LIFE OrgBalt

Demonstration of climate change mitigation potential of nutrients rich organic soils in Baltic States and Finland

Layman's Report

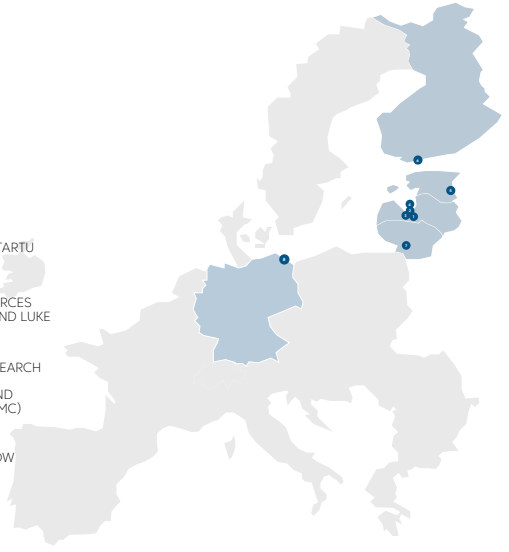
OrgBalt
LIFE project

Project title: Demonstration of climate change mitigation potential of nutrients rich organic soils in Baltic States and Finland
Project code: LIFE18 CCM/LV/001158
Project duration: August 1, 2019 until August 31, 2024

BENEFICIARIES:

Project partners:

1. LATVIAN STATE FOREST RESEARCH INSTITUTE "SILAVA" COORDINATING BENEFICIARY *Latvia*
2. MINISTRY OF AGRICULTURE OF THE REPUBLIC OF LATVIA *Latvia*
3. LATVIA UNIVERSITY OF LIFE SCIENCES AND TECHNOLOGIES *Latvia*
4. ASSOCIATION BALTIC COASTS *Latvia*
5. UNIVERSITY OF TARTU *Estonia*
6. NATURAL RESOURCES INSTITUTE FINLAND LUKE *Finland*
7. LITHUANIAN RESEARCH CENTRE FOR AGRICULTURE AND FORESTRY (LAMMC) *Lithuania*
8. MICHAEL SUCCOW FOUNDATION *Germany*



Latvia	Leading Beneficiary- **Latvian State Forest Research Institute "Silava"** / www.silava.lv Latvia University of Life Sciences and Technologies / https://www.lbtu.lv Ministry of Agriculture of the Republic of Latvia / https://www.zm.gov.lv Association "Baltic Coasts" / www.baltijaskrasti.lv
Lithuania	Lithuanian Research Centre for Agriculture and Forestry / https://www.lammc.lt
Estonia	University of Tartu / https://ut.ee
Finland	Natural Resources Institute Finland LUKE / https://www.luke.fi
Germany	Michael Succow Foundation / https://www.succow-stiftung.de

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Contribution of project partners: 1 077 034 EUR

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*Project disclaimer: 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 for drained organic soils in agriculture and forestry and developed spatial models and tools, it also identified remaining knowledge gaps. A continuation of GHG measurements and model development, as well as a broadening of the evaluated CCM measures, is recommended to bridge the remaining limitations in the after-LIFE-project period. The developed Simulation and PPC models still include limited macroeconomic considerations and external environmental impacts. Therefore, they can be used carefully in CCM strategy development for identification of gaps in climate neutrality transition policy and funding frameworks and optimised as decision-making tools when additional data are available.

Layman’s Report of the LIFE OrgBalt project was developed with the financial support of the European Commission LIFE Program and the State Regional Development Agency of Latvia within the framework of the project “Demonstration of climate change mitigation potential of nutrients rich organic soils in Baltic States and Finland” (LIFE OrgBalt, LIFE18 CCM/LV/001158).

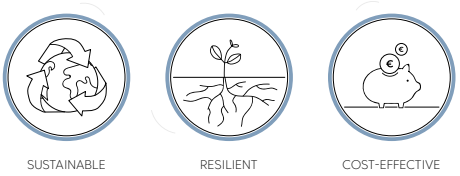
ABOUT LIFE OrgBalt

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 gas (GHG) emissions caused by human activities are the most significant driver of the observed climate change since the mid-20th century.

