

DRAFT. SC19 - FNAWS area and biomass report. SLOVENIA

Country Name: **Slovenia**

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1 INTRODUCTION

1.1 *National Forest Inventory sampling description*

The Slovenian National Forest Inventory (NFI) covers all forest land in Slovenia. At present, four NFI cycles have been completed (NFI1 (2000), NFI2 (2007), NFI3 (2012), NFI4 (2018)). Within one NFI cycle all plots are measured within same year. The NFI is organised and managed by the Slovenian Forestry Institute (SFI). The field work is done by the employees of Slovenian Forest Service (SFS) and partly by SFI.

The data employed here to estimate Slovenian forest area and biomass not available for wood supply (FNAWS) and its above-ground biomass are taken from the 3rd circle of national forest inventory (2012). In the NFI3 field sampling locations were systematically distributed over the forest area on the sampling grid 4 x 4 km. The estimations refer to all forest land including inaccessible locations and poorly productive forests. Out of 1,268 locations, 760 locations were within the forest, from 760 plots 746 were measured directly on the field while 14 plots were located within an inaccessible terrain. For those plots, the assessment of the tree number, basal area, and growing stock was done through stereo photointerpretation. To define the stratum and the forest area in first stage the national land use map is used (MKGP 2018) and in second stage all locations that are near the forest border are visually checked based on the photointerpretation of the newest orthophoto images.

Slovenian field plots consist of four circular concentric fixed areas with radius of 3.09 m (0.3 acre), 7.98 m (2.0 acre), 13.82 m (6.0 acre) and 25.23 m (20 acre). The live standing trees are measured on 6.0-acre circle. On 6.0 acre, trees with diameter at breast height (dbh) ≥ 30 cm are measured; on 2.0-acre concentric circle, trees with dbh ≥ 10 cm are measured; and on the 0.3-acre concentric circle, all trees with $0 \text{ cm} < \text{dbh} < 10 \text{ cm}$ and height $\geq 1.3 \text{ m}$ are measured. The 20-acre plot is used only for measuring of deadwood biomass and for the assessment of the selected stand characteristics (Kovač, et al. 2014, Kušar, et al. 2010).

1.2 *Forest definition employed. Restrictions and thresholds*

In Slovenia for the Specific Contracts we applied the national forest definition. According to Forest Act (Ur. l. RS nr. 30/1993) in Slovenia a forest is:

- land covered with forest trees in the form of a stand that can reach at least 5 metres in height and spanning at least 0.25 hectares;
- land under the process of tree colonisation spanning at least 0.25 hectares, which has not been used for agricultural purposes over the last 20 years and on which forest trees can reach a height of at least 5 metres and tree crown density has reached 75 per cent;
- riparian zones and windbreaks wider than the height of adult trees, spanning at least 0.25 hectares.

Other wooded land is land covered with forest trees or other forest vegetation, covering at least 0.25 hectares, which is not forest and has not been used for agricultural purposes over the last 20 years. Other wooded land includes pens in forests used for raising game and areas within forests spanning at least 0.25 hectares that lie beneath overhead electrical power lines.

Forest infrastructure not allocated into a separate parcel is an integral part of the forest.

Forest or other wooded land under Forest Act does not include individual forest trees, groups of forest trees covering up to 0.25 hectares, tree avenues, parks and forest-tree plantations.

This definition was also used to define forest and no-forest plots for the Specific Contract.

Slovenian land use map (MKGP 2018) contains only category forest while Slovenia Forest Service has separate categories forest and other wooded land (Table 1).

Table 1. National categories forest and other wooded land. Comparison with FRA (2010) classification.

National category	Definition	Area (1,000 ha)	Corresponding FRA classes
Forest	Definition is in the text above the Table 1	1183	Forest
Other wooded land	Definition is in the text above the Table 1	12	Forest

2 FNAWS ESTIMATION METHODS AND DATA

2.1 Definitions

2.1.1 FNAWS national and reference definitions. Restrictions and thresholds

Based on the national legislation (Rules on forest management plans and game management plans. Ur. l. RS, nr. 91/10) in Slovenia forests are divided into four categories:

- a) multipurpose forests
- b) special purpose forests with no legal restrictions on wood production
- c) special purpose forests with legal restrictions which exclude or limit wood production and
- d) protective forests.

