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

STRATEGIES AND ACTION PLANS

(C.4)

ACTIONS

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

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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 as 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 an assessment of all environmental impacts. For all these reasons, these models should be used carefully in CCM strategy development for the identification of gaps in climate neutrality transition policy and funding frameworks and need further optimization for broader applicability as decision-making tools.

2024

SUMMARY

In the scope of the LIFE OrgBalt, LIFE18 CCM/LV/001158 "Demonstration of climate change mitigation potential of nutrient rich organic soils in Baltic States and Finland" (Project) the support tool – Functional land management model – a microeconomic model for public-private cooperation PPC model) for the socio-economic evaluation for the assessment of the costs and impacts of Project climate change mitigation measures implemented in the Project is developed.

This report is prepared based on the previous reports:

- Interim report No. 2021-C4/1 "Proposal for the PPC model and adopting of the Project results in Rural Development Plan (C4.1)" which included following annexes: 1) functional PPC model in MS Excel environment, 2) description of PPC model guiding principles, methodology and process of development of the model and current stage of the development, 3) User manual for the model "Functional land management model – a tool for climate change mitigation and sustainable management" to supplement sustainable and progressive uptake of the model usage and 4) Proposals for the adoption of the project results in Rural Development Plan.
- Report No. 2023-C4/4 "Report on economic benefits of CCM measures for nutrient-rich land management practices on farm level".

At current stage the PPC model structure is completed, and parameters are included and 13 LIFE OrgBalt scenarios (implemented in Latvia) fully integrated in the model. Additional two scenarios from LIFE Restore project are also included in the model. Data of the remaining 3 LIFE OrgBalt scenarios (implemented in Finland) will be added upon availability of verified data.

It is worth noting that during implementation of the project, the Rural Development Plan as the main document setting priorities, measures and funding for rural development before 2023 has been changed to Common Agricultural Policy Strategic Plan for 2023-2027 (CAP SP)- medium-term policy planning document that determines support priorities and support instruments in the field of agriculture and rural development. This report provides insights into results of the PPC model calculations for the 15 organic soil management scenarios implemented in Latvia that may be used for further adaptation in land management practices and possibly integrated into the future Common Agricultural Policy Strategic plans.

ABBREVIATIONS

Average notional ROE	average notional return on equity
CAP SP	Common Agricultural Policy Strategic Plan for 2023-2027
CCM	climate change measures
CO2	carbon dioxide
CO_2-eq	unit of measurement that is used to standardise the climate effects of various greenhouse gases.
Decision amount	Relative amount funding gap rate
ENPV	net present economic value
FNPV	net present financial value of investment
FRR	financial profitability of investments
Funding gap rate	the rate of public financing for the measure to be profitable for its implementer
Funding gap	the amount of costs that can be considered for a public funding request
ERR	economic rate of return
GHG	greenhouse gas
LIFE OrgBalt	LIFE OrgBalt, LIFE18 CCM/LV/001158 "Demonstration of climate change mitigation potential of nutrient rich organic soils in Baltic States and Finland" project
MS Excel	Microsoft Excel
PPC	public-private cooperation
RDP	Rural Development Program

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1. Objectives and structure of PPC model

1.1. Justification

Climate change is one of the greatest environmental, social and economic challenges of our days and the warming of the climate system is unequivocal. Greenhouse gases (GHG) emissions caused by human activities are the most significant driver of the observed climate changes since the mid- 20th century. Managed nutrient rich organic soils are one of the largest key sources of GHG emissions in Boreal and Temperate cool and moist (TCM) climate regions in Europe. In these regions managed organic soils usually are drained forests and fens or mires that when efficiently drained can increase GHG emissions. Total area of managed organic soils in EU is 34.5 mill. ha (7% of the EU area).

Organic soils can have high GHG emission as well as carbon storage potential depending on chosen management strategies. Based on the research and results obtained within the framework of LIFE program project "Demonstration of climate change mitigation potential of nutrient rich organic soils in Baltic States and Finland" (LIFE OrgBalt), Association Baltic Coasts have developed functional land management model – a tool for sustainable and climate friendly management of nutrient rich organic soils (PPC model). The model is designed to allow the user to assess the performance of organic soils depending on the planned land use type (scenario), based on land use performance criteria: financial return, economic return, financial deficit and the optimal amount of public funding, reduction of GHG emissions and ecosystem services assessment. Based on the findings and using the developed model, it is possible to implement deliberative management decisions of managed nutrient rich organic soils, to evaluate potential management costs, plan the expected financial return, assess the benefits of climate mitigation and consider nature values.