WHY

Although found in only ~3% of European Union agricultural land, managed nutrient rich organic soils are one of the largest sources of GHG emissions in the agricultural sector in both boreal and temperate cool and moist climate regions in Europe. In these regions, organic soils are usually drained peatlands that need to be treated differently from mineral soils to sustain their carbon storage function. Organic soils are found on ~25% of all forest lands in the European Union. Forest lands make up approximately 78% of the total area of organic soils and contribute to about 23% of the total emissions from organic soils in 2022 (National emissions reported to the UNFCCC and to the EU Greenhouse Gas Monitoring Mechanism, April 2024).

Scientific evidence shows that it is possible to significantly reduce GHG emissions by changing the way in which organic soils are managed and introducing climate change mitigation (CCM) management practices.



The general idea of LIFE OrgBalt project is to explore the potential of CCM practices that could contribute to a decrease of GHG emissions from drained nutrient-rich organic soils managed for agriculture or forestry purposes and demonstrate how these territories can be managed in a way that is balanced economically, socially, and environmentally.

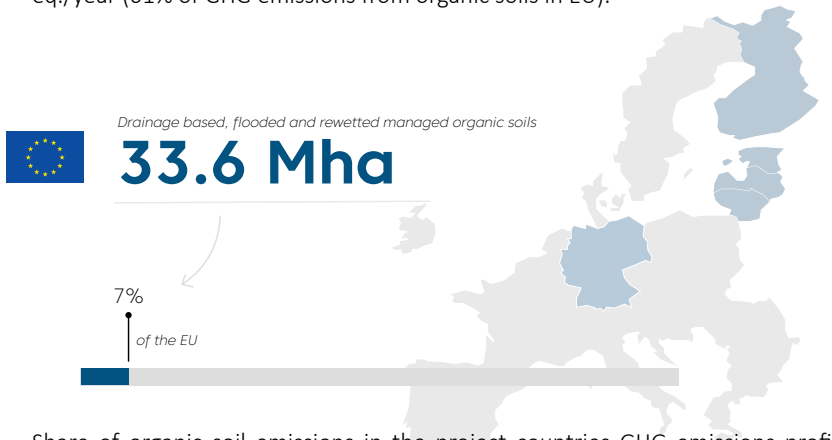
ORGANIC SOILS

Organic soils are soils rich in organic material – plant and animal remains in various stages of decomposition, soils containing cells and tissues of organisms, and soils containing substances synthesised by organisms. Organic soils are defined according to specific parameters {Intergovernmental Panel on Climate Change, IPPC guidelines).

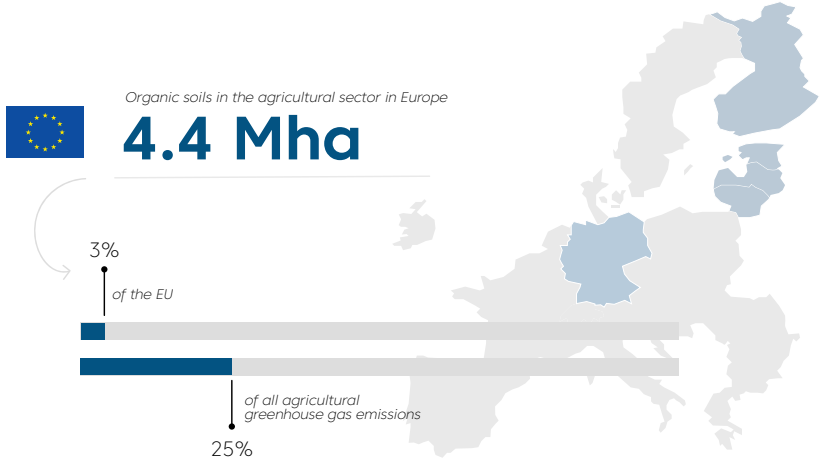
Emissions of these soils are reported under National GHG inventories. Emissions of these soils are reported under the Land use, land use change and forestry (LULUCF) mitigation, which is not yet fully explored.

FACTS

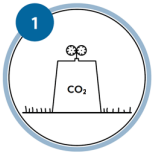
- Total area of managed organic soils in EU is 33.6 mill. ha (7% of the EU area).
- GHG emissions from organic soils in the project countries is 15 mill. tons CO_2 eq./year (61% of GHG emissions from organic soils in EU).



- Share of organic soil emissions in the project countries GHG emissions profiles varies from 0,72% of the net GHG emissions including LULUCF in Germany to 21,19% in Latvia and 8,74% in Finland.
- Managed nutrient rich organic soils are one of the largest key sources of GHG emissions in boreal and temperate cool and moist climate regions in Europe.
- In the agricultural sector in Europe Union organic soils make only 3% of the total agricultural area, but are responsible for 25% of all agricultural GHG emissions (including agriculture and agricultural land use in LULUCF).



