, to achieve a consistent integration with the output in national accounts. This would be important in going to the routine statistical processes and in timeseries view. This impacts the items output (P.1), intermediate consumption (P.2), changes in inventories in work in progress of cultivated biological assets (P.52_AN.1221 standing timber), holding gains and losses (revaluation), reclassification and finally the balance sheet (value of stock AN.1221 standing timber in opening and closing balance sheet).

Used methods in Estonia for the compilation of European forest accounts B and C tables for forestry and logging activity economic aggregates and supply and use tables, project results Grete Luukas

B tables that include economic aggregates of forestry and logging activity plus supply and use tables for the wood in the rough in monetary and physical units and used methodologies for the compilation of tables were presented by Grete Luukas.

Statistics Estonia's methods have initially relied on existing aggregates in national accounts. However, due to the high level of aggregation, micro-level data has also been utilized.

As the EFA manual is now available methods outlined in the manual were applied to compile tables of 2022. The coverage and quality of micro-level data was analysed during the grant project to see if collected micro level information of enterprises fill the needs of the account. Grete presented overview of the enterprises (how their data are collected, what is the structure of enterprises etc) and it was seen that micro data has good quality and is representative to use to calculate necessary values. Mati Valgepea pointed out that it would be good to check the production of woodchips as the forestry enterprises produce in addition to wood in the rough products from processed wood and these can be mixed.

Another topic that was dealt with in the project was calculating the output of "forest trees" and "wood in the rough" for B1 table by methodologies described in the manual. To calculate the output of "forest trees" the net increment must be multiplied with stumpage price, for the output of "wood in the rough" harvested amounts have to multiplied with roadside prices. Removals that are available from A2b are used as intermediate consumption and should be filled in table B1 under product "Trees, tree plants and forest tree seeds". Two separate possibilities were tried out in the project:

1. Grete used the same wood species and wood assortment detailed approach that has been used in national accounts to calculate the changes of work in progress. Gross increment by wood species and harvest by wood species and assortment, and mortality are available from Environment Agency. Gross increment was divided into assortments using the shares of harvest. To calculate net increment (= output of "forest trees") mortality was deducted from gross increment. Roadside prices by different wood species and assortments are asked from State Forest Management Centre and harvest cost that must be subtracted from roadside price to calculate stumpage price are calculated in Statistics Estonia using models that considers breast height, diameter by age class and wood species and average distance from nearest road. For "wood in the rough" fuel wood, pulpwood and logs were separately multiplied with corresponding prices. For intermediate consumption of "trees, tree plants and forest tree seeds" removals were

calculated using same assortment structure as for “wood in the rough” but stumpage prices were used. Changes in work of progress value of removals was subtracted from net increment.

2. Data from A2b was used to fill the value of output of “forest trees” as it should be equal with net increment calculated also for A2b. For the output of “wood in the rough” similar methodology as was used for table A2b was used – average weighted roadside price was multiplied with harvest amounts, amounts and prices of fuel wood, pulpwood and logs were not separately considered.

It was seen that depending on the chosen methodology the results can be very different. A2b table results can be directly used to fill in variables output of forest trees, intermediate consumption of trees, tree plants and forest tree seeds and changes in work in progress in table B1. It is very important to continue discussions on the methodologies and data that are finally used for EFA in routine production. As even small details can have a big impact it is important to have a consensus on chosen methodology.

It was agreed that different prices and cost data remain an issue to consider, but the EFA manual now provides more guidelines for addressing this.

The differences between EFA and national accounts figures were analysed. It was explained that these differences arise from variations in output and intermediate consumption calculation methods, which were discussed throughout the project.

Improvements are planned for gross value added in table B1 – it was decided that it is possible to recalculate some components of GVA to check if results are comparable with results from calculating GVA by subtracting intermediate consumption from output (that was done in this grant project).

Grete gave an overview on how own final consumption by households is calculated in national accounts. Following the analyses conducted during the grant project, it was concluded that the current methodology remains the most reliable. However, if more information becomes available, efforts to develop a better solution will continue.

“Other goods and services” in intermediate consumption part of B1 was also analysed in the grant as it was previously calculated as discrepancy between EFA intermediate consumption and intermediate consumption in national accounts and the percentage of other goods and services from total intermediate consumption in EFA, it was rather high (Eurostat suggests it not to be over 20%). It was possible to divide intermediate consumption to more detailed components during the project and the value of other goods and services were 16-19% depending on the methodology. It was also discussed that forestry services (output and intermediate consumption) need to be more analysed.