The model is a microeconomic model, to be used at farm level as business planning tool. At the same time, its calculations provide information on economic benefits and optimal public funding amount and its results may serve as a basis for further discussion among wide range of stakeholders.

1.2. Main objectives of the PPC model

- Serve as a support model for the assessment of the costs and impact on GHG emissions and CO2 sequestration, of the climate change mitigation measures implemented under the LIFE OrgBalt project.
- A tool for landowners / managers to work with their specific plot of land, to understand how much the implementation of the chosen measure will cost, what the required loan amount is, and what will be their return on investment and necessary amount of public investments.

1.3. Target audience

- Landowners / managers;
- Rural support services, farmers' and foresters' associations;
- Policy planners.

1.4. Format

The PPC model is developed using the MS Excel software (with a user-friendly interface). Minimum sofware requirements include the MS Windows and enabled macros capabilities for the MS Excel.

1.5. Methodology and guiding principles

The model consists of three main pages: "data entry", "results", "help" (user guidelines of the model are available under this section). The model can be used at:

- the "user level" by users who wish to enter data to test the financial and economic return on the investment based on the land type and provided land use scenarios. No password is needed in this case.
- the "operator level" by users interested in modifying the data and assumptions of the model to fit specific characteristics (for example, country specific values). In this case a password is needed and will be provided to all project partners and to all interested users.

Data can be entered at two levels:

1. Restricted criteria: these data include selection of the type of a land plot and selection of the appropriate scenarios by entering values of limiting parameters. Limit values for all scenarios analysed have been entered and are available in the model (accessible through the "Verification of limit values" button of the model's interface) – See Figure 1.
2. Additional criteria: additional data can be entered to provide more characteristics of the selected land plot – See Figure 2.

The model provides financial and socio-economic indicators for different types of land management (agricultural land and forest land) based on two above mentioned levels of input data. The first level data are necessary to understand which CCM measure can be implemented on a given territory (land plot), for instance, for agricultural land: type of agricultural land, soil type, land use assessment, management system, drainage system, restrictions on economic activity. For the first level data there are several restrictive criteria, because the CCM measures included in the model can be implemented only on lands with certain given characteristics. Once the first level input data are entered, all possible implementable CCM measures are shown for the model's user in a separate window. For each implementable CCM measure the second level data must be entered in order to calculate financial and socio-economic indicators. There are no restrictive criteria for the second level data.