In Slovenian legislation there is no definition of FNAWS. Slovenian Forest Service who is responsible for the preparation of forest management plans use in their yearly reports (SFS 2018) the term »area of economically important forests« which are:

all forests (multipurpose forests + special purpose forests with no restrictions on wood production) excluding special purpose forests with legal restrictions which exclude or limit wood production (forest reserves) excluding also protective forests. Both of those categories are defined by Decree on protective forests and forests with a special purpose (Ur. l. RS, nr. 88/05, 56/07, 29/09, 91/10, 1/13 in 39/15).

In the Decree (Ur. l. RS, nr. 88/05, 56/07, 29/09, 91/10, 1/13 in 39/15) the **protective forests** “are forests that protect the lands of landslides, erosion and bruising, forests on steep slopes or banks of waters, forests exposed to strong winds, forests that are in the torrential areas and constrain a drainage of water and therefore protect the land from erosion and avalanches, forest bands

protecting forests and land from the wind, water, spray drift and avalanches, forests in agricultural and suburban landscapes with an exceptionally emphasized biodiversity conservation function and forests above the tree line.”

In protective forests only sanitary logging and logging to preserve and strengthening of the protective functions could be done. Spatially the protective forests are defined on the level of forest compartment. There are no strict (numeric) thresholds how the compartments were selected to be included as protective forest. There are thresholds for defining the protective function of forests for example if the slope is greater as 35° on stable geology etc. However, not all forest on steep slope are automatically included into the Decree. At the end the selection if forest is protective or not bases on the expert opinion which include also the local information (district foresters) – for example in mountainous regions the technology for logging is different (cable yarding) and in many steep terrains the forests are still FAWS. So, the FNAWS is the combination of terrain characteristics.

The **special purpose forests** are forests reserves. Those are forests which, due to their developmental phase and the development so far, are extremely important for exploring, studying and monitoring the natural development of forests, biodiversity and the protection of natural values and cultural heritage.

Concerning the restrictions of wood production there is one additional special case within the Triglav national park (Triglav National Park Act. Ur. l. RS, nr. 52/10, 46/14). In the inner zone of the park harvesting is prohibited but it is permissible to implement urgent protective measures (logging), which are intended to preserve and strengthen the protective functions of forests in providing emergency protection actions in forests, as well as the construction of urgently needed forest infrastructures for the implementation of these measures.

The combined work developed during the FP1001 “Usewood” Cost Action and the SC18 lead to an agreed FNAWS reference definition (harmonized FNAWS):

“Forests where there are environmental, social or economic restrictions that have a significant impact on the current or potential supply of wood. These restrictions can be based on legal acts, management decisions or other reasons.

– Environmental restrictions should consider protected areas, protected habitats or species, and also those protective forests meeting the above requirements. Age or diameter class restriction should not be taken into account (except in the case of protected ancient forest).

– Social restrictions include restrictions to protect aesthetic, historical, cultural, spiritual, or recreational values, areas where the owner has made the decision to cease wood harvesting in order to focus on other goods and services (e.g. leisure, landscape, aesthetic value).

– The economic restrictions are considered as those affecting the economic value of wood utilisation (profitability). These includes accessibility, slope and soil condition. Short-term market fluctuations should not be considered.”

Reporting notes:

- A significant impact occurs when harvesting is totally prohibited or when restrictions severely limit the feasibility of cuttings for commercial purposes. When restrictions do not severely limit commercial utilization of wood in an area, it should be considered available for wood

supply even if current harvesting is for auto-consumption only, or no harvest at all is taking place. Conversely, when restrictions limit the feasibility of commercial wood utilization, even if there are occasional cuttings for auto-consumption or other small-scale interventions of a non-commercial nature, the forest should be considered as FNAWS.

- Protected areas would be desirable to be estimated according to IUCN classification (including particularly Ia and Ib) or MCPFE classification (including particularly 1.1 and 1.2).
- Regarding the assessment of availability for wood supply, the following recommendations were proposed for reporting: (i) the three different categories should be accounted for separately if possible (environmental, social, and economic); (ii) restrictions considered for each category should be detailed if possible (e.g. protected areas, protected species).
- Permanently small unstocked forest areas could be considered as not available for wood supply.

