EU LIFE Programme project
"Demonstration of climate change mitigation potential of nutrients rich organic soils in Baltic States and Finland"

REPORT

ON IMPLEMENTATION OF THE PROJECT

DEMONSTRATION OF CLIMATE CHANGE MITIGATION MEASURES IN NUTRIENTS RICH DRAINED ORGANIC SOILS IN BALTIC STATES AND FINLAND

WORK PACKAGE

REPLICABILITY TOOLS (C.5)

ACTIONS

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"LIFE OrgBalt compiled the first regional Baltic/ Finnish GHG emission factors for managed nutrient-rich organic soils (current and former peatlands), which have been made available for the customary scientific review and further verification for national GHG inventories in the hemiboreal region in Finland and the Baltic countries. While the project analysed selected CCM measures for drained organic soils in agriculture and forestry and developed spatial models and tools, it also identified remaining knowledge gaps. To bridge the remaining limitations and fill the gaps, it is essential to continue GHG measurements and model development, as well to broaden and complete the scope of the evaluated CCM measures in the after-LIFE-project period, notably by including rewetting and restoration of peatlands that are currently considered to be among the most recommended CCM measures on drained peatlands in the EU. In addition, the developed Simulation and PPC models still include limited macroeconomic considerations and lack assessment of all environmental impacts. For all these reasons, these models should be used carefully in CCM strategy development for identification of gaps in climate neutrality transition policy and funding frameworks and need further optimization for broader applicability as decision-making tools."

SUMMARY

Action C5 is aimed on support of implementation of the Project results in Baltic States. Finland. Germany and the whole cool & TCM climate region in Europe. The primary objectives of this Action are development of modelling instruments for planning of management of nutrient-rich organic soils at a single holding and regional level; elaboration of recommendations for implementation of improvements into the national land use strategies for the post-2020 period and ensuring of replicability and transferability of the developed tools outside the Project area.

To reach the proposed objectives the Action C.5 consists of the following Tasks:

- Task 1: Elaboration of a Simulation model for a single field and regional level projections of GHG emissions and socio-economic outputs;
- Task 2: Development of default parameters for calculation of CCM effect;
- Task 3: Integration of the application of the developed tool in policy planning.

The Task 2: Default parameters for calculation of CCM effect is aimed to elaborate parameters' tables for calculation of climate change mitigation effect in the simulation model elaborated within the scope of the Task 1 to provide the set of activity data. calculation parameters and EFs applied in the calculation model so that they can be implemented as modules in other tools and adopted to other regions and conditions. Tables of parameters are supplied as a part to the spreadsheet model to support end users. Here in this report we are providing examples for values to be used in the tables based on the study in Latvia. We are also providing here recommendations for logical control and description of calculations.

The results of the activity will be applied in Task 3: Integration of the developed tool in the policy planning to elaborate transferability and replicability tools for the Project outcomes. Transferability is reached by implementation of air temperature and water regime sensitive emission factors (EFs) for CO_2 and water regime sensitive EFs for N_2O and CH_4. Comparison of land use and water regimes will ensure implementation of robust methodology for characterisation of GHG emissions from organic soils and potential impact of the CCM measures.

Scientifically validated methods are used in elaboration of EFs. thus securing transferability of the applied methodology. The tool developed within the Task 1 of the Action C.5 is elaborated for use with the NFI and “wall to wall” inventories based land use information. Both types of activity data are commonly used in EU countries. which is important advantage for transferability of the Project results outside the participating countries.

ABBREVIATIONS

C = carbon

CH_4 = methane

CO_2 = carbon dioxide

CCM = climate change mitigation

EF = emission factor

GHG = greenhouse gas

IPCC = Intergovernmental Panel on Climate Change

NFI = National Forest Inventory

N_2O = nitrous oxide

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1. STRUCTURE OF THE DATA TABLES

The data tables in the elaborated spreadsheet model are arranged in 5 supplementary data tables providing information on assortments structure and biofuel production in forest lands; modelling of assortments production. supplementary information on costs and income in forestry and agro-forestry. coefficients for calculation of GHG emissions and carbon stock changes; forest growth tables for modelling of of forest growth and production of harvested wood products; temperature projections and supplementary information for calculation of substitution effect of forest biofuel.

Economic figures are provided for the forest management activities. as well as default assumptions for the forest management activities like tending and pre-commercial thinning. maintenance of drainage systems and restoration of the short rotation coppice. Since in willow plantations calculations are done differently. specific data tables are provided for these crops. which are part of the shelter belts and can be grown separately.

Calculation of effect of the climate mitigation effect in the spreadsheet model is provided in Figure 1. Additional options for selection are country. including default factors for temperate and boreal climate regions. The emissions factors primarily divided into drained and pristine wet organic soils.

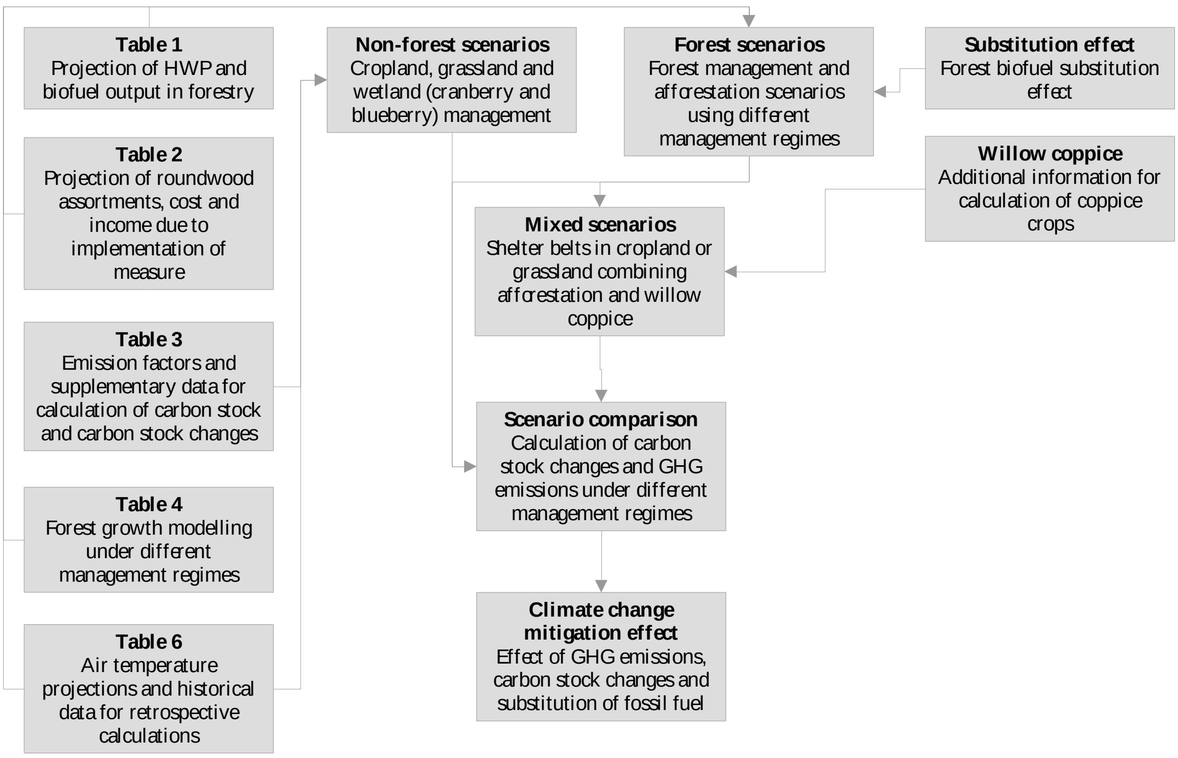

Figure 1. Basic structure of calculations.