Grete also presented table B2 which can be considered most easy to compile as all necessary data are available from national accounts and table B1.

n extra issue arises with Table B3b, where it is challenging to identify the use of wood in the rough by forestry activity (NACE 02). In the current project, shares from the national accounts’ use table were utilized. However, this should be further analysed, as the national accounts provide an aggregated value that includes forestry services in addition to wood in the rough. Therefore, it might not accurately reflect the actual usage of wood in the rough. This issue also affects Table C1b, where the physical amounts of wood in the rough by user must be shown. For Table C1b, the same consumption share of NACE 02 was used.

Franz states that Mati mentioned that the production of wood chips for energy can be done on big scale by some Estonian forestry units. This could explain at least partly the significant intermediate consumption of wood in the rough by NACE02 units. The consequences would be following (includes double entries or offsetting!):

In Table B1, Output must comprise the production wood chips (1.3 Other products from connected secondary activities in the local KAU). Attention: the output of wood in the rough by NACE02 must remain consistent with Tables C1a/B3a (NACE02).

In Table B1, Intermediate consumption must comprise the use of wood in the rough to produce wood chips and remain consistent with Tables C1b/B3b (NACE02).

Consistency with the Supply-Use Table of National Accounts must be achieved at the end of the process, and/or B3a/B3b/B1 must be consistent with SUT-NA (NACE02, other industries, other uses and supplies).

Concerning mixed amounts of under and over bark of wood in the rough in trade statistics it was decided that the amounts that could be filled in C tables cannot be ideally separated in trade statistics and C tables should be filled using the information that is available from trade statistics.

It was described that while on a study trip to Switzerland, Grete, Kaia and Franz visited Achim Schafer of the Federal Office for Environment, who compiles especially the trade aspects of the JFSQ, which data can be used for the EFA C1a and C1b tables. In the Swiss JFSQ, specific coefficients or factors are used to harmonise (under bark, over bark) the wood volumes of the different imported or exported assortments.

Franz discussed that further in the regular production of accounts it would be good to:

For regular production to elaborate the methodology and data sources and data detail to use: to determine the methodology and level of data detail further on.

Time series analysis: Examine especially the time series of forestry output, intermediate consumption, and gross value added, as this has an impact of GVA level and variations (from the production approach, part and contribution of NACE02 to the level and variation of Estonian GVA and GDP). The implementation of EFA and its bridge with NA will also have an impact on the GNI inventory.

Discussion on the potential integration of European Forest Accounts (EFA) into National accounts (NA) and vice-versa implementation of NA data into EFA. All items of the accounting sequence EFA B1, B2, B3a and B3b are impacted, as well as the monetary aspects of the land (A1b) and standing timber (A2b) balances. Inputs to a specific chapter will be provided in the EFA report dealing with the bridge between NA and EFA.

Overview of forestry activity and standing timber value in relation to GDP and GVA.

Robert gave an overview of forestry activity and standing timber value in relation to GDP and GVA.

Estonia should include the output produced by forestry industries in the GNI data or demonstrate that it has a non-material impact on GNI. Action Point A4. As Estonia is missing EFA it is not known to what extent is forestry accounted for. Question is if EFA will add some additional estimates to GDP. Usually the changes will be linked to revision. As the revision will take place in 2029 but as Estonia has reservation, the estimates could be added any time. Robert acknowledged also that forestry is just 1% of GDP.

Robert gave the insight to the importance of methodological changes in national accounts, particularly in the context of Gross National Income (GNI) and Gross Domestic Product (GDP).

Main points:

Methodological Changes: When new methodologies are introduced, they should ideally be applied to the entire time series, not just a single year or a few years. This ensures consistency and accuracy in national accounts.

Materiality Threshold: If an economic activity or subject exceeds 0.1% of the GNI, it becomes a mandatory component in the methodology for compiling GDP and GNI. This threshold ensures that significant economic activities are accurately reflected in national accounts.

Forestry's Role: Forestry, although a small part of the economy (about 1% of gross value added), is significant. When auxiliary industries related to forestry are included, this share can rise to 5-6% of GDP. This sector's stability and growth are closely tied to the overall economic trends of Estonia.

Institutional Sectors: Forestry in Estonia is represented in two institutional sectors: non-financial corporations and households. Despite the large state company managing a significant portion of Estonian forests, it is classified as a non-financial enterprise in the private sector.

Economic Trends: The forestry industry's growth rate has been stable, matching the general growth rate of Estonia's GDP. However, it has faced challenges during economic downturns, such as the COVID-19 pandemic.

Methodological changes are crucial for maintaining the accuracy and relevance of national accounts, especially when significant economic activities are involved.

The possible impact of EFA (Environmental Footprint Analysis) estimates compared to current national accounts estimates can be significant. Here are the key points:

Methodology Impact: Depending on the methodology used for EFA, there can be a substantial impact on total output, potentially around €150-€400 million or more. Differences in methodologies can lead to remarkable variations in estimates.