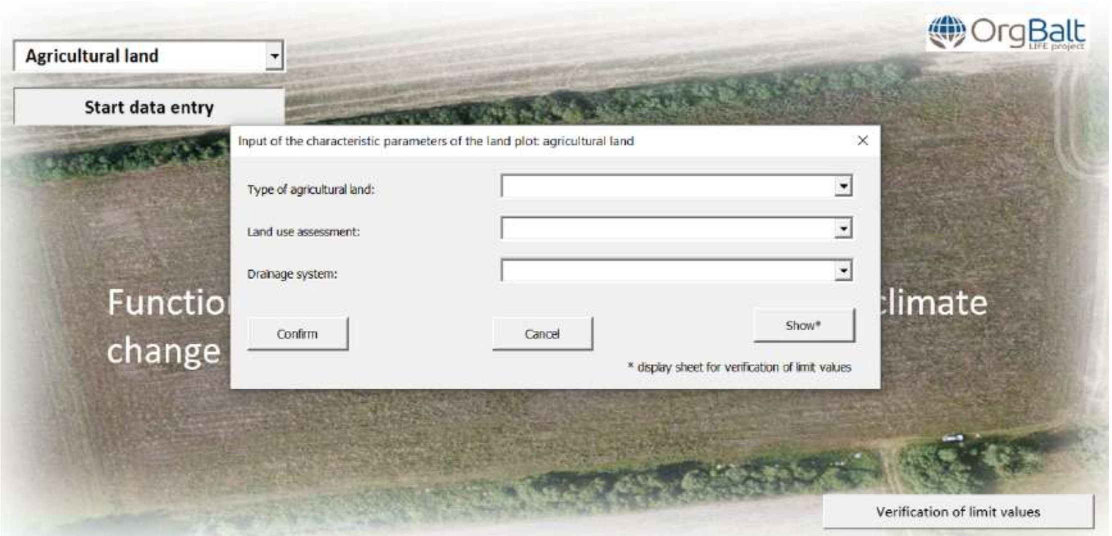

Figure 1 – Restricted criteria

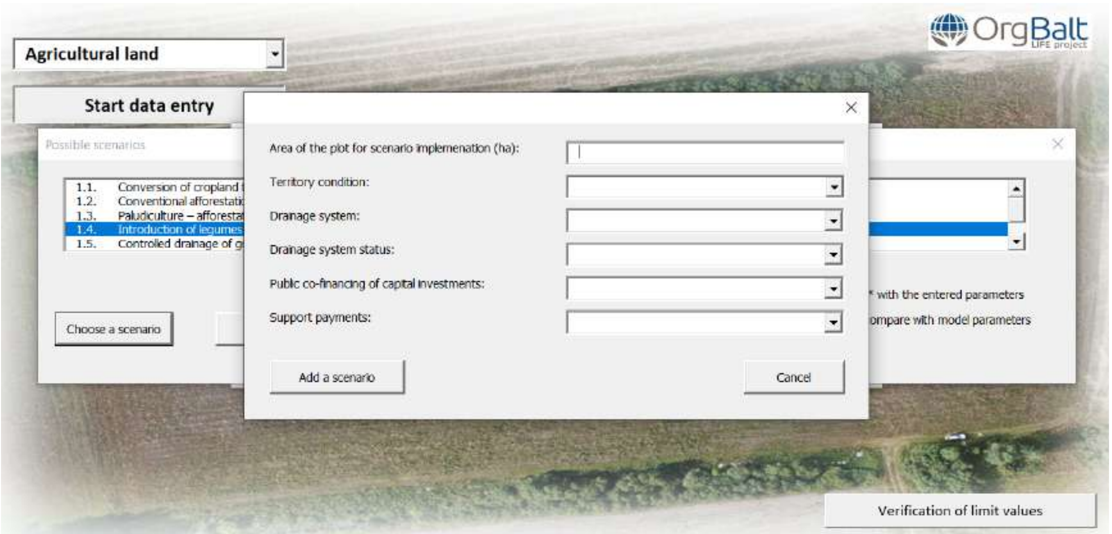

Figure 2 – Additional criteria

The model calculates the financial and economic return on the investment for six different periods of an investment project's life cycle: 5 years, 10 years, 25 years, 50 years, 100 years, and 200 years . The model can be flexibly implemented in all partner countries by changing data entry parameters.

The model is designed to allow users to assess the performance of organic soils depending on the planned land use type (scenario), based on the land use performance criteria. The model provides the following financial and economic indicators for each potentially implemented CCM:

1. **Financial indicators**: (1) **Average investment costs (EUR)** -The average amount of money spent for the investment - the model calculates the average amount of money what needs to be invested to implement the chosen CCM measure on a predetermined territory (ha) of land. The amount varies and is influenced by the average costs of territory cleaning, the type of management chosen, the status of a drainage system, the type of planting culture, the presence or the absence of public funding; (2) **Average net profit margin** - A net profit margin is calculated by dividing total forecasted profit (difference between revenues and operating costs) by total revenue during a particular life cycle and divided by the number of years of the life cycle (5, 10, 25, 50, 100, and 200 years); (3) **Average return on equity (ROE)** - a measure of financial performance calculated by dividing net income by shareholders' equity. In the model the average ROE is calculated by dividing a net cash flow with investment costs and the number of years of the life cycle; (**4) (EUR) Financial Net Present Value (FNPV)** (real discount rate: 4%) - A financial net present value of a measure's investment. A negative FNPV means that a selected measure is likely to operate at a loss, while a positive FNPV indicates that the measure should be profitable. The measure qualifies for attracting public funding if a FNPV is less than 0 EUR: **(5) Financial Internal Rate of Return (%) (FRR)** - The financial profitability of a measure's investments. If a FRR is higher than the discount rate used in the calculation (4%), then a measure has sufficient revenues to cover investment and operating costs, and possibly the EU co-financing is not needed or is needed in a smaller amount.
2. **Economic indicators: (1) Reduction of GHG emissions** (tons / year) - Total reduction of GHG emissions in tons obtained as a result of the CCM measure's implementation; **(2) GHG emission reduction value (EUR)** -An economic value attributed to obtained GHG emissions' reduction. Yearly economic benefits for the reduction of GHG emissions (EUR) is calculated by multiplying the forecasted GHG emissions' reduction value (t/ha) by the price attributed to that reduction (EUR/t CO_2 eqv.) and by the size of a land area (ha). **(3) Value of ecosystem services (EUR)** - An estimation of the value of ecosystem services, based on previous researches; (4) **Economic Net Present Value** (**ENPV) (total value) (EUR)** (real discount rate 5%) -Difference between the present value of economic and financial benefits (including the value of ecosystem services) and the present value of economic and financial costs of a measure **(5) Economic Internal Rate of Return (total value) (ERR) (%) – an** economic rate of return of a measure over a specified time period (life cycle) expressed as a percentage of the initial investment. If an ERR is greater or equal to the social discount rate, then a measure is socio-economically