According to the above-mentioned reference definition, the restrictions and thresholds considered in Slovenia are shown in Table 2.

Table 2. Detailed description of the restrictions and thresholds considered (“x”) in Slovenia to estimate FNAWS based on »national« and potential reference definitions (and by subtraction FAWS)

National	Reference	Category	Restriction	Threshold
x	x	Environmental	Protected areas / Special purpose forests with restriction in wood supply	National Parks and Forest Reserves (according to national categories) *
	x	Environmental	Protected tree species	Stands dominated by critically endangered and vulnerable tree species
x	x	Economic	Erosion	
x	x	Economic	Slope	Protective forests*
x	x	Economic	Accessibility	

* Forest reserves and protective forests are defined with the Decree on protective forests and special purpose forests. The forest compartments included in this category are selected on the basis of expert knowledge.

2.1.2 FAWS definition considered to report in SoEF. Restrictions and thresholds

In the definition considered in SoEF 2015 the FAWS was multipurpose forests and special purpose forests with no restrictions on wood production. The special purpose forests with legal restrictions which exclude or limit wood production (forest reserves) and protective forests were reported as FNAWS. Both categories together (FAWS + FNAWS) represents the area of all forests in Slovenia

There is no difference between national and SoEF definition due to the reason mention above that Slovenia has no national definition what are FAWS in the legislation. For SC19 we would suggest using the SoEF definition. However, the protective forests and special purpose forests with limited wood supply could be reported as forest restricted for wood supply (FRAWS).

2.1.3 Restriction list (National and according to reference definition)

Table 3. Restriction list

National	Reference	Category
Protected areas - Forest reserves	Protected areas	Environmental
Protective forests*	Erosion	Environmental
	Slope	Economic
	Accessibility	Economic

* determined based on expert knowledge

2.2 FNAWS area and aboveground biomass estimation

2.2.1 Area and biomass estimation based on the Slovenian NFI data

In Slovenia, the forest area is estimated based on the Land use map made by Ministry of Agriculture, Forestry and Food. The map is later aligned with the forest management plans of SFS.

Currently, there is no national definition of biomass. For the Slovenia's National Inventory Report 2018 (GHG emissions inventories 1986 – 2016) the definition of biomass includes the following tree compartments: stem (from trees of 10 cm diameter at breast height), branches, stem top and roots (Slovenian Environment Agency 2018). Stem volume of live trees is calculated based on the tariff functions (Kušar, et al. 2010), volume of branches (< 7 cm) are calculated based on the biomass expansion factor (BEF), while the volume of roots is calculated with root-to-shoot ratio (R). Based on biomass the carbon stock is calculated using parameters of basic wood density (D) and carbon fraction of dry matter (CF). The parameters were selected based on the values given in the GPG2006 (Aalde, et al. 2006).

Reference or harmonized definition (SC13-SC17) of aboveground biomass includes also: foliage and seeds, stump, stem (from trees of 0 cm dbh to 10 cm) and stem top. Main differences between the current national and reference definitions are therefore trees from 0 to 10 cm dbh, stump, stem top, foliage and seeds. Dead branches were not included neither in the national considered equations.

Using data NFI3, **FNAWS area and biomass** is assessed once the NFI3 plots were classified based on the abovementioned restrictions.

2.2.2 FNAWS estimation based on National and reference definitions

In Slovenia, the plot assignment to FAWS or FNAWS is made “posteriori”, after the field measurements are collected and based on georeferenced ancillary information (see restrictions and sources of information considered and used in Table 4). Tools such as databases management systems and geographic information systems are needed in this step.

Table 4. Restrictions and sources of information considered in Slovenia to estimate FNAWS (and by subtraction FAWS).

Category	Restriction	Sources of information
Environmental	Forest reserves and parks	Map of forest reserves (Slovenia Forest Service) Land use map Map of national parks
Environmental	Protective forests	Map of protective forests (Slovenia Forest Service) Land use map

2.3 The dataset

760 (746 on the field measured plots + 13 RS assessed plots due to inaccessibility (steep terrain)) NFI plots are used to estimate FNAWS area and dry biomass. Slovenia is divided in two NUTS2 regions (Figure 1, Table 5). SI04 region contains four NUTS3 regions and SI03 region contains eight NUTS 3 regions (Figure 1, Table 5).