Detail Level: National accounts may not capture the same level of detail as EFA, which can provide additional insights.

Intermediate Consumption: Changes in intermediate consumption could also affect the estimates. If intermediate consumption changes more than output, the impact on value added might be minimal. However, if it changes less, the impact on gross value added could be notable.

Value Added Components: Estimating value added components from the bottom up can be challenging due to data source limitations. While compensation of employees and taxes/subsidies can be estimated relatively easily, consumption of fixed capital and operational surplus are more complex.

Operational Surplus: In national accounts, operational surplus is often a residual component, as GDP is primarily estimated from the production side.

Consumption of Fixed Capital: EFA could use business reports for this, but national accounts have their own methods and rules for calculating depreciation, leading to potential differences.

Overall, the EFA provides a more detailed and potentially different perspective compared to national accounts, which can lead to significant variations in estimates.

Regarding methodological changes, new methodologies must be evaluated for their impact on both production and consumption sides to ensure balanced national accounts.

EFA work can significantly impact national accounts and provide deeper insights into economic trends.

Last part of the presentation highlighted the importance of understanding and addressing statistical discrepancies and the impact of methodological changes on GDP estimates.

Summary of the key points:

Intermediate Consumption: For national accounts, both output and intermediate consumption are important. If both increase by the same amount, there is no material impact on GDP. However, if they change by different amounts, it affects value added.

Incorporating New Estimates: There is no conceptual issue with incorporating new estimates into GDP, as long as the methodology is solid. This is done regularly during benchmark revisions.

Data Stability: The data used for estimates must be stable and regularly updated. Estimates produced infrequently (e.g., every 10 years) are not useful for national accounts. Regular annual and quarterly data are needed.

Quarterly Trends: National accounts require indicators to provide insights into quarterly trends before annual data is available.

EFA Data Sources: For EFA, data sources must be stable and reliable for future use. The chosen methodology should be reproducible on a regular basis.

Feedback regarding the compilation of forestry and logging activity economic accounts in Estonia: European forest accounts tables B, Franz Murbach

European forest accounts tables B1, B2 data sources and methods were presented by Franz Murbach. Implementing EFA Discussion points, focus B1-B3, based on Estonia’s figures.

Franz analysed Estonia's latest preliminary EFA results of B tables and gave an overview of his findings. The data has been brought to a balance and everything that could be easily checked have been checked. Thanks to a regular exchange of work-in-progress on the implementation of EFA during 2024, Franz was able to give step by step comments or elements of answers on open questions, especially in the tables B and C. Based on the actual state of the EFA implementation, following considerations were presented:

Value of EFA total forestry output – as the value is higher than in NA, it is important to know where the differences come from to adjust and integrate EFA and NA.

Discussion: it needs timeseries and quality assurance. Comment: Necessary to calculate timeseries to integrate with NA, also to cooperate with NA to know the methodology behind the values. Will describe this issue in the report and work will continue in next years.

Output of wood in the rough – when validating the value, it is important to compare with removals in A2b (has to be considered that B1 covers NACE02 but A2b coverage can be larger) and supply of wood in the rough in C1a.

Comment: We can make the comparison on general level this year and add it to the report.

Services characteristic of the forestry and logging activity – as the value is quite high it is important to analyse if it is adjusted with NA. SUT of NA aggregates wood in the rough and services as one product, further work is needed to distinguish services value in NA and compare with EFA result.

Comment: Will cover the issue in the report but work will continue next year. This year we'll use an assumption based on EKOMAR.

Regular maintenance and repair of equipment and maintenance of buildings as intermediate consumption of forestry activity – the value is zero as enterprises did not report the values separately, Franz suggested alternative methods, like using percentage from assets value or consumption of fixed capital (P.51c).

Comment: Will cover this issue in the report, work will continue next year.

Other subsidies on production (D.39) - it had a negative value but should be positive. This issue was solved after the seminar and Franz was correct, D.39 has a positive value.

Comment: Solved.

Employment – Franz suggested to compare employment results with D.1 (compensation of employees) and consistency of self-employees with net entrepreneurial income and forestry output of households in B2 table.

Comment: Will cover the issue in the report and make the calculation this year.

Net fixed capital formation – if it has a positive value, it shows that NACE02 is growing (invests more in fixed assets than is the consumption of fixed capital), both aggregates (consumption of fixed capital and capital formation) are calculated in NA and can be considered correct therefore it can be said that forestry activity has finances to invest and buy more machinery, buildings etc. Another test is to compare investments with B.4n Net entrepreneurial income (less an estimated compensation of non-salaried work), to assess if the forestry industry generates an income sufficient to finance a significant part of investments.

Comment: Solved.