2. ASSORTMENTS' STRUCTURE IN FOREST LANDS

Dominant species in the calculation are spruce. pine. birch. aspen. hybrid poplar. black alder and other species (Table 1). Water regime is divided in two classes – wet or rewetted and drained soils. Felling types represented are thinning or selective felling and clear-felling. Calculation parameters are share of sawn materials from logs. proportion of plate-wood. proportion of bark from roundwood. processing residues and losses of harvesting residues. if they are extracted for biofuel production.

Table 1. Example of assortments' structure

Dominant species	Water regime	Felling type	Share of sawn materials from logs	Proportion of platewood	Proportion of bark from roundwood	Proportion of processing residues	Losses of harvesting residues
Spruce	Drained	Thinning	25%	25%	11%	50%	50%
Spruce	Wet	Thinning	25%	25%	11%	50%	50%
Pine	Drained	Thinning	25%	25%	11%	50%	50%
Pine	Wet	Thinning	25%	25%	11%	50%	50%
Birch	Drained	Thinning	25%	25%	11%	50%	50%
Birch	Wet	Thinning	25%	25%	11%	50%	50%
Hybrid poplar	Drained	Thinning	25%	25%	11%	50%	50%
Hybrid poplar	Wet	Thinning	25%	25%	11%	50%	50%
Aspen	Drained	Thinning	25%	25%	11%	50%	50%
Aspen	Wet	Thinning	25%	25%	11%	50%	50%
Black alder	Drained	Thinning	25%	25%	11%	50%	50%
Black alder	Wet	Thinning	25%	25%	11%	50%	50%
Spruce	Drained	Final felling	25%	25%	10%	50%	30%
Spruce	Wet	Final felling	25%	25%	10%	50%	30%
Pine	Drained	Final felling	25%	25%	10%	50%	30%
Pine	Wet	Final felling	25%	25%	10%	50%	30%
Birch	Drained	Final felling	25%	25%	11%	50%	30%
Birch	Wet	Final felling	25%	25%	11%	50%	30%
Hybrid poplar	Drained	Final felling	25%	25%	11%	50%	30%
Hybrid poplar	Wet	Final felling	25%	25%	11%	50%	30%
Aspen	Drained	Final felling	25%	25%	11%	50%	30%
Aspen	Wet	Final felling	25%	25%	11%	50%	30%
Black alder	Drained	Final felling	25%	25%	11%	50%	30%
Black alder	Wet	Final felling	25%	25%	11%	50%	30%

Losses (direct biofuel output) during pulp production is assumed to be 50% for all species suitable for pulp production (Table 2).

Table 2. Production losses of pulpwood

No.	Species	Proportion of processing residues
1.	All species	50.0%

3. ASSORTMENTS' PRODUCTION. COSTS AND INCOME IN FORESTRY

Assortments' structure is calculated using modelling results derived from harvester data (AS 'Latvijas valsts meži'. 2010) acquired in Latvia in the final and intermediate felling of state forests. The calculation is based of the polynomial equation No. **Error! Reference source not found.**. Species and felling type specific coefficients for the formula are provided in Table 3. Since that the equation is not always returning 100% of volume. when all assortments are calculated. in the second step of the calculation the relative values are adjusted by increasing or decreasing relative value of all assortments so that the sum is 100%.

Structure of assortments is adopted to situation in Latvia. but can be adopted to other regions. It is important then to adjust other parameters. e.g. price of certain assortments and their output in the harvested wood products.

$$V_{rel} = a * V_{av}^3 + b * V_{av}^2 + c * V_{av} + d, \quad (1)$$

$where$

V_{rel} - relative proportion of the assortment;

a, b, c, d - coefficients;

V_{av} - volume of average tree, m^3.

Table 3. Forecasts of assortment production in forestry

Felling type	Species	Factor	Assortment	Group of assortment	Value
Regenerative	Aspen	a	12-17.9	Fine logs	0.0339
Regenerative	Aspen	b	12-17.9	Fine logs	-0.1105
Regenerative	Aspen	c	12-17.9	Fine logs	0.0659
Regenerative	Aspen	d	12-17.9	Fine logs	0.0250
Regenerative	Aspen	a	18-23.9	Logs	0.0626
Regenerative	Aspen	b	18-23.9	Logs	-0.2308
Regenerative	Aspen	c	18-23.9	Logs	0.2012
Regenerative	Aspen	d	18-23.9	Logs	0.0076
Regenerative	Aspen	a	24<	Logs	0.1093
Regenerative	Aspen	b	24<	Logs	-0.5102
Regenerative	Aspen	c	24<	Logs	0.6688
Regenerative	Aspen	d	24<	Logs	-0.0511
Regenerative	Aspen	a	Firewood	Firewood	-0.2724
Regenerative	Aspen	b	Firewood	Firewood	1.1721
Regenerative	Aspen	c	Firewood	Firewood	-1.4547
Regenerative	Aspen	d	Firewood	Firewood	0.8198
Regenerative	Aspen	a	Pulpwood 7-49.9	Pulp wood	0.0666
Regenerative	Aspen	b	Pulpwood 7-49.9	Pulp wood	-0.3206
Regenerative	Aspen	c	Pulpwood 7-49.9	Pulp wood	0.5188
Regenerative	Aspen	d	Pulpwood 7-49.9	Pulp wood	0.1986

Felling type	Species	Factor	Assortment	Group of assortment	Value
Regenerative	Birch	a	12-17.9	Fine logs	0.0677
Regenerative	Birch	b	12-17.9	Fine logs	-0.2084
Regenerative	Birch	c	12-17.9	Fine logs	0.1458
Regenerative	Birch	d	12-17.9	Fine logs	-0.0080
Regenerative	Birch	a	FIA 18<	Logs	-0.0496
Regenerative	Birch	b	FIA 18<	Logs	0.0916
Regenerative	Birch	c	FIA 18<	Logs	0.0034
Regenerative	Birch	d	FIA 18<	Logs	-0.0009
Regenerative	Birch	a	FIB 18<	Logs	0.2414
Regenerative	Birch	b	FIB 18<	Logs	-1.1339
Regenerative	Birch	c	FIB 18<	Logs	1.3990
Regenerative	Birch	d	FIB 18<	Logs	-0.1136
Regenerative	Birch	a	Firewood	Firewood	-0.0477
Regenerative	Birch	b	Firewood	Firewood	0.1578
Regenerative	Birch	c	Firewood	Firewood	-0.1253
Regenerative	Birch	d	Firewood	Firewood	0.0598
Regenerative	Birch	a	Pulpwood 7-49.9	Pulp wood	-0.2119
Regenerative	Birch	b	Pulpwood 7-49.9	Pulp wood	1.0927
Regenerative	Birch	c	Pulpwood 7-49.9	Pulp wood	-1.4229
Regenerative	Birch	d	Pulpwood 7-49.9	Pulp wood	1.0627
Regenerative	Hybrid poplar	a	12-17.9	Fine logs	0.6569
Regenerative	Hybrid poplar	b	12-17.9	Fine logs	-1.4486
Regenerative	Hybrid poplar	c	12-17.9	Fine logs	0.7090
Regenerative	Hybrid poplar	d	12-17.9	Fine logs	0.0819
Regenerative	Hybrid poplar	a	18-23.9	Logs	0.5558
Regenerative	Hybrid poplar	b	18-23.9	Logs	-1.5782
Regenerative	Hybrid poplar	c	18-23.9	Logs	1.2204
Regenerative	Hybrid poplar	d	18-23.9	Logs	-0.0559
Regenerative	Hybrid poplar	a	Firewood	Firewood	-1.2127
Regenerative	Hybrid poplar	b	Firewood	Firewood	3.0268
Regenerative	Hybrid poplar	c	Firewood	Firewood	-1.9295
Regenerative	Hybrid poplar	d	Firewood	Firewood	0.9740
Regenerative	Spruce	a	10-13.9	Fine logs	0.2120
Regenerative	Spruce	b	10-13.9	Fine logs	-0.0472
Regenerative	Spruce	c	10-13.9	Fine logs	-0.2098
Regenerative	Spruce	d	10-13.9	Fine logs	0.1186
Regenerative	Spruce	a	14-17.9	Fine logs	1.9789
Regenerative	Spruce	b	14-17.9	Fine logs	-2.5517
Regenerative	Spruce	c	14-17.9	Fine logs	0.7940