MAIN ACTIVITIES OF THE LIFE OrgBalt PROJECT



IMPROVED GHG CALCULATIONS

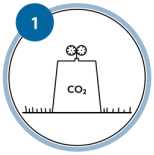
- Measurements of GHG emissions in managed organic soils which allows to develop and publish regional GHG emission factors.
- Improving spatial prediction models, with help of depth to water and wet area maps, for the spatial modelling of GHG emissions.

CLIMATE CHANGE MITIGATION MEASURES

- Implementation of sustainable, resilient, and cost-effective CCM management practices in selected demonstration sites.
- Development of proposals for sectoral strategies and action plans to reduce GHG emissions from organic soils.

TOOLS AND GUIDANCE

- Development of a simulation tool for estimation of GHG emissions and socio-economic benefits of various land-management approaches.
- Demonstration of public and private partnership model in implementation of the CCM measures.



IMPROVEMENT OF NATIONAL GHG INVENTORY

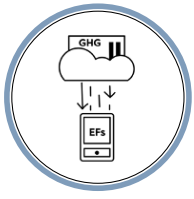
Over a two-year period, LIFE OrgBalt project has carried out measurements of GHG fluxes and other environmental variables in agricultural and forest land with nutrient-rich drained organic soils of different land use types, different moisture and other factor conditions.

Data were collected from measurements and samplings in 53 monitoring sites of the project including 17 demonstration sites and 36 reference sites. More than 9000 measurements of soil heterotrophic respiration were. Additionally, 8 220 gas samples, 2 544 water samples, and 2 226 soil samples were collected for analysis, along with several thousand samples of litter, micro-roots, moss growth, and litter decomposition.

- Estonia: 10 reference sites
- Finland: 8 reference and demonstration sites
- Latvia: 29 reference and demonstration sites
- Lithuania: 10 reference sites

Improving GHG inventory methods used in assessment and projections of GHG emissions and carbon sequestration in the management of nutrient-rich organic soils.

More transparent, accurate, complete, comparable and consistent data for the national GHG inventory thereby supporting efforts to mitigate and adapt to climate change.



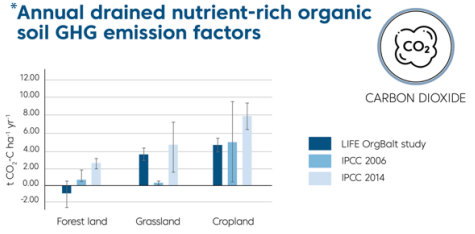
The inventories help policymakers set targets and identify areas and sectors where actions should be taken to achieve a reduction in GHG emissions and adhere to international agreements.

Improvement of GHG inventory calculation methods (regionally specific GHG emission factors) and activity data sets is crucial for more precise GHG inventory calculations and GHG emission projections.

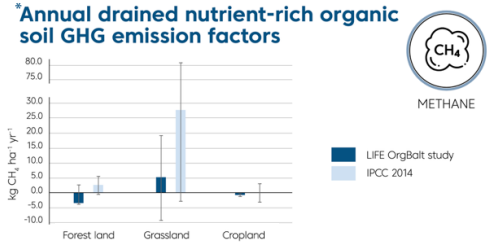
There are several emission factor estimation methods to produce credible and traceable high-quality data for the national GHG inventory. An emission factor allows estimation of GHG emissions per unit of activity. It is the average emission rate of a given source, relative to units of activity or process.

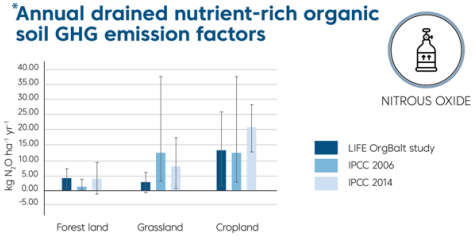
RESULTS OF GHG MONITORING CONDUCTED OVER A TWO-YEAR PERIOD IN THE LIFE ORGBALT PROJECT