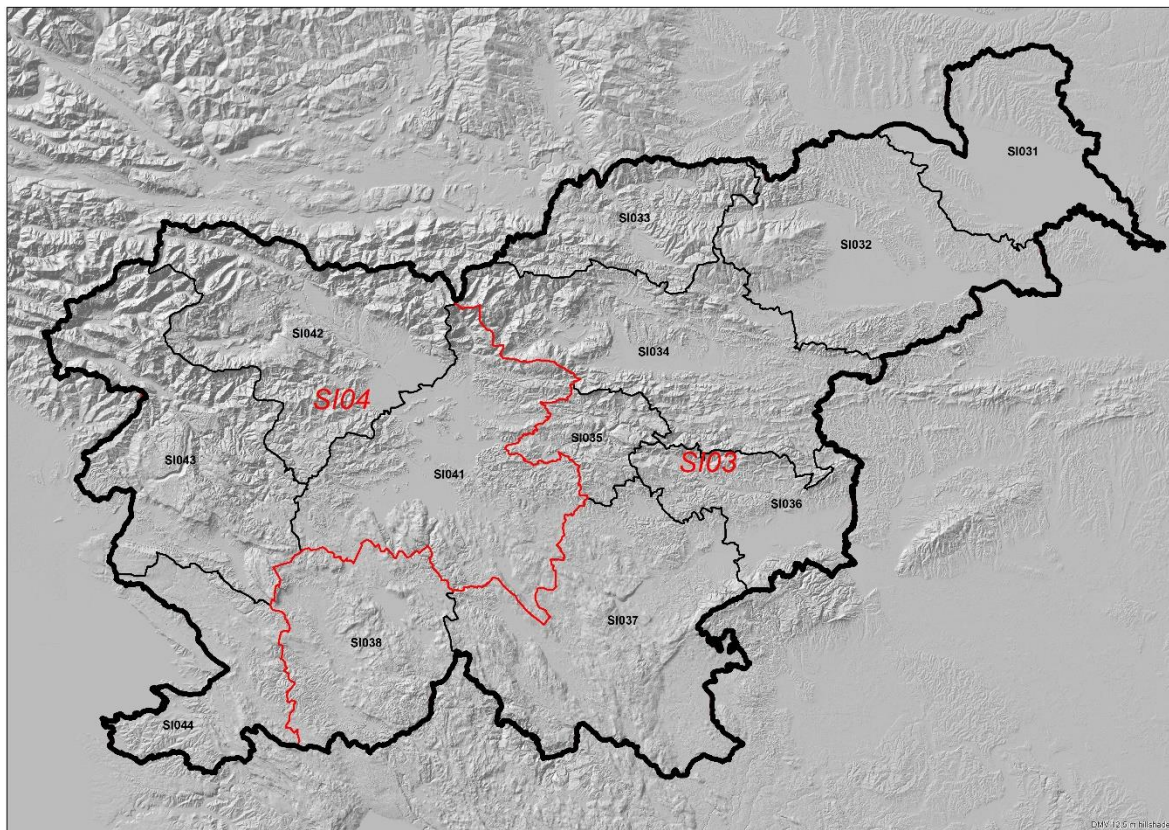


Figure 1. NUTS2 and NUTS 3 regions in Slovenia.

Slovenia is divided on two NUTS2 regions (East Slovenia and West Slovenia) and on 12 NUTS3 regions (Figure 1 and Table 5). Due to low number of sampling points on 4 x 4 km grid only the NUTS2 regions are used in this analysis. Together there were 453 NFI plots in eastern Slovenia (SI03) and 307 NFI plots in western Slovenia (SI04) (Table 5).