Felling type	Species	Factor	Assortment	Group of assortment	Value
Regenerative	Spruce	d	14-17.9	Fine logs	0.0626
Regenerative	Spruce	a	18-27.9	Logs	3.2228
Regenerative	Spruce	b	18-27.9	Logs	-5.0622
Regenerative	Spruce	c	18-27.9	Logs	2.4443
Regenerative	Spruce	d	18-27.9	Logs	-0.0550
Regenerative	Spruce	a	28<	Logs	-0.2904
Regenerative	Spruce	b	28<	Logs	0.1783
Regenerative	Spruce	c	28<	Logs	0.5099
Regenerative	Spruce	d	28<	Logs	-0.0321
Regenerative	Spruce	a	6-9.9	Fine logs	0.0627
Regenerative	Spruce	b	6-9.9	Fine logs	-0.0360
Regenerative	Spruce	c	6-9.9	Fine logs	-0.0214
Regenerative	Spruce	d	6-9.9	Fine logs	0.0118
Regenerative	Spruce	a	Firewood	Firewood	-0.1404
Regenerative	Spruce	b	Firewood	Firewood	0.1497
Regenerative	Spruce	c	Firewood	Firewood	-0.0500
Regenerative	Spruce	d	Firewood	Firewood	0.0702
Regenerative	Spruce	a	Pulpwood 7-49.9	Pulp wood	-4.9692
Regenerative	Spruce	b	Pulpwood 7-49.9	Pulp wood	7.3769
Regenerative	Spruce	c	Pulpwood 7-49.9	Pulp wood	-3.6122
Regenerative	Spruce	d	Pulpwood 7-49.9	Pulp wood	0.8205
Regenerative	Spruce	a	Low grade logs 18<	Logs	-0.0763
Regenerative	Spruce	b	Low grade logs 18<	Logs	-0.0077
Regenerative	Spruce	c	Low grade logs 18<	Logs	0.1452
Regenerative	Spruce	d	Low grade logs 18<	Logs	0.0033
Regenerative	Black alder	a	12-17.9	Fine logs	0.7819
Regenerative	Black alder	b	12-17.9	Fine logs	-1.7200
Regenerative	Black alder	c	12-17.9	Fine logs	0.9175
Regenerative	Black alder	d	12-17.9	Fine logs	-0.0196
Regenerative	Black alder	a	18-23.9	Logs	0.5889
Regenerative	Black alder	b	18-23.9	Logs	-1.5957
Regenerative	Black alder	c	18-23.9	Logs	1.1145
Regenerative	Black alder	d	18-23.9	Logs	-0.0752
Regenerative	Black alder	a	24<	Logs	-0.4343
Regenerative	Black alder	b	24<	Logs	0.6916
Regenerative	Black alder	c	24<	Logs	0.1630
Regenerative	Black alder	d	24<	Logs	-0.0179
Regenerative	Black alder	a	Firewood	Firewood	-0.9365
Regenerative	Black alder	b	Firewood	Firewood	2.6240

Felling type	Species	Factor	Assortment	Group of assortment	Value
Regenerative	Black alder	c	Firewood	Firewood	-2.1950
Regenerative	Black alder	d	Firewood	Firewood	1.1127
Regenerative	Pine	a	10-13.9	Fine logs	0.0542
Regenerative	Pine	b	10-13.9	Fine logs	-0.1287
Regenerative	Pine	c	10-13.9	Fine logs	0.0462
Regenerative	Pine	d	10-13.9	Fine logs	0.0351
Regenerative	Pine	a	14-17.9	Fine logs	0.2436
Regenerative	Pine	b	14-17.9	Fine logs	-0.6652
Regenerative	Pine	c	14-17.9	Fine logs	0.4115
Regenerative	Pine	d	14-17.9	Fine logs	0.0605
Regenerative	Pine	a	18-27.9	Logs	0.6905
Regenerative	Pine	b	18-27.9	Logs	-2.3510
Regenerative	Pine	c	18-27.9	Logs	2.1808
Regenerative	Pine	d	18-27.9	Logs	-0.1459
Regenerative	Pine	a	28<	Logs	-0.2041
Regenerative	Pine	b	28<	Logs	0.5633
Regenerative	Pine	c	28<	Logs	-0.0721
Regenerative	Pine	d	28<	Logs	0.0015
Regenerative	Pine	a	A 28<	Logs	-0.0709
Regenerative	Pine	b	A 28<	Logs	0.1384
Regenerative	Pine	c	A 28<	Logs	0.0043
Regenerative	Pine	d	A 28<	Logs	-0.0022
Regenerative	Pine	a	Firewood	Firewood	-0.5307
Regenerative	Pine	b	Firewood	Firewood	1.7369
Regenerative	Pine	c	Firewood	Firewood	-1.7533
Regenerative	Pine	d	Firewood	Firewood	0.5643
Regenerative	Pine	a	Pulpwood 7-49.9	Pulp wood	-0.2060
Regenerative	Pine	b	Pulpwood 7-49.9	Pulp wood	0.7739
Regenerative	Pine	c	Pulpwood 7-49.9	Pulp wood	-0.9204
Regenerative	Pine	d	Pulpwood 7-49.9	Pulp wood	0.4850
Regenerative	Pine	a	Long poles 18<	Logs	0.0024
Regenerative	Pine	b	Long poles 18<	Logs	-0.0104
Regenerative	Pine	c	Long poles 18<	Logs	0.0113
Regenerative	Pine	d	Long poles 18<	Logs	-0.0022
Regenerative	Pine	a	Low grade logs 18<	Logs	0.0209
Regenerative	Pine	b	Low grade logs 18<	Logs	-0.0571
Regenerative	Pine	c	Low grade logs 18<	Logs	0.0919
Regenerative	Pine	d	Low grade logs 18<	Logs	0.0039
Thinning	Aspen	a	12-17.9	Fine logs	0.5592