Use of wood in the rough in B3b – right now methodology uses shares from NA but needs to be checked as NA includes also forestry services. Also, consistency with B1 output and intermediate consumption to be checked in relation with secondary activities and energy.

Comment: Will cover the issue in the report, work will continue next year.

Franz also gave useful tips: for example that the input to EFA from NA should be transparent and logical to reproduce in future work flow as well: Transactions and flows: especially P.1 (P.11, P.12, P.13), P.2, D.1, D.29, D.39, P.51c, P.51g, P.52(AN.1221), P.52 (Others); assets: especially AN.1221, AN.211. Flows and assets (especially output) should be indicated separately for S.11 and S.14. If this knowledge is shared, then it is possible:

To analyse differences between the accounts and see if anything needs to be changed/adjusted.

To build a bridge for routine statistical production between EFA and NA

Franz mentioned that in general the major input from EFA to NA should come from Net annual increment of standing timber that should be included to P.1 Output and from the removals of standing timber, to be included in P.2 Intermediate consumption, the difference of both equals to the third major component, P.52 (on AN.1221) Changes in inventories in work-in-progress on cultivated biological assets (standing timber). But to integrate these variables into NA requires that the EFA implementation and statistical production needs to be consolidated and timeseries are necessary to make the assessment analysis.

Processing of own wood was another topic Franz introduced; he suggested three approaches how to estimate the value of consumption of wood in the rough by NACE 02.

Franz Murbach discussed the mapping of the actors in forest activity by describing the mapping between the type of producers and institutional units. In addition the mapping of the types of production (market output, own final use, non-market output) by the institutional sector.

Statistics Estonia showed the analyses of the forest sector to ensure the proper allocation of the flows.

Connections between the EFA tables Franz, Grete, all

Franz described the relations between EFA tables which are important from the viewpoint of quality. Franz analysed latest results of Estonian EFA and pointed out issues/indicators that need further attention. He also suggested to take physical amounts of C tables and monetary values from B tables to analyse if the price between physical and monetary values seems reasonable.

Physical connections to check:

A1a – A2a – if wooded land is consistent with standing timber stock (m3/ha);

A2a – C1a – if removals of standing timber are consistent with supply of wood in the rough (conversion of standing timber equivalents to wood in the rough is necessary if different volume units are used in table A2a (stem wood over bark) and C1a (round wood over bark). This comparison would underline the mentioned issue that wood supply come from outside the border of A1 and A2.

Monetary connections to check:

net annual increment in A2b – output of forest trees in B1;

removals of standing timber in A2b – intermediate consumption of standing timber in B1;

net annual increment in A2b – removals in A2b = changes in inventories of work in progress in B1;

supply of wood in the rough in B3a– output of wood in the rough in B1.

Franz also provided tables which variables to be cross-checked. Statistics Estonia will investigate these links further on.

Also, suggestion to use reported financial data for the biggest enterprises to calculate the output of wood in the rough for table B1 was provided by Franz: to analyse if results would be similar to output that is calculated by using quantity * price method. This hybrid approach is only possible if the production of wood in the rough of the biggest enterprises is known in physical terms; if not, such comparisons could be difficult or impossible to assess.

Conclusions:

Franz Murbach suggested that the choice of methodology should be based on optimising the available it's important to show annual volatility in prices. Connection in the tables is vital. The elements in different tables need to be compared.

Partners, Environmental Agency, Paavo Kaimre, Franz Murbach and Statistics Estonia will compile minutes and methods descriptions during coming weeks and it was agreed that on follow up meeting and discussions are still needed for final decision regarding the details of the finalization of this year's work and setting up the plans for future workflows of EFA.

Kaia thanked Franz for the overall positive feedback. Team is grateful for the great work Franz has done in analysing Estonian data. The advice related to simplifying and improving quality and transparency in the next stages of work is very useful and necessary. The analytical material and feedback received also exceeds our expectations and Statistics Office is grateful for the detailed observations and recommendations. The methodological clarifications made will certainly allow us to work towards establishing a routine accounting process in Estonia, apply EFA guidelines and integrate forest accounts satellite account further on with the production processes in national accounts in coming years.

Powerpoint presentations are available on demand.

ANNEX 4 Stakeholder kick off meeting on the development of forest accounts

Online

October 25, 2023

Conclusions/minutes

Participants: Statistics Estonia (Kaia Oras, Grete Luukas),

Estonian Environment Agency (Mati Valgepea),

Ministry of Climate (Head of the department of forestry Meelis Seedre, expert of the department of forestry Leno Kuura)

Agenda

- The interim developments in area of forest statistics
- Conclusions on efforts taken so far
- Goals of the grant work and objectives
- Alternative data sources and experts' availability
- Specific tasks to be carried out and the agreement on the relevance of specific issues
- The process and the involvement of experts

Introduction regarding the aim of the meeting was given by Statistics Estonia.