Table 5. NUTS2 and NUTS3 region codes considered for this analysis

Country Code	NUTS2 code	NUTS3 code	NUTS3 label	Nr. of plots 4 x 4 km grid	Nr. of forest plots 2012 4 x 4 km grid
SI	SI04	SI044	Obalno-kraska	62	34
SI	SI04	SI043	Goriska	144	103
SI	SI04	SI042	Gorenjska	133	90
SI	SI04	SI041	Osrednjeslovenska	145	80
SI	SI03	SI038	Primorsko-notranjska	92	72
SI	SI03	SI037	Jugovzhodna Slovenija	171	123
SI	SI03	SI036	Posavska	63	36
SI	SI03	SI035	Zasavska	29	17
SI	SI03	SI034	Savinjska	143	84
SI	SI03	SI033	Koroska	65	49
SI	SI03	SI032	Podravska	138	50
SI	SI03	SI031	Pomurska	83	22

3 RESULTS: FNAWS AREA AND ABOVEGROUND BIOMASS from E-forest

3.1 National and reference FNAWS area and biomass by NUTS regions and species groups

Table 6. FNAWS total area and aboveground dry biomass (average value per hectare) according to national and reference definitions in Slovenia

	FNAWS National definition	FNAWS Reference definition
Forest Area (1000 ha)	1,214.98	
FNAWS area (1000 ha)	118.30	118.30
FNAWS area (%)	9.7	9.7
FNAWS harmonized biomass (mil t)	20.55	20.55
FNAWS harmonized biomass (%)	7.5	7.5

Table 7. FNAWS total area and aboveground dry biomass (average value per hectare) according to national and reference definitions in Slovenia by NUTS2 region.

NUTS regions	FNAWS National definition		FNAWS Reference definition	
	FNAWS area (1000 ha)	FNAWS harmonized biomass (mil t)	FNAWS area (1000 ha)	FNAWS harmonized biomass (mil t)
SI03	39.97	7.8	39.97	7.8
SI04	78.33	12.7	78.33	12.7

Table 8. FNAWS total area and aboveground dry biomass (average value per hectare) according to national and reference definitions in Slovenia by restriction at national level.

Restriction	FNAWS area 1000 ha (National)	FNAWS area 1000 ha (Reference)	FNAWS biomass t/ha (National)	FNAWS biomass t/ha (Reference)
Protected areas	27.18	27.18	164.55	164.55
Protected tree species	/	/	/	/
Protective forest - Decree (Ur. l. RS, nr. 88/05...)	Erosion	107.11	107.11	161.61
	Accessibility			
	Slope			

Table 9. FNAWS total area and aboveground dry biomass (average value per hectare) according to national and reference definitions in Slovenia by restriction at NUTS2 region.

NUTS regions	Restriction	FNAWS National definition		FNAWS Reference definition	
		FNAWS area (1000 ha)	FNAWS harmonized biomass (T/ha)	FNAWS area (1000 ha)	FNAWS harmonized biomass (T/ha)
SI03	1100000	39.97	195.80	39.97	195.80
	1110000	7.99	295.36	7.99	295.36
	1120000	31.97	170.91	31.97	170.91
	1111000	7.99	295.36	7.99	295.36
	1120000	31.97	170.91	31.97	170.91
	1111200	7.99	295.36	7.99	295.36
	1120000	31.97	170.91	31.97	170.91
	1111200	7.99	295.36	7.99	295.36
	1120000	31.97	170.91	31.97	170.91
	1111200	7.99	295.36	7.99	295.36
	1120000	31.97	170.91	31.97	170.91
SI04	1100000	78.33	162.43	78.33	162.43
	1110000	19.18	110.05	19.18	110.05
	1120000	75.14	157.66	75.14	157.66
	1111000	19.18	110.05	19.18	110.05
	1120000	75.14	157.66	75.14	157.66
	1111100	17.59	92.35	17.59	92.35
	1111200	3.20	274.72	3.20	274.72
	1120000	75.14	157.66	75.14	157.66
	1111100	17.59	92.35	17.59	92.35
	1111200	3.20	274.72	3.20	274.72
	1120000	75.14	157.66	75.14	157.66
	1111100	17.59	92.35	17.59	92.35
	1111200	3.20	274.72	3.20	274.72
	1120000	75.14	157.66	75.14	157.66

4 DISCUSSION OF THE RESULTS

4.1 Similarities and differences between harmonized and national FNAWS estimation

In Slovenia, 9.7% of all forests could be reported as FNAWS (Figure 2). Within this report, there are no differences in the area between the national and reference definition of FNAWS.

At the time of writing, there was no clear definition of FNAWS in Slovenian legislation. The Rules on forest management plans (Ur. l. RS, nr. 91/10) divide forests into multipurpose, special purpose and protective forests.