beneficial for society. (4) and (5) can be calculated both with or without the ecosystem services' value.

3. **Funding gap: (1) Eligible costs (EUR)** - Amount of costs that can be considered for a public funding request (depends on eligibility requirements of a particular financier); **(2) Financing deficit rate (funding gap) (%)** -A financial deficit is the part of the investment costs that is not covered by a measure's net revenue. The financing deficit is the amount of public financing for a measure to be profitable for its implementer (FNPV = 0 EUR). A financial deficit determines the maximum amount of public funding to be attracted for a measure's implementation. (**3) Decision amount (EUR)** (the amount of eligible public financing based on a funding gap calculation).
4. **Cost effectiveness: (1)** Investment payback period (years) – investment costs divided by net revenue over the selected life cycle of a measure; (2) GHG reduction costs (EUR / tonne) - The total reduction of GHG emission costs obtained as a result of a measure's implementation in EUR. For the emission reduction price, the value 50 EUR/t CO_2 eqv.is used.

1.6. Data included in the PPC model

The PPC model includes data about the costs and benefits (financial and economic) of implementation of included scenarios. That includes investment costs, maintenance costs, productivity (yield of production or forest stand growth data), support payments, public funding and its rates for different ownership types, projected data for GHG emissions for the period up to 200 years of implementation of the CCM measures, prices for labour, GHGs as well as ecosystem services valuation.

1.7. CCM measures included in the PPC model

The PPC model's methodology is approbated within the project LIFE OrgBalt demonstrated CCM measures. The PPC model incorporates the current project's measurement data on GHG reduction obtained through the implementation of specific CCM measures.

The following scenarios have been fully integrated in the PPC model:

- Agricultural sector CCM measures:
  - Measures involving change of crop type:
    - (LVC301) Conversion of cropland to grassland;
    - (LVC304) Introduction of legumes in crop rotation.
  - Measures involving controlled water level:
    - (LVC305) Controlled drainage of grassland considering even groundwater level during the whole vegetation period.
  - Measures involving complete or partial afforestation:

- (LVC302) Conventional afforestation (spruce);
- (LVC303) Paludiculture – afforestation of grassland with black alder and birch;
- (LVC306) Agroforestry – fast growing trees and grass;
- (LVC310) Fast growing species in riparian buffer zones.

- Forestry sector CCM measures:
  - (LVC307) Application of wood ash in spruce stand;
  - (LVC308) Continuous forest cover as a forest regeneration method in spruce stand;
  - (LVC309) Semi-natural regeneration with black alder without reconstruction of drainage systems;
  - (LVC311) Riparian buffer zone in forest land planted with black alder;
  - (LVC312) Forest regeneration (coniferous trees) without reconstruction of drainage systems;
  - (LVC313) Strip harvesting in pine stand.
- Additional LIFE Restore project scenarios:
  - (LIFE Restore) Rewetting and cultivation of blueberries;
  - (LIFE Restore) Rewetting and cultivation of cranberries;

The PPC model at this stage focuses on conditions specific to the Baltic states. The CCM measures implemented in Finland are listed below although data from Finland modelling work is underway and currently is not fully integrated into the model, therefore will not be further analysed in this report:

- (FIC101) Continuous cover forestry in drained, nutrient rich peatland spruce forest;
- (FIC102) Shifting to continuous cover forestry in a drained nutrient rich peatland site;
- (FIC103) Shifting to continuous cover forestry on drained, nutrient rich peatland.