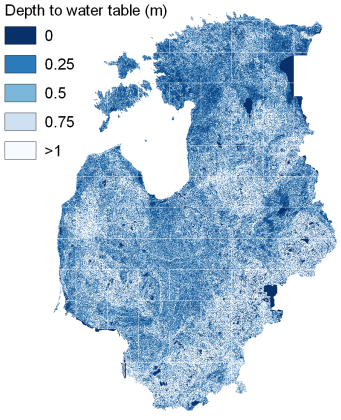
GHG flux monitoring allowed the development of regional emission factors for carbon dioxide, methane, and nitrous oxide from drained, nutrient-rich organic soils. Key findings revealed that carbon dioxide and nitrous oxide emissions from grasslands and croplands are comparable and significantly higher than from forest lands. Forest lands showed no soil carbon stock loss, resulting in a negative carbon dioxide emission factor, resulting in a negative carbon dioxide emission factor net CO_2 fluxes close to zero during the monitoring period, what needs further validation to sort out uncertainties. Considering uncertainties, the methane emission factors developed for drained, nutrient-rich organic soils are not significantly different from the default ones (IPCC 2014) across all land use categories.



*results based on scientific manuscripts prepared for or submitted for publishing. Slight changes may occur during the publishing process.



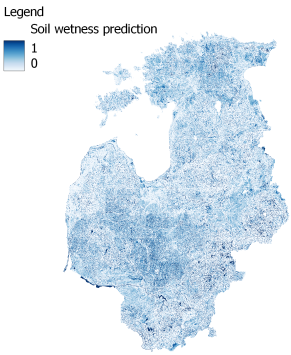




FILLING KNOWLEDGE GAPS ON ACTIVITY DATA BY DEVELOPING DEPTH TO WATER AND WET AREA MAPS

Activity data (e.g. land use and management practices and conditions) is one of the most important elements of the GHG calculation and projections from organic soils, especially if change in climate conditions is considered in modelling. A set of maps as a practical tool for planning sustainable soil management activities, both in the forestry and agricultural sectors was developed.

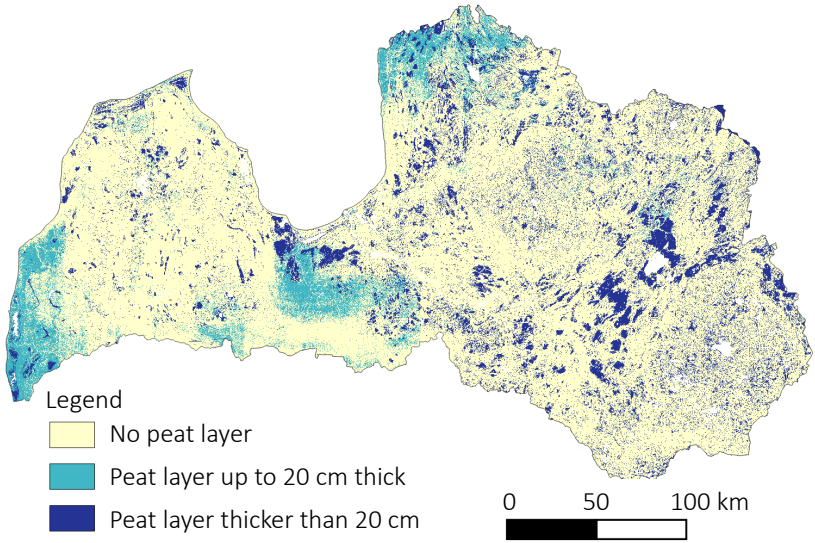
Water table depth maps for the entire territory of the Baltic States – the single source of information that allows modelling of water accumulation sites by showing water table depth in meters.



Wet area maps for the territory of the Baltic States are generated in 5 m horizontal resolution and depict the surface of water objects, areas and possible accumulation areas of surface water.

Wet area maps can be used in a variety of forestry and agricultural areas to plan areas for the establishment of paludiculture, the movement of heavy forestry and agricultural machinery, thus reducing the risk of soil damage, to select the most suitable tree and crop species for specific forest and agricultural areas, as well as in other respects.