The official list of special-purpose forests and protective forests was done in 2005 based on the expert opinion and the list was renewed in 2015. All forest compartments that meet the requirements (slope, terrain, erosion, accessibility ...) are listed within the Decree on protective forests and forests with a special purpose (Ur. l. RS, nr. 88/05, 56/07, 29/09, 91/10, 1/13 in 39/15). This list of forest compartments is used for the current national reporting and it was used also for the reference definition. There are advantages and disadvantages of this approach. Advantages are that each forest is evaluated individually. With this, the geographical differences could be also included in the decision if the forest is FNAWS or FNAWS. Due to different local harvesting techniques (for example timber extraction with a cable crane) there are differences between the alpine regions in the northwest and more hill regions in the southeast. Disadvantages are that there are no strict definitions concerning the thresholds, but only approximate boundaries for example slope. Within this study also the protected areas from the national park (TNP) were included in the FNAWS category.

The main difference between the national and reference definition could be the protected tree species restriction in the environmental category. The only protected tree species in Slovenia is *Taxus baccata* L. (Decree on protected wild plant species Ur. l. RS, nr. 46/04, 110/04, 115/07, 36/09 and 15/14) but due to the small size of those stands it was not possible to detect them with the current NFI grid 4 km x 4 km.

Open question is also social restrictions which are not easy to define especially in the combination of spatially defined areas.

FAWS vs FNAWS area [1000 ha]

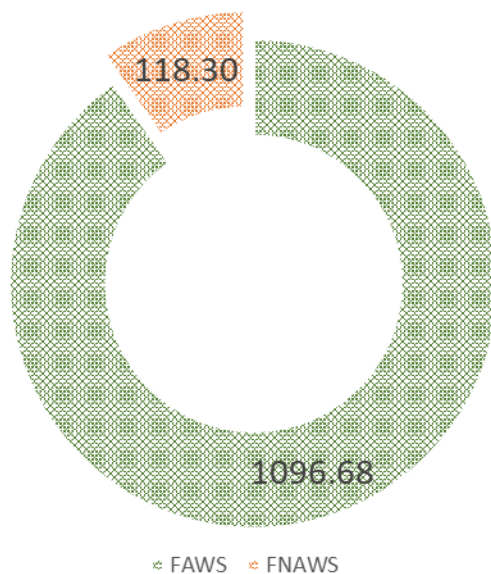


Figure 2. FNAWS and FAWS estimation considering both national and reference definitions.

FNAWS [%]

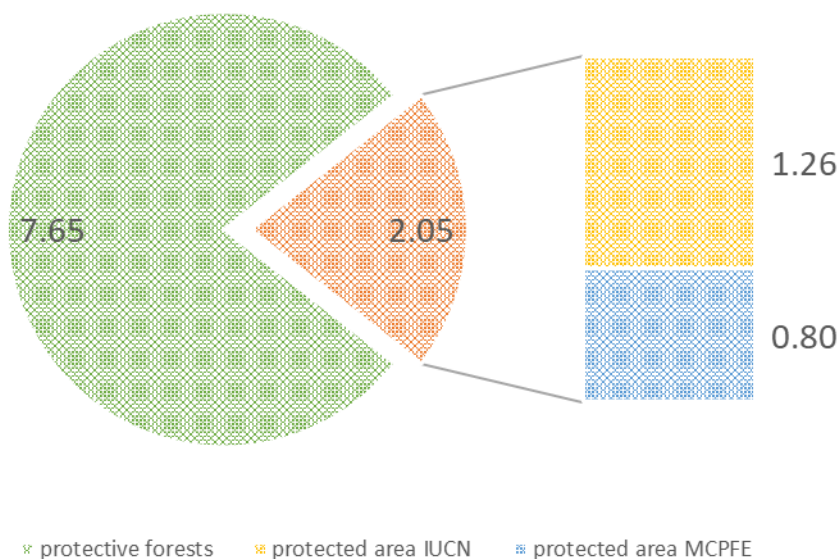


Figure 3. Contribution of each restriction to the FNAWS estimation considering national definition.

The analysis of overlaps between the restrictions (meaning that a plot could present more than one restriction) considered when estimating FNAWS (Figure 4) show little coincidence for most of the restrictions. In total 11 plots from 74 were located. All of them in the combination with the Triglav

national park and protective forests. The modest overlapping found between restrictions confirms the suitability of all the restrictions used for FNAWS estimation.