The interim developments in area of forest statistics and accounts were discussed. Representatives of Ministry of Climate and Estonian Environment Agency provided feedback on the developments in Estonia.

Efforts taken so far for development of forest accounts were summarized: the results of the work for one round of account compilation were briefly analysed based on materials made available beforehand. The report and tables with methodological notes were made publicly available beforehand. It was discussed how to improve the compilation logic already applied. [1]

Goals of the grant work, project tasks and objectives were presented by Kaia Oras.

Kaia Oras also described the work related to the compilation of the Eurostat manual and thanked Environmental Agency for the contributions. The workplan and specific tasks to be carried out were handled and the workplan document was presented. The relevance of specific issues was discussed.

As some of the issues mentioned in the current grant agreement were partially already tackled in 2022 and 2023, it was discussed that the issues which were already analysed and conclusions made need not to be handled methodologically once more in current grant work, just data, need to be produced.

The process and the involvement of national and international experts was considered. Consultations with other statistical organizations was discussed. Statistics Estonia explained that after the agreement on the further work schedule and identification of the specific needs, Statistics Estonia has started analysing and will analyse further the work and methods of other countries as well. The needs for additional methodological support were assured and topics were initially discussed. It was proposed that the consultations and discussions would be foremost needed regarding the methodological approaches to adjust forest area and stock estimates to relevant categories in balance sheet (in A tables). Also data sources and methods for the valuation of the B tables detailed breakdowns could be the subject for discussion. Regarding the cooperation and methodological discussions with national statistical offices the involvement of the CBS, Statistics Finland, Statistics Austria as candidates were discussed. Initial correspondence with Statistics Austria has started.

The involvement and the tasks of the national subcontractors were reviewed. It was discussed if additional experts need to be included in addition to the ones involved in earlier grant work for the development of the set of tables regarding accounting for forest area and stock both in physical and monetary units. Testing of the approaches highlighted in the EFA manual were depict.

Alternative data sources for C tables were explored on the basis of the results of earlier work and feedback gathered on final seminar of the grant in summer 2023.

Regarding the physical accounting tables (in terms of forest area and stock indicators), the quality and the content of the breakdowns in accounting tables was discussed. It was discussed what would be feasible to achieve in short run.

The methodological improvements of forest management tables B1 and B2, were discussed as well as the need for additional work to identify and improve the quality of some categories in the tables.

Conclusions

First round of the methods applied in 2021 - 2023 were considered satisfactory, however it was acknowledged that the methodological issues described in previous work need to be addressed further. General agreement was reached on the scope of the work to be carried out.

The information on the gained results of some of the methodological tasks which were already performed or partially carried out in the frame of earlier grant work will be reported via partnership portal. These tasks will not be handled to full extent once more in current grant work methodologically, just data will be produced for the year 2022. The list of the methodological tasks which were already performed in the frame of earlier grant work and published here is as follows:

The workstreams related to the linkages between EFA and various reporting's (climate change LULUCF, environmental goods and services sector) what was considered in a time of making of the proposal and signing the contract in 2022 (to be performed and to contribute to the long-term streamlining of these lines of reporting), was already analysed and described in previous grant.

The breakdown of "Other wooded land" into "OWL available for wood supply" and "OWL not available for wood supply" and adding the balancing item "Other changes in volume N.E.C." in A table was performed in the process of compilation of the tables by June 2023 and are published in tables here. Feedback on category "Other changes in volume N.E.C." was given to Eurostat. In current grant work data for 2022 will be compiled and in case of the methodological issues, these will be handled and described.

In the work description of the grant agreement it is said that "the breakdown of "Fuel wood" into "Coniferous" and "Broadleaf" in EFA table C1 will be done and that the feasibility of estimating these breakdowns could be analysed and the efforts to estimate these could be taken". The effort was taken and the task was performed in the compilation of the tables by June 2023 and are published in tables here. In current grant data for 2022 will be compiled and in case of the methodological issues, these will be handled and described.

In the work description of the grant agreement it is described that "if feasible and relevant the supply and use tables of product wood in the rough (tables B3a and B3b) would be further disaggregated (the product group in National Accounts, as the main data source) and the consistency between tables of EFA B1, B2 and B3 should be analysed and improved based on the experience gained in previous grant." Analyses is initially published in earlier work. In current grant data for 2022 will be compiled and in case of the methodological issues, these will be handled and described.

Next steps were agreed. In-depth discussion with partners and subcontractors regarding accounting tables for 2022 and methodological issues will start. Statistics Estonia will organize a seminar in coming months in order to discuss how to proceed further in advancing of the methods currently already applied.