Felling type	Species	Factor	Assortment	Group of assortment	Value
Thinning	Aspen	b	12-17.9	Fine logs	-1.1869
Thinning	Aspen	c	12-17.9	Fine logs	0.6358
Thinning	Aspen	d	12-17.9	Fine logs	-0.0191
Thinning	Aspen	a	18-23.9	Logs	0.5933
Thinning	Aspen	b	18-23.9	Logs	-1.1952
Thinning	Aspen	c	18-23.9	Logs	0.6079
Thinning	Aspen	d	18-23.9	Logs	-0.0311
Thinning	Aspen	a	24<	Logs	-0.3895
Thinning	Aspen	b	24<	Logs	0.3742
Thinning	Aspen	c	24<	Logs	0.0399
Thinning	Aspen	d	24<	Logs	-0.0041
Thinning	Aspen	a	Firewood	Firewood	2.0856
Thinning	Aspen	b	Firewood	Firewood	-1.2707
Thinning	Aspen	c	Firewood	Firewood	-0.7086
Thinning	Aspen	d	Firewood	Firewood	0.7343
Thinning	Aspen	a	Pulpwood 7-49.9	Pulp wood	-2.8485
Thinning	Aspen	b	Pulpwood 7-49.9	Pulp wood	3.2786
Thinning	Aspen	c	Pulpwood 7-49.9	Pulp wood	-0.5750
Thinning	Aspen	d	Pulpwood 7-49.9	Pulp wood	0.3200
Thinning	Birch	a	12-17.9	Fine logs	0.6263
Thinning	Birch	b	12-17.9	Fine logs	-0.6459
Thinning	Birch	c	12-17.9	Fine logs	0.1659
Thinning	Birch	d	12-17.9	Fine logs	-0.0037
Thinning	Birch	a	FIB 18<	Logs	-1.9262
Thinning	Birch	b	FIB 18<	Logs	1.5544
Thinning	Birch	c	FIB 18<	Logs	-0.0727
Thinning	Birch	d	FIB 18<	Logs	0.0022
Thinning	Birch	a	Firewood	Firewood	3.4293
Thinning	Birch	b	Firewood	Firewood	-1.4652
Thinning	Birch	c	Firewood	Firewood	-0.0487
Thinning	Birch	d	Firewood	Firewood	0.0901
Thinning	Birch	a	Pulpwood 7-49.9	Pulp wood	-2.1299
Thinning	Birch	b	Pulpwood 7-49.9	Pulp wood	0.5569
Thinning	Birch	c	Pulpwood 7-49.9	Pulp wood	-0.0445
Thinning	Birch	d	Pulpwood 7-49.9	Pulp wood	0.9114
Thinning	Hybrid poplar	a	12-17.9	Fine logs	5.7592
Thinning	Hybrid poplar	b	12-17.9	Fine logs	-7.7544
Thinning	Hybrid poplar	c	12-17.9	Fine logs	2.7791
Thinning	Hybrid poplar	d	12-17.9	Fine logs	-0.0721

Felling type	Species	Factor	Assortment	Group of assortment	Value
Thinning	Hybrid poplar	a	18-23.9	Logs	0.6465
Thinning	Hybrid poplar	b	18-23.9	Logs	0.0483
Thinning	Hybrid poplar	c	18-23.9	Logs	0.3567
Thinning	Hybrid poplar	d	18-23.9	Logs	-0.0132
Thinning	Hybrid poplar	a	Firewood	Firewood	-6.4055
Thinning	Hybrid poplar	b	Firewood	Firewood	7.7060
Thinning	Hybrid poplar	c	Firewood	Firewood	-3.1357
Thinning	Hybrid poplar	d	Firewood	Firewood	1.0853
Thinning	Spruce	a	10-13.9	Fine logs	11.6270
Thinning	Spruce	b	10-13.9	Fine logs	-9.5729
Thinning	Spruce	c	10-13.9	Fine logs	1.6378
Thinning	Spruce	d	10-13.9	Fine logs	0.0416
Thinning	Spruce	a	14-17.9	Fine logs	13.2470
Thinning	Spruce	b	14-17.9	Fine logs	-12.5580
Thinning	Spruce	c	14-17.9	Fine logs	3.0184
Thinning	Spruce	d	14-17.9	Fine logs	-0.0612
Thinning	Spruce	a	18-27.9	Logs	4.4392
Thinning	Spruce	b	18-27.9	Logs	-5.8942
Thinning	Spruce	c	18-27.9	Logs	2.4259
Thinning	Spruce	d	18-27.9	Logs	-0.0883
Thinning	Spruce	a	28<	Logs	0.7191
Thinning	Spruce	b	28<	Logs	0.2455
Thinning	Spruce	c	28<	Logs	-0.0370
Thinning	Spruce	d	28<	Logs	0.0016
Thinning	Spruce	a	6-9.9	Fine logs	0.7843
Thinning	Spruce	b	6-9.9	Fine logs	0.0041
Thinning	Spruce	c	6-9.9	Fine logs	-0.4134
Thinning	Spruce	d	6-9.9	Fine logs	0.0957
Thinning	Spruce	a	Firewood	Firewood	-1.0618
Thinning	Spruce	b	Firewood	Firewood	0.3326
Thinning	Spruce	c	Firewood	Firewood	0.2256
Thinning	Spruce	d	Firewood	Firewood	0.0597
Thinning	Spruce	a	Pulpwood 7-49.9	Pulp wood	-26.2910
Thinning	Spruce	b	Pulpwood 7-49.9	Pulp wood	24.6300
Thinning	Spruce	c	Pulpwood 7-49.9	Pulp wood	-6.4957
Thinning	Spruce	d	Pulpwood 7-49.9	Pulp wood	0.9328
Thinning	Spruce	a	Low grade logs 18<	Logs	-3.4646
Thinning	Spruce	b	Low grade logs 18<	Logs	2.8136
Thinning	Spruce	c	Low grade logs 18<	Logs	-0.3616

Felling type	Species	Factor	Assortment	Group of assortment	Value
Thinning	Spruce	d	Low grade logs 18<	Logs	0.0181
Thinning	Black alder	a	12-17.9	Fine logs	3.9099
Thinning	Black alder	b	12-17.9	Fine logs	-6.1471
Thinning	Black alder	c	12-17.9	Fine logs	2.4010
Thinning	Black alder	d	12-17.9	Fine logs	-0.0820
Thinning	Black alder	a	18-23.9	Logs	-3.9167
Thinning	Black alder	b	18-23.9	Logs	3.3285
Thinning	Black alder	c	18-23.9	Logs	-0.3414
Thinning	Black alder	d	18-23.9	Logs	0.0202
Thinning	Black alder	a	24<	Logs	-0.4865
Thinning	Black alder	b	24<	Logs	0.3092
Thinning	Black alder	c	24<	Logs	0.0198
Thinning	Black alder	d	24<	Logs	-0.0033
Thinning	Black alder	a	Firewood	Firewood	0.4936
Thinning	Black alder	b	Firewood	Firewood	2.5091
Thinning	Black alder	c	Firewood	Firewood	-2.0793
Thinning	Black alder	d	Firewood	Firewood	1.0651
Thinning	Pine	a	10-13.9	Fine logs	1.1890
Thinning	Pine	b	10-13.9	Fine logs	-2.3049
Thinning	Pine	c	10-13.9	Fine logs	0.7424
Thinning	Pine	d	10-13.9	Fine logs	0.0738
Thinning	Pine	a	14-17.9	Fine logs	1.8589
Thinning	Pine	b	14-17.9	Fine logs	-4.0513
Thinning	Pine	c	14-17.9	Fine logs	1.9056
Thinning	Pine	d	14-17.9	Fine logs	-0.0330
Thinning	Pine	a	18-27.9	Logs	0.3739
Thinning	Pine	b	18-27.9	Logs	-1.6720
Thinning	Pine	c	18-27.9	Logs	1.7189
Thinning	Pine	d	18-27.9	Logs	-0.0841
Thinning	Pine	a	28<	Logs	-0.3768
Thinning	Pine	b	28<	Logs	0.7335
Thinning	Pine	c	28<	Logs	-0.2015
Thinning	Pine	d	28<	Logs	0.0127
Thinning	Pine	a	6-9.9	Fine logs	-0.3656
Thinning	Pine	b	6-9.9	Fine logs	0.8966
Thinning	Pine	c	6-9.9	Fine logs	-0.5953
Thinning	Pine	d	6-9.9	Fine logs	0.1250
Thinning	Pine	a	A 28<	Logs	0.0074
Thinning	Pine	b	A 28<	Logs	-0.0163