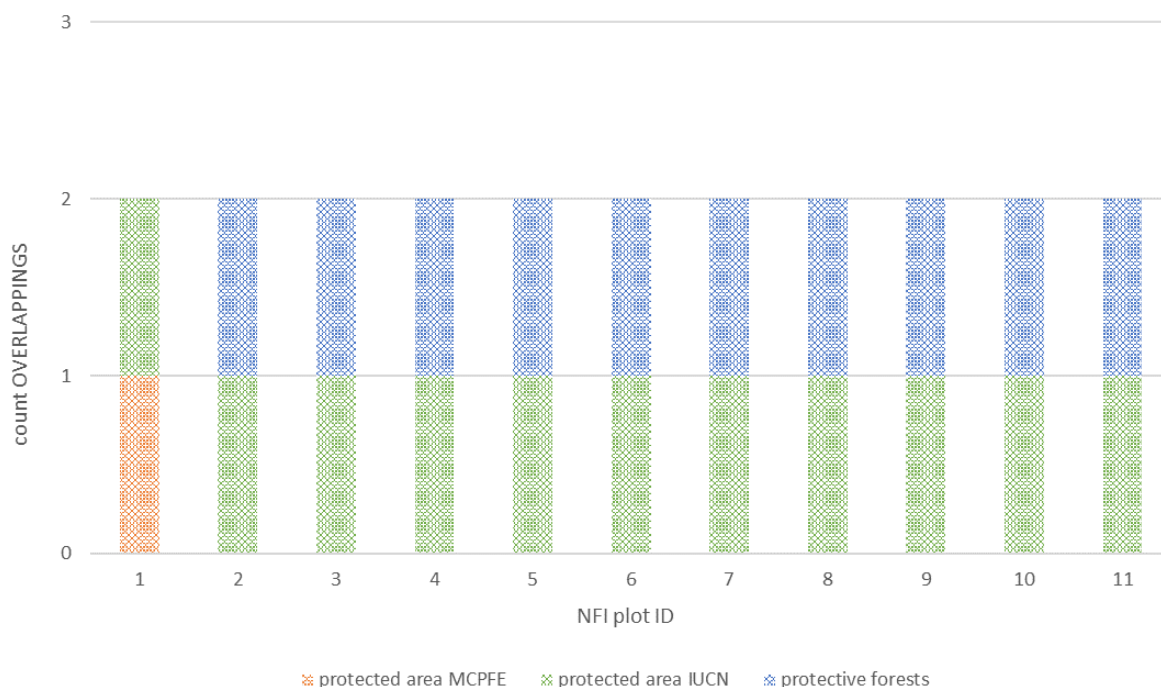


Figure 4. Overlaps of each restriction with other restrictions when estimating FNAWS.

4.2 Comparison with SoEF estimates

The main differences between the results of this report and the values reported in SoEF 2015 (see Table 10) can be explained by the use of new sources (protected areas) and the transition from the national biomass estimation to the harmonized biomass estimations.

Table 10. Comparison of FNAWS total area and aboveground dry biomass estimates and provided information for international requirements

	Reference year	FNAWS area (1000 ha)	Percentage of FNAWS forest land (%)	FNAWS harmonised biomass (t/ha)	Percentage of FNAWS biomass (%)
Country report	2012	118	9.7	173.7	7.5
SoEF 2015	2015	109	8.7	-	-

4.3 Plans for improving the harmonized FNAWS estimation

The main difference between FNAWS estimation according to the national and harmonized definitions in Slovenia are categories: protected tree species and social restrictions. Due to a small number of NFI plots (760), it was not possible to assess the area of protected European tree species

yew. Different social restrictions such as recreation, historical, etc. were not included as FNAWS. The Slovenian Act on forests (Ur. l. RS nr. 30/1993) defines that all forests must be managed multifunctional or multi-purpose. This is a balanced significance of ecological, productional, and social roles of forests.

In the future, efforts should be done to improve the assessment of all restriction based on the field survey. When the NFI field teams visit the plots, they should also assess if the plot is FNAWS or FAWS based on well-described indicators. The used indicators should be harmonized and defined in detail on the EU level.

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