2. Model results

The report examines various model options and its outputs by analyzing CCM measures in agricultural and forest lands using the model's data. The provided data encompasses a range of the model's output indicators, including investment costs, return on investment, GHG emissions reduction, , and environmental impact.

Results of the calculations are impacted by parameters (additional criteria as indicated in Point 2 of Section "Methodology and guiding principles") entered in the model (the second level input data) that characterizes type and amount of investment necessary, meaning that financial and economical return as well as other model output data for implementation of a specific CCM measure may vary significantly based on the conditions of the particular land area.

The PPC model's output data provide sufficient basis for further analysis of the preferred CCM measure and potential outcomes of its implementation.

The model compares "situation without the CCM measure" with the" situation with the CCM measure".

Certain indicators are selected as they promote available choices for landowners and decision-makers. Regarding the financial return of the CCM measures, it is important to note that for many measures this return is small or even negative due to long investment payback period (limited revenue potential compared to investment costs). This is especially relevant for long-term (100 and 200 years) measures such as afforestation and forestry measures. Public funding option (for tree planting, tending or regarding expenses for drainage system renovation) is also included in the calculated results if selected in the second level input data as may be seen in Figure 2. The analysis of data is based on calculations for a land area of one hectare but the time periods differ based on the type of the CCM measures and their crop rotation cycles: for agricultural CCM measures calculations are for a 5-year period; for afforestation measures the period is 100 years; but calculations for forestry measures are considered for the period of 200 years.

2.1. Results for the agricultural sector CCM measures

Analysis of the agricultural CCM measures is conducted over a five-year period on a one-hectare agricultural land plot and the results are summarized in Table 1. From data presented in the table it can be inferred that measure LVC301 has the shortest investment payback period of 2,5 years, followed by LVC305 of 3 years and LVC304 of 4,7 years. A shorter payback period means faster recovery of the initial investment.
Measure LVC301 shows the highest reduction in GHG emissions of 1,5 tonnes/year, while LVC304 and LVC305 have negative reduction of greenhouse gases, indicating an increase in emissions for the five-year period, of0,6 and 0,2 tonnes/year respectively. The FNPV at a real discount rate of 4% is positive for all measures, indicating a positive financial return on the investment for farmers. .
The ENPV at a real discount rate of 5% is also positive for all measures, but specially for LVC305 and LVC301, indicating a positive economic impact based on ecosystem service values, revenue from sales of products and in some scenarios also GHG emission reduction. The funding gap rate is negative for LVC305 and LVC301, usually for measures with zero or negative FNPV a funding gap rate exceeds 0% of eligible

investment costs and a decision amount (the amount of eligible public subsidy) exceeds 0 EUR and could reach the planned investment amount of measure.

Table 1: Model output data for agricultural sector measures

CCM measures	Conversion of cropland to grassland (LVC301)	Introduction of legumes in crop rotation (LVC304)	Controlled drainage of grassland considering even groundwater level during the whole vegetation period (LVC305)
Life cycle (years)	5	5	5
Land territory (ha)	1	1	1
Average investment costs (EUR/ha)	2,022	5,878	2,503
Investment payback period (years)	3	5	3
Reduction of GHG emissions (tons / year)	1.5	-0.6	-0.2
FNPV (EUR) (real discount rate: 4%)	4,045	4,533	4,694
ENPV: total value (EUR) (real discount rate 5%)	23,043.	9,010	33,661
Revenue from sales of products (EUR) (Discounted value of revenues used in the calculation of the ENPV)	7,157.	8,699.	7,958
Funding gap rate (%)	-218%	2%	-254%
GHG reduction costs (EUR / ton)	1,730	0	321

The results of the PPC model's calculations reveal that over a five-year period in agricultural organic soils the most financially and economically beneficial CCM measures are LVC305, which includes controlled drainage of grassland, and LVC301 which includes conversion of cropland to grassland. It means that implementation of these CCM measures is profitable for landowners and are also from the socio-economic aspects including provision of ecosystem services. Therefore, those measures can be considered as good option for climate change mitigation and at same time not losing productivity.