Felling type	Species	Factor	Assortment	Group of assortment	Value
Thinning	Pine	c	A 28<	Logs	0.0082
Thinning	Pine	d	A 28<	Logs	-0.0003
Thinning	Pine	a	Firewood	Firewood	-1.1057
Thinning	Pine	b	Firewood	Firewood	2.1413
Thinning	Pine	c	Firewood	Firewood	-0.8431
Thinning	Pine	d	Firewood	Firewood	0.1926
Thinning	Pine	a	Pulpwood 7-49.9	Pulp wood	-2.1720
Thinning	Pine	b	Pulpwood 7-49.9	Pulp wood	4.9220
Thinning	Pine	c	Pulpwood 7-49.9	Pulp wood	-2.9452
Thinning	Pine	d	Pulpwood 7-49.9	Pulp wood	0.7218
Thinning	Pine	a	Low grade logs 18<	Logs	0.5909
Thinning	Pine	b	Low grade logs 18<	Logs	-0.6489
Thinning	Pine	c	Low grade logs 18<	Logs	0.2101
Thinning	Pine	d	Low grade logs 18<	Logs	-0.0085

Here in this sheet it is also possible to set cost of assortment and forest biofuel. The default values are provided in Table 4. Cost of management activities associated with implementation of the measures in forest lands can aslo be updated in sheet [2]. Default values are provided in Table 5. The most of the values are based on the publications of the National statistical bureau[1].

Table 4. Price of different assortments

Assortment	Unit	Value. €
10-13.9	€ m^{-3}	57.0
12-17.9	€ m^{-3}	61.0
14-17.9	€ m^{-3}	65.0
18-23.9	€ m^{-3}	72.0
18-27.9	€ m^{-3}	60.0
24<	€ m^{-3}	79.0
28<	€ m^{-3}	86.0
6-9.9	€ m^{-3}	53.0
A 28<	€ m^{-3}	94.0
FIA 18<	€ m^{-3}	73.0
FIB 18<	€ m^{-3}	74.0
Firewood	€ m^{-3}	34.0
Pulpwood 7-49.9	€ m^{-3}	63.0
Long poles 18<	€ m^{-3}	75.0
Low grade logs 18<	€ m^{-3}	66.0
Wood chip price	€ LV m^{-3}	20.0

1 http://www.csb.gov.lv

Table 5. Average cost of forest operations

Type	Unit	Value
Soil scarification	€ ha^{-1}	450.0
Seedlings	€ ha^{-1}	426.0
Long cuttings	€ ha^{-1}	1200.0
Short cuttings	€ ha^{-1}	1200.0
Planting	€ ha^{-1}	151.1
Mechanized planting	€ ha^{-1}	700.0
Tending	€ ha^{-1}	144.7
Pre-commercial thinning	€ ha^{-1}	157.2
Harvest in commercial thinning	€ m^{-3}	9.9
Harvest in regenerative felling	€ m^{-3}	7.1
Forwarding in thinning	€ m^{-3}	6.4
Forwarding in regenerative felling	€ m^{-3}	4.9
Production of harvesting residues	€ ton^{-1}	4.9
Road transport	€ m^{-3}	6.5
Application of mineral fertilizers	€ ha^{-1}	350.0
Application of wood ash	€ ha^{-1}	120.0
Establishment of drainage systems[2]	€ ha^{-1}	1500.0
Maintenance of drainage systems	€ ha^{-1} yr^{-1}	25.0
Administration	% of total costs	7%

[2] https://www.diva-portal.org/smash/get/diva2:1020388/FULLTEXT01.pdf

4. CALCULATION OF EMISSIONS AND SUPPLEMENTARY INFORMATION

Table 6 is the most important for calculation of GHG emissions from soil. Table 6 shows the main species and moisture conditions based calculation parameters in forest land depending from moisture conditions and dominant tree species. Additionally for strip felling in pine stands with drained peat soils it is assumed in the model that net removals of CH_4 increases by 23% and CO_2 emissions reduces by 1% during the rotation period. Emission factors are calculated as averages from different studies. including default values for DOC emissions and carbon stock in living biomass in non-forest lands (Bārdule et al.. 2023; Bērziņa et al.. 2018; Butlers. Lazdiņš. et al.. 2022; Butlers. Spalva. et al.. 2022; Butlers & Lazdins. 2022; Eggleston et al.. 2006; Hiraishi et al.. 2013; Jauhiainen et al.. 2023; Lazdins et al.. 2022; Lazdiņš et al.. 2024; Lazdiņš & Lupiķis. 2019; Vanags-Duka et al.. 2022).

Table 6. Carbon turnover and GHG emissions' calculation parameters in forest lands

Dominant species	Water regime	Average wood density. tons m^{-3}	Carbon content in wood. tons ton^{-1}	Dead wood turnover period. years	CH_4 emission factor for ditches. kg CH_4 ha^{-1} yr^{-1}	Proportion of ditch area	CH_4 emission factor. kg CH_4 ha^{-1} yr^{-1}	N_2O emission factor. kg N_2O ha^{-1} yr^{-1}	DOC emission factor. tons CO_2 ha^{-1} yr^{-1}	Average carbon stock in litter. tons C ha^{-1}	Period to reach steady stage. years
Spruce	Drained	0.4	0.5	40.0	217.0	0.0	-5.2	5.7	1.1	12.1	150.0
Spruce	Wet	0.4	0.5	40.0	0.0	0.0	20.2	0.9	0.9	12.1	150.0
Pine	Drained	0.4	0.5	40.0	217.0	0.0	-3.1	0.1	1.1	12.1	150.0
Pine	Wet	0.4	0.5	40.0	0.0	0.0	-4.4	0.8	0.9	12.1	150.0
Birch	Drained	0.5	0.5	20.0	217.0	0.0	1.6	8.7	1.1	12.1	150.0
Birch	Wet	0.5	0.5	20.0	0.0	0.0	64.4	3.1	0.9	12.1	150.0
Aspen	Drained	0.5	0.5	20.0	217.0	0.0	1.6	8.7	1.1	12.1	150.0
Aspen	Wet	0.5	0.5	20.0	0.0	0.0	64.4	3.1	0.9	12.1	150.0
Hybrid poplar	Drained	0.5	0.5	20.0	217.0	0.0	1.6	8.7	1.1	12.1	150.0
Willow	Drained	0.5	0.5	20.0	217.0	0.1	1.6	8.7	1.1	1.0	5.0
Black alder	Drained	0.5	0.5	20.0	217.0	0.0	1.6	8.7	1.1	12.1	150.0
Black alder	Wet	0.5	0.5	20.0	0.0	0.0	59.0	1.0	0.9	12.1	150.0

The main parameters for calculation of GHG emissions from soil in non-forest lands are provided in Table 7. They are elaborated as averages of different studies (Eggleston et al.. 2006; Hiraishi et al.. 2013; Līcīte et al.. 2022; Licite & Lupikis. 2020; Purvina et al.. 2023; Rancāne et al.. 2023; Vahter et al.. 2024).