Regarding the compilation of the physical and monetary asset tables (A tables) the tasks were discussed and the need for the involvement of the experts was acknowledged. No new potential subcontractors were identified- Estonian

Environment Agency and experts of the University of the Life Sciences were suggested as the main experts in the field by Ministry of Climate.

Experts in other NSI-s will be contacted and the terms of the work will be agreed. It was agreed that the volume of the work under each workstream will be agreed. It was agreed that possible study visit and /or invitation of the experts will be agreed as well.

Statistics Estonia asked if alternative methods, data and data sources which could be used to further improve the methods and quality of the forest accounts are or will be available (including references to additional data sources), Statistics Estonia would greatly appreciate such information from Ministry of Climate and Estonian Environment Agency in due time. Data sources and a reference to the initial methodological approach are referred in the table of the workstreams.

Further development of the macro level asset valuation was considered a necessary task both in sense of timber and forest land valuation. Proposed approaches in EFA will be tested. Asset valuation in national accounts will be studied further. Coherence between national accounts and EFA was considered important and will be analysed further.

Tallinn, 25.10.2023.

Kaia Oras

ANNEX 5 Communication related to timing and details of methodological work

Communication via partnership portal related to timing and details of the methodological work.

We let you know on some of the adjustments regarding the timing of the meetings of the workplan of the grant 101113157 - 2022-EE-EGD on „Development of the forestry, environmental subsidies and ecosystem accounts". In addition some clarification on adjustments in the work description is given. The later mainly concerns some rather minor workflows already initiated in previous grant work 101022852 — 2020-EE-ENVACC, partial results achieved and methodologies now to be adjusted due to the advancements of work on methodological manual of European Forest Accounts.

1.Timing of the stakeholder meeting. Initially stakeholder kick off meeting was planned on a first month of the grant work. Due to the need of the analyses of the methodological work finished on June 30th (second phase in 2022 and 2023 (101022852 — 2020-EE-ENVACC) and the questions regarding the approach to be taken, the expert kick off meeting were carried out in July 2023 in first order and the stakeholder kick off meetings were carried out after the analyses of the efforts taken so far for development of these three modules of the accounts was done. The stakeholder kick off meetings were carried out in October and November 2023 (for environmental subsidies account in October 2023, for ecosystem accounts in November 2023 and for Forest Accounts in November 2023 respectively). This change in the timing of the kick of seminars with stakeholders was adequate in current circumstances, analyses needed and was in the best interests of the project results to be reached and the success of the action.

2. Regarding the first batch of the seminars (Seminars 1) on methodological issues, it is said in the grant agreement that timing is to be agreed depending on the availability of experts. We let you know that first project seminar on ecosystem accounts was carried out in November 2023 and first seminar on environmental subsidies accounts was carried out in October 2023. First seminar (Seminar 1) on forest accounts was agreed to take place on February 2024 (month M+7 or M+8) in order to have time for analyses of additional methodological materials, test the methodological approaches proposed in the EFA handbook in development, prepare data and approaches for discussion.

3. We let you know that some of the minor methodological issues listed in the current grant agreement (on forest accounts) were partially already tackled in earlier grant work second phase in 2022 and 2023 (101022852 — 2020-EE-ENVACC) and initial analyses of these issues is also presented in the methodological report. As said, these issues are minor and there is no adjustment in the amount of the grant needed and foreseen. So, in order to avoid misunderstanding we clarify that the issues which were initially analysed and some descriptions and conclusions were made, would not be address as the new methodological challenges again. We propose that data for these issues will be produced for the year 2022 and the methods will be outlined. The descriptions compiled will be revised if relevant for examples from the viewpoint of the methods specified in upcoming manual of European forest accounts (EFA manual). The list of the methodological tasks which were already partially performed in the frame of earlier grant work and published here is as follows:

1.In the Technical descriptions chapter "3 Impact", subchapter "3.1. Impact and ambition" of the grant agreement it is said that the linkages between EFA and various reporting's (climate change LULUCF, environmental goods and services sector) will be carried out. These linkages have to certain extent been already analysed and described in previous grant (101022852 — 2020-EE-ENVACC). In current grant work data for 2022 will be compiled, EFA manual approaches will be analysed and in case of the additional methodological details revealed, these will be handled and described. Statistics Estonia is also contributing to the development of methodology of EFA handbook via Eurostat EFA webinars and written consultations.

2.In the Technical descriptions chapter "2 Quality" and subchapter "2.1 Concept and methodology" of the grant agreement it is said that the breakdown of "Other wooded land" into "OWL available for wood supply" and "OWL not available for wood supply" and adding the balancing item "Other changes in volume N.E.C." in A tables will be performed. This division was performed in the process of compilation of the tables by June 2023 and are published in tables here. Feedback on category "Other changes in volume N.E.C." was given to Eurostat. Based on the methodological approaches that will be taken in EFA manual (in development), the raised questions and consistency will be tested in current grant work and data for 2022 will be compiled. In case of the methodological issues, these will be handled and described. Statistics Estonia is also contributing to the development of this stream of methodology of EFA handbook via Eurostat EFA webinars and written consultations.