2.2. Results for the CCM measures involving afforestation

Afforestation measures are analysed separately due to considerably different land management approaches that may require land use change.

Table 2: Model output data for CCM measures involving afforestation

CCM measures	Conventional afforestation (spruce) (LVC302)	Paludiculture – afforestation of grassland with black alder and birch (LVC303)	Agroforestry – fast growing trees and grass (LVC306)	Fast growing species in riparian buffer zones (LVC310)
Life cycle (years)	100	100	100	100
Land territory (ha)	1	1	1	1
Average investment costs (EUR/ha)	3,427	1,677	4,112	4,145
Investment payback period (years)	60	70	21	21
Reduction of GHG emissions (tons / year)	23	211	311	31,3
FNPV (EUR) (real discount rate: 4%)	-897	-1,095	3,642	3,642
ENPV: total value (EUR) (real discount rate 5%)	95,340	86,524	129,938	129,974
Revenue from sales of products (EUR) (Discounted value of revenues used in the calculation of the ENPV)	2,522	523,000	15,135	15,135
Funding gap rate (%)	99%	259%	-2%	-3%
GHG reduction costs (EUR / ton)	2	1	4	4

Calculations for the afforestation CCM measures (see Table 2) are also done for one-hectare area, but over a different time period of 100 years due to significantly longer rotation periods.

Among afforestation measures LVC303 has the longest investment payback period because the measure includes afforestation with black alder and there are no thinnings planned until the final harvest. That makes the final harvest generating the first revenue while implementation of the measure. On the opposite, the investment payback period for LVC306 and LVC310 is much shorter because those measures involve fast growing tree species. All afforestation measures show a significant reduction in GHG emissions, ranging from 21,1 tonne/year for LVC303 to approximately 31,3 tonnes/year for LVC306 and LVC310.

The FNPV is negative for LVC302 and LVC303, indicating a negative financial return on the investment. The ENPV is positive for all afforestation measures, indicating a positive socio-economic impact. The positive funding gap rate for LVC302 and LVC303 indicates there is a need for public funding at some point of implementation of these measures. It should be noted that a FNPV is positive for LVC306 and LVC310, therefore and implementation of these measures does not require public funding.

Necessity for public funding for conventional afforestation with spruce (LVC302) and paludiculture – afforestation of grassland with black alder and birch (LVC303) should be considered in further political discussions about agricultural practices and climate change mitigation because landowners otherwise might choose alternative ways of land management promising higher profits and faster investment repayment. Agroforestry with fast-growing trees and grass (LVC306) and planting fast-growing species in riparian buffer zones (LVC310) provide the best financial and socio-economic returns among the afforestation measures over a 100-year period.

2.3. Results for forest sector CCM measures

The analysis of the PPC model's output indicators for the CCM measures in forest land is analysed for a period of 200 years due to even longer rotation periods. Otherwise the calculations for most measures would include only one full rotation and additional period with expenses. That is balanced by analysing output data for a longer period. Calculations for the forestry CCM measures are included in Table 3.

Table 3: Model output data for the CCM measures on forest lands

CCM measures	Application of wood ash in spruce stand (LVC307)	Continuous forest cover as a forest regeneration method in spruce stand (LVC308)	Semi-natural regeneration with black alder without reconstruction of drainage systems (LVC309)	Riparian buffer zone in forest land planted with black alder (LVC311)	Forest regeneration (coniferous trees) without reconstruction of drainage systems (LVC312)	Strip harvesting in pine stand (LVC313)
Life cycle (years)	200	200	200	200	200	200
Land territory (ha)	1	1	1	1	1	1
Average investment costs (EUR/ha)	2,102	2,102	1,352	1,352	1,352	2,102
Investment payback period (years)	60	60	71	70	80	79
Reduction of GHG emissions (tonnes / year)	1,2	1,3	-1,0	0,7	1,2	0,1
FNPV (EUR) (real discount rate: 4%)	-849	-797	-2,502	-1,813	-1,527	-939
ENPV: total value (EUR) (real discount rate 5%)	63,214	77,398	84,251	65,280	64,404	78,309