Table 7. Carbon turnover and GHG emissions' calculation parameters in non-forest lands

Land use	Management	Water regime	Carbon stock at a steady stage. tons C ha^{-1}		Rotation period	Soil carbon input. tons C ha^{-1} yr^{-1}				Proportion of ditch area	CH_4 emission factor for ditches. kg CH_4 ha^{-1} yr^{-1}	CH_4 emission factor. kg CH_4 ha^{-1} yr^{-1}	N_2O emission factor. kg N_2O ha^{-1} yr^{-1}	DOC emission factor. tons CO_2 ha^{-1} yr^{-1}
			above ground	below ground		above ground	below ground	fine root	other input					
Cropland	Conventional	Drained	4.4	0.9	1.0	2.7	0.6	0.3		5%	1165.00	-1.15	10.51	1.14
Cropland	Conventional with legumes	Drained	3.6	0.7	3.0	2.8	0.5	0.2		5%	1165.00	2.09	10.51	1.14
Cropland	Organic farm-ing	Drained	3.6	0.7	1.0	2.8	0.5	0.2		5%	1165.00	-1.15	10.51	1.14
Cropland	Cranberry field	Wet	2.5		3.0	2.5				5%	542.00	6.26	0.35	0.88
Cropland	Blueberry field	Wet	5.0	2.5	5.0	2.5		1.3		5%	542.00	27.58	1.08	1.14
Wetland	Peat extraction	Drained	0.0	0.0	0.0					5%	542.00	12.11	0.67	1.14
Wetland	Restored wet-land	Wet	6.8			1.9						133.22	0.76	0.88
Grassland	Fodder produc-tion	Drained	3.2	1.2	1.0	0.9	0.5	0.7		5%	1165.00	-1.53	6.34	1.14
Grassland	Regulated groundwater	Drained	3.2	1.2	1.0	0.9	0.5	0.7		5%	1165.00	2.70	6.31	1.14
Grassland	Rewettwed	Wet	3.2	1.2	1.0	0.9	0.5	0.7				32.19	-0.01	
Grassland	Pastures	Drained	6.8		1.0	0.9	0.5	0.7		5%	1165.00	2.70	0.50	1.14

GHG equivalent for CH_4 in the calculation is 28 and for N_2O 265 according to the (Edenhofer. 2014).

Table 8. CO_2 equivalents of GHG

No	GHG	Value
1.	CH_4	28
2.	N_2O	265

Coefficients for calculation of woody biomass is provided for above-ground biomass. stem biomass. branch biomass and below-ground biomass for all species listed in sheet [3] except willows. for which biomass is calculated separately using cone formula. The default factors based on (Liepiņš et al.. 2017. 2021) are provided in Table 9. Following formula (No. 2) is used for calculation of all types of woody biomass.

$$\text{Biomasa, kg} = k \times \exp\left(a + b \times \left(\frac{D}{D+m}\right) + c \times H + d \times \ln(H) + e \times \ln(D)\right) \tag{2}$$

AGB – Above ground (SB+BB); SB – Stem; BB – Branches and needles; BGB – Below-ground biomass.

Table 9. Coefficients for biomass calculations

Dominant species	Biomass	a	b	c	d	e	m	k
Spruce	AGB	-0.5244	8.8563	0.0000	0.3879	0.0000	19.0000	1.0127
Spruce	SB	-2.5842	7.0769	0.0232	0.9631	0.0000	15.0000	1.0022
Spruce	BB	0.3300	12.0986	0.0000	-1.0682	0.0000	16.0000	1.0121
Spruce	BGB	-2.4967	10.8184	0.0000	0.0000	0.0000	14.0000	1.0388
Pine	AGB	-1.4480	8.7399	0.0000	0.5624	0.0000	16.0000	1.0086
Pine	SB	-2.8125	7.1368	0.0118	1.1270	0.0000	15.0000	1.0053
Pine	BB	-1.6032	14.7696	0.0000	-1.5888	0.0000	11.0000	1.0415
Pine	BGB	-3.2937	9.0334	0.0000	0.5353	0.0000	14.0000	1.0350
Birch	AGB	-2.1284	9.3375	0.0221	0.2838	0.0000	11.0000	1.0041
Birch	SB	-2.9281	8.2943	0.0184	0.7374	0.0000	11.0000	1.0020
Birch	BB	-1.0091	16.9249	0.0000	-2.0462	0.0000	12.0000	1.0745
Birch	BGB	-3.6432	0.0000	0.0000	0.0000	2.5127	0.0000	1.0060
Hybrid poplar	AGB	-1.9434	9.7506	0.0337	0.0000	0.0000	11.0000	0.9900
Hybrid poplar	SB	-2.8955	8.3896	0.0226	0.6148	0.0000	11.0000	1.0058
Hybrid poplar	BB	-2.3703	14.3352	0.0000	-1.0849	0.0000	12.0000	1.0040
Hybrid poplar	BGB	-2.3114	10.3644	0.0000	0.0000	0.0000	15.0000	0.9917
Aspen	AGB	-1.9434	9.7506	0.0337	0.0000	0.0000	11.0000	0.9900
Aspen	SB	-2.8955	8.3896	0.0226	0.6148	0.0000	11.0000	1.0058
Aspen	BB	-2.3703	14.3352	0.0000	-1.0849	0.0000	12.0000	1.0040
Aspen	BGB	-2.3114	10.3644	0.0000	0.0000	0.0000	15.0000	0.9917
Grey alder	AGB	-2.2207	9.7183	0.0336	0.0000	0.0000	10.0000	1.0051
Grey alder	SB	-2.6141	9.0687	0.0576	0.0000	0.0000	9.0000	0.9934
Grey alder	BB	-2.3445	17.3595	0.0000	-2.2770	0.0000	9.0000	1.0791
Grey alder	BGB	-2.9585	0.0000	0.0000	0.0000	2.1141	0.0000	1.0142
Black alder	AGB	-1.6846	9.3412	0.0221	0.2489	0.0000	14.0000	0.9962
Black alder	SB	-2.4428	8.4713	0.0295	0.5315	0.0000	13.0000	1.0069
Black alder	BB	-0.4283	15.6239	0.0000	-1.9661	0.0000	15.0000	1.0262
Black alder	BGB	-2.6672	0.0000	0.0000	0.0000	2.1004	0.0000	1.0145

Carbon input with woody litter is calculated using species specific polynomial equation. Upper limit for the carbon input is set according to the basal area threshold values (Bārdule et al.. 2021). Calculation formula (No. 3) is provided below. G is basal area expressed as $m^2\ ha^{-1}$. Default coefficients are provided in Table 10.

$$C_{litter}(tonsCha^{-1}yr^{-1}) = G^4 * a + G^3 * b + G^2 * c + G * d + e \quad (3)$$

Table 10. Coefficients of polynomial equations – carbon input with woody litter

Dominant species	a	b	c	d	e	Max value
Spruce	-0.000008	0.000542	-0.011340	0.190236	0.000000	30.0
Pine	-0.000014	0.000969	-0.021880	0.245253	0.000000	30.0
Birch	-0.000015	0.000546	-0.000466	0.069636	0.000000	26.0
Aspen	-0.000015	0.000546	-0.000466	0.069636	0.000000	26.0
Hybrid poplar	-0.000015	0.000546	-0.000466	0.069636	0.000000	26.0
Willow	-0.000015	0.000546	-0.000466	0.069636	0.000000	26.0
Black alder	-0.000015	0.000546	-0.000466	0.069636	0.000000	26.0

Carbon input with non-woody litter in forest land is calculated using species specific polynomial equation. Upper limit for the carbon input is set according to the basal area threshold values. Calculation formula (No. 4) is provided below. G is basal area expressed as m^2 ha^{-1}. Default coefficients are provided in Table 11.

$$C_{non-woodlitter}(tonsCha^{-1}yr^{-1}) = G^4 * a + G^3 * b + G^2 * c + G * d + e \quad (4)$$

Table 11. Coefficients of polynomial equations – carbon input with non-woody litter

Dominant species	a	b	c	d	e	Max value
Spruce	0.000027	-0.002093	0.057749	-0.663115	3.183354	30.0
Pine	0.000011	-0.001056	0.035375	-0.496942	3.194996	30.0
Birch	0.000017	-0.001394	0.042332	-0.575063	3.268113	26.0
Aspen	0.000017	-0.001394	0.042332	-0.575063	3.268113	26.0
Hybrid poplar	0.000017	-0.001394	0.042332	-0.575063	3.268113	26.0
Willow	0.000017	-0.001394	0.042332	-0.575063	3.268113	26.0
Black alder	0.000017	-0.001394	0.042332	-0.575063	3.268113	26.0