3. In the Technical descriptions chapter “2 Quality” and subchapter “2.1 Concept and methodology” of the grant agreement it is said that “the breakdown of “Fuel wood” into “Coniferous” and “Broadleaf” in EFA table C1 will be done and that the feasibility of estimating these breakdowns could be analysed and the efforts to estimate these could be taken”. The effort was already taken and the task was performed in the compilation of the tables by June 2023 and are published in tables here. In current grant work, data for 2022 will be compiled and in case of the methodological issues, these will be handled and described. The consistency with the approaches that will be outlined in EFA manual, will be tested.

4. In the technical descriptions part “2.Quality” subchapter “2.1 Concept and methodology” of the grant agreement it is described that “if feasible and relevant the supply and use tables of product wood in the rough (tables B3a and B3b) would be further disaggregated (the product group in National Accounts, as the main data source) and the consistency between tables of EFA B1, B2 and B3 should be analysed and improved based on the experience gained in previous grant.” Analyses was carried out to certain extent and is initially published in earlier work. In current grant, data for 2022 will be compiled and in case of the methodological issues, these will be handled and described. The consistency with the approaches that will be outlined in EFA manual, will be tested.

ANNEX 6 Acronyms

€	Euro (currency, also abreviated EUR)
ALS	Airborne laser scanning
AN.121	Materials and supplies (Inventories, Non-financial assets (AN) classification of ESA2010)
AN.1221	Work-in-progress on cultivated biological assets (Non-financial assets (AN) classification of ESA2010)
AN.123	Finished goods (Inventories, Non-financial assets (AN) classification of ESA2010)
AN.213	Uncultivated biological assets (Non-financial assets (AN) classification of ESA2010)
AWS	Available for wood supply (opposite: NAWS)
AWU	Annual work unit
BAL	Balancing item (EFA methodology and transmission tables)
BEA	Bureau of Economic Analysis, United States Department of Commerce
CFC	Consumption of fixed capital (transactions in products (P) classification of ESA2010)
CIF	Cost, insurance and freight (ESA2010)
CPA	Classification of products associated to NACE
CPA 02.10.30	Forest trees, Classification of products (CPA 2.1) associated to NACE Rev.2
CPA 02.20.1	Wood in the rough, Classification of products (CPA 2.1) associated to NACE Rev.2
CRT	Common reporting tables
D.1	Compensation of employees (distributive transactions (D) classification of ESA2010)
D.29	Other taxes on production (distributive transactions (D) classification of ESA2010)
D.39	Other subsidies on production (distributive transactions (D) classification of ESA2010)
D.4	Property income (distributive transactions (D) classification of ESA2010). Components are in particular D.41 Interests, D.42 Distributed income of corporations, D.43 Reinvested earnings on foreign direct investment, D.44 Other investment income, D.45 Rent
D.52	Changes in inventories (transactions in products (P) classification of ESA2010)
D.9	Capital transfers (current transfers in cash and kind (D.5-D.8) classification of ESA2010)
dito	idem, same as above
EELIS	Estonian Nature Information System
ECE, UNECE	United Nations Economic Commission for Europe
EFA	European Forests Accounts
EFA A1a	Wooded land, Area of wooded land, in 1000 ha
EFA A1b	Wooded land, Area of wooded land, in million national currency
EFA A2a	Timber, timber on wooded land, in 1000 m3 over bark
EFA A2b	Timber, timber on wooded land, in million national currency
EFA B1	Economic aggregates of the forestry and logging industry
EFA B2	Output of the forestry and logging industry by economic type and institutional producing sector
EFA B3a	Supply of wood in the rough by all industries, in million national currency
EFA B3b	Use of wood in the rough by all industries, in million national currency
EFA C1a	Supply of wood in the rough by all industries, in 1000 m3 over bark
EFA C1b	Use of wood in the rough by all industries, in 1000 m3 over bark
EGSS	Environmental Goods and Services Sector (module of SEEA)
EKOMAR	Structural business statistics, annual economic data questionnaire (Statistics Estonia)
EO	Earth Observation
ESA	European System of Accounts (actual methodology framework is ESA2010, compliant to SNA2008)
eSTAT	Statistics Estonia (National Statistical Institution for Estonia)