CCM measures	Application of wood ash in spruce stand (LVC307)	Continuous forest cover as a forest regeneration method in spruce stand (LVC308)	Semi-natural regeneration with black alder without reconstruction of drainage systems (LVC309)	Riparian buffer zone in forest land planted with black alder (LVC311)	Forest regeneration (coniferous trees) without reconstruction of drainage systems (LVC312)	Strip harvesting in pine stand (LVC313)
Revenue from sales of products (EUR) (Discounted value of revenues used in the calculation of the ENPV)	1,984	2,665	1,273	539	940	1,999
Funding gap rate (%)	143%	93%	382%	259%	207%	101%
GHG reduction costs (EUR / tonne)	25	26	0	25	20	244

All forestry CCM measures have comparatively long investment payback periods ranging from approximately 60 years for LVC307 and LVC308 to approximately 80 years for LVC312 and LVC313.

Almost all analysed forestry CCM measures show positive reduction in GHG emissions, indicating their effectiveness in mitigating climate change. The exception is LVC309 involving semi-natural regeneration with black alder without reconstruction of drainage systems. The calculations indicate slight emissions of GHG (-1,0 tonnes/year) for the period of 200 years.

The FNPV is negative for all forestry CCM measures, indicating a negative financial return on the investment for foresters considering long rotation periods (meaning long periods without income) and discount rates. Therefore, public funding support should be considered for these measures. That is explained further by a positive funding gap rate requiring additional public funding in case if these measures are implemented.

At the same time all forestry CCM measures are characterized by high socio-economic return as indicated by the ENPV values. Among the most socio-economically beneficial measures are semi-natural regeneration with black alder without reconstruction of drainage systems (LVC309), strip harvesting in pine stand (LVC313) and continuous cover as a forest regeneration method in spruce stand (LVC308).

2.4. Results for wetland CCM measures

Data and calculations for these measures were collected and elaborated within the EU LIFE program project "Sustainable and responsible management and re-use of degraded peatlands in Latvia" (referred to as LIFE REstore project).

The analysis of the PPC model's output indicators for the CCM measures in wetland is analysed for a 10-year period on a one-hectare large land plot, and the results are summarized in Table 4.

Table 4: Model output data for the CCM measures in wetlands

CCM measures	(LIFE Restore) Rewetting and cultivation of blueberries	(LIFE Restore) Rewetting and cultivation of cranberries
Life cycle (years)	10	10
Land territory (ha)	1	1
Average investment costs (EUR/ha)	22,540	21,520
Investment payback period (years)	7	0
Reduction of GHG emissions (tons / year)	13.8	4.6
FNPV (EUR) (real discount rate: 4%)	32,296	-6,106

CCM measures	(LIFE Restore) Rewetting and cultivation of blueberries	(LIFE Restore) Rewetting and cultivation of cranberries
ENPV: total value (EUR) (real discount rate 5%)	168,680	305,207
Revenue from sales of products (EUR) (Discounted value of revenues used in the calculation of the ENPV)	114,895	32,877
Funding gap rate (%)	0%	60,30%
GHG reduction costs (EUR / ton)	771	1,156

Data presented in the table shows that the investment payback period is expected within 7 years at most for the CCM measure involving blueberries. The average investment costs for scenario involving blueberries may reach 22,540 EUR/ha, and no public funding is necessary. In contrary, the calculations on the CCM measure involving cranberries, particularly the FNPV and the funding gap rate, indicates that financial revenues compared to investments are not sufficient, and implementation of these scenarios may require public funding. On the other hand, socio-economic benefits that include provision of ecosystem services, revenue from sales of products and GHG emission reductions, for this scenario are substantial even compared to the other wetland CCM measure of blueberries.

Both mentioned scenarios indicate significant GHG emission reduction making these measures more beneficial than forestry and agricultural measures.

2.5. Summary of the main results of the CCM measures

For the CCM measures in agricultural organic soils over a five year life cycle, the most financially and economically beneficial CCM measure is **Conversion of cropland to grassland** as well as potentially efficient, but still requiring further evaluation, **Controlled drainage of grassland**. These CCM measures appear profitable for landowners and are also beneficial from the socio-economic perspective, including provision of ecosystem services and in some scenarios also GHG emission reduction. However, due to limited knowledge about the effect of the Controlled drainage of grassland, only Conversion of cropland to grassland can be recommended for climate change mitigation while maintaining productivity, and further studies are necessary to reveal the mitigation potential of Controlled drainage.