Carbon stock in non-woody plants in forest land is calculated using dominant tree species specific polynomial equation. Upper limit for the carbon input is set according to the basal area threshold values. Calculation formula (No. 5) is provided below. G is basal area expressed as m^2 ha^{-1}. Default coefficients are provided in Table 12.

$$C_{non-woodlitter}(tonsCha^{-1}) = G^4 * a + G^3 * b + G^2 * c + G * d + e \quad (5)$$

Table 12. Coefficients of polynomial equations – carbon stock in non-woody plants

Dominant species	a	b	c	d	e	Max value
Spruce	0.000022	-0.001758	0.051752	-0.621823	4.100750	30.0
Pine	-0.000012	0.000637	-0.004307	-0.115528	4.108225	30.0
Birch	0.000018	-0.001497	0.046709	-0.657709	4.216530	26.0
Aspen	0.000018	-0.001497	0.046709	-0.657709	4.216530	26.0
Hybrid poplar	0.000018	-0.001497	0.046709	-0.657709	4.216530	26.0
Willow	0.000018	-0.001497	0.046709	-0.657709	4.216530	26.0
Black alder	0.000018	-0.001497	0.046709	-0.657709	4.216530	26.0

Carbon stock in dead wood in forest land is calculated using species and basal area specific polynomial equation. This parameter is not calculated in afforested lands. and it is used only to determine initial carbon stock in dead wood. Upper limit for the carbon input is set according to the basal area threshold values. Calculation formula (No. 6) is provided below. G is basal area expressed as $m^2\ ha^{-1}$. Default coefficients are provided in Table 13. Default carbon stock values are calculated on the base of the model run for two generations of trees of the same species or at least 180 years long period.

$$C_{deadwood}(tonsCha^{-1}) = G^4 * a + G^3 * b + G^2 * c + G * d + e \quad (6)$$

Table 13. Coefficients of polynomial equations – carbon stock in dead wood in managed forests

Dominant species	a	b	c	d	e
Spruce	0.000424	-0.030501	0.710823	-7.083432	93.865713
Pine	0.000037	-0.006855	0.270987	-3.903290	61.217237
Birch	0.000178	-0.013469	0.312192	-2.664939	18.727676
Aspen	0.000178	-0.013469	0.312192	-2.664939	18.727676
Hybrid poplar	0.000178	-0.013469	0.312192	-2.664939	18.727676
Willow	0.000000	0.000000	0.000000	0.000000	0.000000
Black alder	0.000178	-0.013469	0.312192	-2.664939	18.727676

Carbon stock in dead wood in forest land is calculated using species and basal area specific polynomial equation. This parameter is not calculated in afforested lands. and it is used only to determine initial carbon stock in dead wood. Upper limit for the carbon input is set according to the basal area threshold values. Calculation formula (No. 7) is provided below. G is basal area expressed as $m^2\ ha^{-1}$. Default coefficients are provided in Table 13. Default carbon stock values are calculated on the base of the model run for two generations of trees of the same species or at least 180 years long period.

$$C_{deadwood}(tonsCha^{-1}) = G^4 * a + G^3 * b + G^2 * c + G * d + e \quad (7)$$

Initial carbon stock in HWP in calculated using linear regression equation (No. 8) depending from basal area and dominant species (G expressed as $m^2\ ha^{-1}$). Coefficients for equation No. 8 for sawnwood are provided in Table 14. for platewood – in Table 15. for pulpwood – in Table 16. Default carbon stock values are calculated on the base of the model run for two generations of trees of the same species or at least 180 years long period.

$$C_{HWP}(tonsCha^{-1}) = G * a + b \quad (8)$$

Table 14. Coefficients of polynomial equations – carbon stock in sawn-wood (5.C & 5.NC) in managed forests

Dominant species	a	b
Spruce	-0.437336	20.840077
Pine	-0.476845	22.100373
Birch	-0.304579	12.090044
Aspen	-0.096996	4.826518
Hybrid poplar	-0.145217	29.000000

Dominant species	a	b
Black alder	-0.304579	12.090044

Table 15. Coefficients of polynomial equations – carbon stock in plate-wood (6 1. 6 2. 6 3. 6.4.1. 6.4.2. 6.4.x. 6.4.3) in managed forests

Dominant species	a	b
Spruce	-0.420516	20.038535
Pine	-0.458505	21.250359
Birch	-0.292864	11.625042
Aspen	-0.093266	4.640883
Hybrid poplar	-0.139632	28.011337
Black alder	-0.292864	11.625042

Table 16. Coefficients of polynomial equations – carbon stock in paper and cardboard (10) in managed forests

Dominant species	a	b
Spruce	-0.008311	0.403860
Pine	-0.344292	1.253129
Birch	-1.495479	4.966780
Aspen	-0.805852	2.326979
Hybrid poplar	0.000000	0.000000
Black alder	0.000000	0.000000

Soil heterotrophic respiration is calculated using exponential equation (No. **Error! Reference source not found.**) and average monthly temperature values. Coefficients for the forest lands are provided in Table 17 and for the non-forest land – in Table 18.

$$Y = A * exp(B * X) \quad (9)$$
$$Y - heterotrophicrespiration, mgCO_2 - Cm^{-2}h^{-1};$$
$$X - averagemontlytemperature, ^o C;$$
$$A, B - coefficients.$$

Table 17. Factors for CO_2 emissions from soil in forest land

Dominant species	Water regime	a	b
Spruce	Drained	95.117710	0.055480
Spruce	Wet	36.195530	0.076470
Pine	Drained	74.754810	0.042220
Pine	Wet	74.911240	0.042210
Birch	Drained	83.622600	0.046360
Birch	Wet	84.771620	0.044140
Aspen	Drained	83.622600	0.046360
Aspen	Wet	84.771620	0.044140
Hybrid poplar	Drained	83.622600	0.046360

Dominant species	Water regime	a	b
Willow	Drained	83.622600	0.046360
Black alder	Drained	83.622600	0.046360
Black alder	Wet	84.771620	0.044140

Table 18. Factors for CO_2 emissions from soil in non-forest land

Land use	Management	Water regime	a	b
Cropland	Conventional	Drained	59.269208	0.122268
Cropland	Conventional with leg-umes	Drained	59.269208	0.122268
Cropland	Organic farming	Drained	59.269208	0.122268
Cropland	Cranberry field	Wet	19.756840	0.100550
Cropland	Blueberry field	Wet	23.135080	0.105940
Wetland	Peat extraction	Drained	6.717880	0.138760
Wetland	Restored wetland	Wet	14.778340	0.117810
Grassland	Fodder production	Drained	68.256937	0.085210
Grassland	Regulated groundwater	Drained	85.648390	0.083230
Grassland	Rewettwed	Wet	58.156930	0.098220
Grassland	Pastures	Drained	68.256937	0.085210

Important parameter for calculation of soil heterotrophic respiration is average monthly temperature. Default parameters are provided in the model till 2050. For the period after 2050 static values from 2050 are used. Example of the temperature projections for Latvia is shown in Figure 2.