EstEA	Estonian Environment Agency
EU	European Union
EUR	Euro (currency, also abreviated €)
Eurostat	Statistical office of the European Union
FAO	Food and Agriculture Organization of the United Nations (also UNFAO)
FAWS	Forests available for wood supply (opposite: FNAWS)
FISIM	Financial intermediation services indirectly measured (output component P.119 of producers of financial services and couterpart in P.2 Intermediate consumption for all sectors using financial services, ESA2010)
FL	Forest Land
FNAWS	Forests not available for wood supply (opposite: FAWS)
FOB	Free on board (ESA2010)
FTE	Full time equivalents (jobs in FTE)
FRA	Global Forest Resources Assessments (FAO, Food and Agriculture Organization of the United Nations
GAI	Gross annual increment
GFCF	Gross fixed capital formation (transactions in products (P) classification of ESA2010)
GHG	Greenhouse Gas (inventory)
GIS	Geographic Information System
ha	Hectare (10000m2)
IE	Included elsewhere
IPCC	Intergovernmental Panel on Climate Change (of the United Nations)
ITGS	International trade in goods statistics
IOT	Input-Output Tables (ESA2010)
ITTO	International Tropical Timber Organization
JFSQ	Joint Forest Sector Questionnaire (Eurostat)
KAU	kind-of-activity unit; local KAU: local kind-of-activity unit
kha	Thousand hectares (see also ha)
LEV	Land Expectation Value
LOSS	Irretrievable losses (EFA methodology and transmission tables)
LUKE	Luonnonvarakeskus (Natural Resources Institute Finland)
LULUCF	Land Use, Land-Use Change and Forestry, United Nations, Climate Change
m3	Cubic meter
M	Mortality
MCPFE	Ministerial Conference on the Protection of Forests in Europe
MDE	micro-data exchange
MFA	Material flow accounts (module of SEEA)
MSI	Tartu Ülikooli matemaatika ja statistika instituudi, Tartu University Institute of Mathematics and Statistics
n	year (under review) (also noted 'T')
n/a	not available
n-1	previous year (under review) (also noted 'T-1')
NA	National accounts
NACE	Statistical classification of economic activities of the EU (actual relevant classification for EFA is NACE Rev.2; replacement with NACE Rev.2.1 will take place by 2029)
NACE 02	Division 02 'Forestry and logging' of the NACE Rev.2 (and NACE Rev.2.1)
NACE 16	Division 16 'Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials' of the NACE Rev.2 (and NACE Rev.2.1)

NACE A	Section A 'Agriculture, forestry and fishing' of the NACE Rev.2 (and NACE Rev.2.1)
NAI	Net annual increment (EFA methodology and transmission tables)
NAI	Net annual increment (EFA methodology and transmission tables)
NAWS	Not available for wood supply (opposite: AWS)
nec	not elsewhere comprised
ned	not elsewhere defined
NFI	National Forest Inventory
NID	National Inventory Document
NPV	Net Present Value
OB, o.b.	Over bark (opposite: under bark)
OLTC	Other land with tree cover
OWL	Other wooded land
P.1	Output (transactions in products (P) classification of ESA2010). Output types are in particular P.11 Market output, P.12 Output for own final use, P.13 Non-market output
P.2	Intermediate consumption (transactions in products (P) classification of ESA2010)
P.51c	Consumption of fixed capital (transactions in products (P) classification of ESA2010)
P.51g	Gross fixed capital formation (transactions in products (P) classification of ESA2010)
P52_PRO	Changes in inventories in work-in-progress on cultivated biological assets (standing timber, EFA Table B1)
RCLAS	Statistical reclassification (EFA methodology and transmission tables)
RE, RE95	Relative error, relative error at 95% confidence interval
REVAL	Revaluation (EFA methodology and transmission tables)
RMK	Riigimetsa Majandamise Keskus (State Forest Management Center, Estonia)
RMOV	Removals (EFA methodology and transmission tables)
RMOV	Removals (EFA methodology and transmission tables)
S.1	Total economy (classification of institutional sectors of ESA2010)
S.11	Non-financial corporations (classification of institutional sectors of ESA2010)
S.14	Households (classification of institutional sectors of ESA2010)
SE	Statistics Estonia (National Statistical Institution for Estonia), also abreviated eSTAT
SEEA	System of Environmental-Economic Accounts
SMI	Silvicultural management intensity indicator, SMI also: Statistilise metsainventuuri
SNA	System of National Accounts, United Nations (actual methodology framework is SNA2008)
STK	Stocks (EFA methodology and transmission tables): STK_OP: Opening stocks, STK_CL: Closing stocks
SUT	Supply and Use Tables (ESA2010)
T	year (under review) (also noted 'n')
T-1	previous year (under review) (also noted 'n-1')
UB, u.b.	Under bark (opposite: over bark)
UNECE, ECE	United Nations Economic Commission for Europe
UNFAO	Food and Agriculture Organization of the United Nations (also FAO)
US, USA	United States of America
VAT	Value added tax