Agroforestry with fast-growing trees and grass and planting **Fast-growing species in riparian buffer zones** provide the highest financial and socio-economic returns among afforestation measures over a 100-year period. However, plant protection measures are crucial to reach reasonable financial and economic return.

The CCM measures such as **Conventional afforestation with spruce** and **Paludiculture – afforestation of grassland with black alder and birch** shows relatively high socio-economic benefits but are not very profitable for landowners. These measures should be considered in further political discussions for public funding support to promote practices that ensure climate change mitigation.

In forest lands, the most socio-economically beneficial measures are **Application of wood ash**, especially in mature forests, and **Regeneration with black alder** by planting trees on mounds. **Strip harvesting in pine stands** requires further evaluation of long-term effect and the effect of size and shape of openings of the tree growth and soil GHG emissions. All forestry CCM measures indicate a negative financial return for foresters in the long term. Therefore, public funding support should be considered for these measures.

In general, results demonstrate the financial viability and potential environmental impact of the proposed CCM measures. Additionally, they provide valuable insights for decision-making and investment strategies.

3. Main conclusions

1. Achieving a balance between productivity and climate mitigation in organic soil management requires a comprehensive understanding of the trade-offs involved. Sustainable practices that enhance soil carbon sequestration, maintain soil fertility, and optimize agricultural productivity are essential for addressing the challenges posed by climate change while ensuring the long-term sustainability of agriculture and forestry sector. By quantifying these trade-offs, researchers and policymakers can develop sustainable land management practices that optimize both productivity and carbon storage while maintaining ecosystem health and resilience.
2. The PPC model shows that all afforestation measures are related to significantly bigger cumulative reductions of GHG emissions than other sets of measures because of more significant changes in land use. Investment costs

and financial return differ significantly due to growth rate of selected species and lengths of rotation periods respectively. Measures related to planting fast growing tree plantations are the most profitable within the group of afforestation measures taken into consideration, while the least profitable is the set of measures related to planting of black alder and excluding maintenance of drainage systems.
3. Agriculture CCM measures financial return is higher, and an investment payback period is shorter compared to forestry measures. It must be considered that these sets of measures provide annual revenue but on the other hand, compared to forestry measures, risks related to weather conditions (droughts, frosts, snowless winters, flooding, hail, etc.) may be comparatively higher and could negatively affect crop yield.
4. CCM measures in forest lands, mainly related to continuous forest practices, as well as afforestation CCM measures with longer rotation periods, have relatively high economical value based on GHG emission reduction and ecosystem services. However, the model's calculations indicate negative financial return on the investment for foresters, which means that for these measures there can be considered public funding support.
5. Based on the findings from the PPC model, it is possible to implement deliberative management decisions of sustainable management of organic soils, evaluate potential CCM measures' implementation costs, plan the expected financial return, and calculate the economic benefits of climate mitigation. Analysis of these model output indicators provide a comprehensive understanding of the financial, environmental, and investment aspects of the particular measure, enabling stakeholders to make informed decisions regarding its implementation and potential impact in order to meet current and future EU environmental requirements.
6. Estimation of GHG emissions provided with the PPC model allows to evaluate potential inclusion of these measures in policy documents and national plans, such as the Nature Restoration Plan which will be adopted by states following the enforcement of the EU Nature Restoration Law. In addition, policy makers will be able to evaluate necessary support payments and other public co-financing measures, including GHG credit selling opportunities, to make those measures implementable and profitable for landowners.
7. Almost each CCM measure in organic soils have different conditions, environmental and climate impacts (drainage, afforestation, etc). Therefore, further research of clear benefits and adverse effects is necessary. There are various studies shedding light on potential trade-offs and synergies, emphasizing importance of managing forests and agriculture land for multiple ecosystem services while considering trade-offs.

8. In the future, the PPC model could be enhanced by incorporating additional suitable CCM measures, thereby broadening the range of evaluation options for both farmers/foresters and policy planners.

4. Further activities concerning the PPC model

- Data inclusion for the remaining 3 scenarios (Finland) will be finalized upon availability of verified data;
- Model enhancement and maintenance;
- Support provided to its users.

5. Annexes

Annex 1 "PPC MS Excel model" available on LIFE OrgBalt website https://www.orgbalt.eu/?page_id=2761