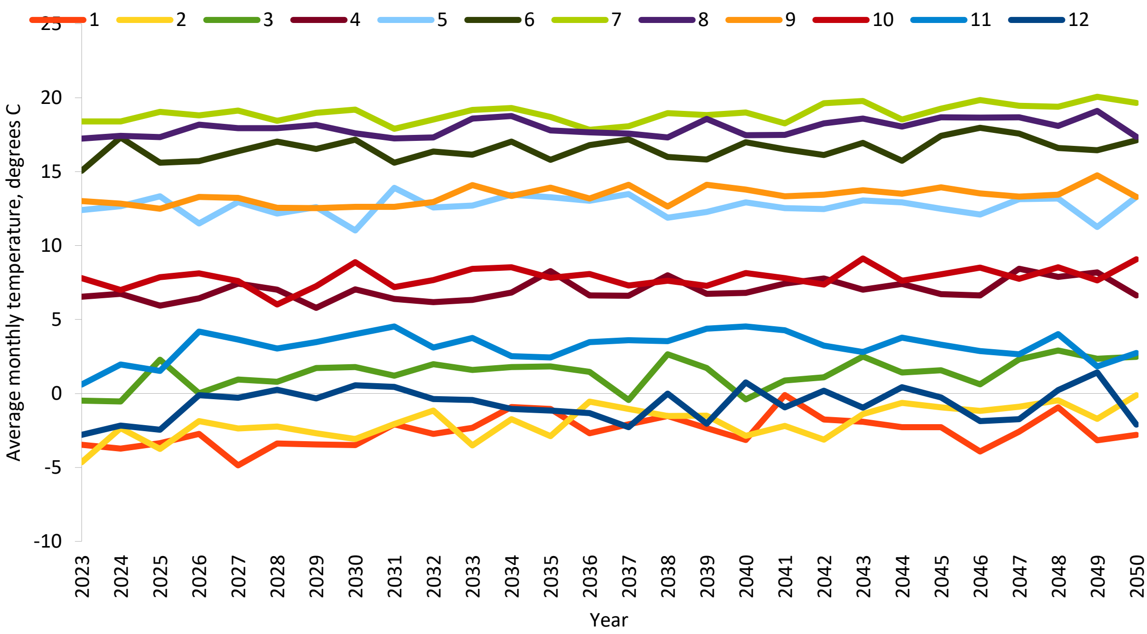

Figure 2. Average monthly temperature in Latvia.

Due to large amount of information the default parameters for the forest growth are not provided in the report due large amount of information, but these parameters can be accessed through the spreadsheet model for calculation of GHG emissions. They covers 200 years period assuming that every next generation repeats growth rate of the previous generation. Different growth rates are provided depending from dominant species, moisture conditions, treatment (selective felling, fertilization). Parameters determined in the calculation are site index, A – age in years, H – average tree height in m, D – average tree diameter in cm, G – basal are as m^2 ha^{-1}, N – number of living trees per ha^{-1}, M – growing stock as m^3 ha^{-1}, Incr. – potential increment of living trees in m^3 ha^{-1} yr^{-1}, Hnoc – height of average extracted tree in m, Dnoc – diameter of average extracted tree in cm, Gnoc – basal area of extracted tree in m^2 ha^{-1}, Nnoc – number of extracted trees per ha^{-1}, Mnoc – harvested stock in m^3 ha^{-1}, Hatm – height of average diseased tree in m, Datm – diameter of average diseased tree in cm, Gatm – basal area of diseased trees in m^2 ha^{-1} yr^{-1}, Natm – number of diseased trees per ha^{-1} yr^{-1}, Matm – stock of diseased trees in m^3 ha^{-1} yr^{-1}. All parameters are listed in Table 19.

Table 19. Forest growth parameters

No.	Parameter	Unit
1.	Bon	-
2.	A	Years
3.	H	m
4.	D	cm
5.	G	m^2 ha^{-1}
6.	N	gab. ha^{-1}
7.	M	m^3 ha^{-1}
8.	Incr.	m^3 ha^{-1} yr^{-1}
9.	Hnoc	m
10.	Dnoc	cm
11.	Gnoc	m^2 ha^{-1}
12.	Nnoc	gab. ha^{-1}
13.	Mnoc	m^3 ha^{-1}
14.	Hatm	m
15.	Datm	cm
16.	Gatm	m^2 ha^{-1} yr^{-1}
17.	Natm	gab. ha^{-1} yr^{-1}
	Matm	m^3 ha^{-1} yr^{-1}

Additional parameters for calculation of GHG emissions due to establishment of short rotation crops and shelter belts containing short rotation crops are provided in Table 20 and Table 21.

Table 20. Willow coppice growth parameters

No.	Parameter	Unit
1.	Age of trees	-1

2.	Age of coppice	years
3.	Annual net increment of above ground biomass	$m^3\ ha^{-1}\ yr^{-1}$
4.	Growing stock of above ground biomass	$m^3\ ha^{-1}$
5.	Annual net increment of above ground biomass	tons $ha^{-1}\ yr^{-1}$
6.	Annual gross increment of below ground biomass	tons $ha^{-1}\ yr^{-1}$
7.	Gross increment of above and below ground biomass	tons $ha^{-1}\ yr^{-1}$
8.	Above ground biomass stock	tons ha^{-1}
9.	Below ground biomass stock	tons ha^{-1}
10.	Total biomass stock	tons ha^{-1}
11.	Basal area equivalent	$m^2\ ha^{-1}$
12.	Harvesting of above ground biomass	$m^3\ ha^{-1}\ yr^{-1}$
		tons $ha^{-1}\ yr^{-1}$
13.	Mortality of below ground biomass	tons $ha^{-1}\ yr^{-1}$

Table 21. Additional parameters for willow coppice

Parameter	Unit	Value
Wood density	tons m^{-3}	0.5
Bulk density	LV $m^3\ m^{-3}$	2.5
Carbon content in biomass	tons C ton^{-1}	0.5
Shoot to root ratio	-	0.3
Mortality rate of below ground biomass	-	0.9
Decomposition of dead wood	years	10
Rotation period	years	5
Number of rotations	-	6
CH_4 emission factor for ditches	kg $CH_4\ ha^{-1}\ yr^{-1}$	217.0
Proportion of ditch area	%	5%
CH_4 emission factor	kg $CH_4\ ha^{-1}\ yr^{-1}$	1.6
N_2O emission factor	kg $N_2O\ ha^{-1}\ yr^{-1}$	8.7
Carbon stock in litter	tons C ha^{-1}	1.0
Transition period for accumulation of litter	years	5.0
Dead wood turnover period	years	20.0

5. CALCULATION OF REPLACEMENT EFFECT

Biofuel replacement effect is calculated assuming that woody biofuel substitutes natural gas. It is conservative approach resulting in sibnificantly smaller replacement effect than in case of substitution of othe fossil fuels. The default parameters for recalculation are rovided in Table 22.

Table 22. Calculation of replacement effect

Parameter	Unit	Value
Emission factors for natural gas		
Heat value	MWh m^{-3}	0.0094
Boiler efficiency	-	85%
CO_2 emission factor[3]	tons CO_2 MWh^{-1}	0.1984
N_2O emission factor[4]	tons N_2O MWh^{-1}	0.00000036
CH_4 emission factor[5]	tons CH_4 MWh^{-1}	0.00000360
Biofuel characteristics		
Heat value	MWh ton^{-1}	4.9000
Boiler efficiency	-	80%
N_2O emission factor[6]	tons N_2O MWh^{-1}	0.000014
CH_4 emission factor[7]	tons CH_4 MWh^{-1}	0.000108

[3] According to http://www.meteo.lv/fs/files/CMSP_Static_Page_Attach/00/00/00/02/03/2012.pdf

[4] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-8 on Page 1.36 of the Reference Manual)

[5] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-7 on Page 1.35 of the Reference Manual)

[6] 4 kg TJ^{-1} Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-8 on Page 1.36 of the Reference Manual)

[7] 30 kg TJ^{-1} Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-7 on Page 1.35 of the Reference Manual)

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