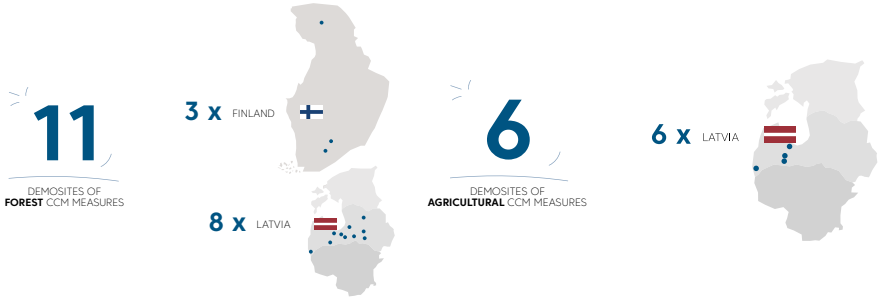
DISTRIBUTION OF PEAT AND ORGANIC SOILS IN LATVIA MODELLED WITH HELP OF A MACHINE LEARNING BASED CLASSIFICATION APPROACH



CLIMATE CHANGE MITIGATION MEASURES

IMPLEMENTATION OF LOW EMISSION LAND MANAGEMENT PRACTICES IN DEMONSTRATION SITES

Climate change mitigation management practices were implemented in nutrient rich organic soils in 17 demonstration sites on agricultural and forestry lands – each of differing land use type, drainage conditions and other characteristics. The process of establishing the climate change mitigation measures in the demonstration sites differs for each scenario, while the key benefits brought by the practices are the same – reduction of GHG emissions and increase in CO_2 removals.



Examples of low emission management measures demonstrated and analysed in the project include such practices as introduction of paludicultures, conversion of cropland to grassland, controlled drainage, agroforestry, continuous forest cover, and wood ash application.

Data collected at the demonstration sites of implemented CCM scenarios, among other parameters, is analysed and applied in modelling tools developed. The results reveal the most cost-effective climate change mitigation measures in organic soil management.
The table below shows the CCM measures implemented in the LIFE OrgBalt project.

Forest sector CCM measures
Application of wood ash in coniferous tree stands (LVC307)
Continuous forest cover in spruce stand (LVC308)
Forest regeneration with black alder and birch in non-drained organic soil (LVC309)
Riparian buffer zone in forest land planted with black alder (LVC311)
Forest regeneration with pine in non-drained organic soil (LVC312)
Strip harvesting in pine stand (LVC313)
Agricultural sector CCM measures
Conversion of cropland to grassland (LVC301)
Introduction of legumes in crop rotation (LVC304)
Controlled drainage of grassland (LVC305)
Measures involving complete or partial afforestation
Conventional afforestation (Spruce) (LVC302)
Introduction of forest paludiculture (Deciduous trees) (LVC303)
Agroforestry – fast growing trees and grass (LVC306)
Fast growing species in riparian buffer zones (LVC310)

BENEFITS OF CCM MEASURES IMPLEMENTED

- Over a five-year period in agricultural organic soils, the most financially and economically beneficial CCM measure (but with limited GHG mitigation potential) is **Conversion of cropland to grassland** followed by potentially efficient, but still requiring further evaluation, **Controlled drainage of grassland**. These CCM measures appear profitable for landowners and beneficial from socio-economic perspectives, including GHG emission reductions and the provision of ecosystem services. 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 best financial and socio-economic returns among afforestation measures over a 100-year period; however, plant protection measures are crucial to ensure the proposed effect.
- CCM measures such as **Conventional afforestation** with spruce and **Paludiculture - afforestation of grassland with black alder and birch** show relatively high socio-economic benefits but are not very profitable for landowners.
- 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. Continuous cover as a forest regeneration method in spruce stands is not recommended due to significant increase of risk of natural disturbances and limited ability to regenerate forest stands with high quality planting material. All forestry CCM measures indicate a negative financial outcome for foresters in the long term.

PROPOSALS FOR SECTORAL STRATEGIES AND ACTION PLANS TO REDUCE GHG EMISSIONS FROM ORGANIC SOILS

Proposals for improvement of sectoral strategies and action plans to reduce GHG emissions from organic soils are developed to provide comprehensive and transparent information on the situation in Latvia and the project partner countries, and in the European Union (EU) as a whole. Organic soil management and GHG accounting improvements are crucial for climate policy as it is now. There are many policy documents – legislative acts, strategies and action plans – not only in the partner countries but also on EU level, which can benefit from improved CCM measures, especially when incorporated in a model that can give the overall picture on both farm level and regionally. The most important documents where the CCM measures can be implemented are the Common Agriculture Policy and National Climate and Energy Plans.

The proposals are summarised and accessible online at:
https://www.orgbalt.eu/wp-content/uploads/2022/11/2022_C4_3_Interim_proposals-for-sectorial-strategies_-.pdf

TOOLS AND GUIDANCDE

LIFE OrgBalt project has developed important tools to provide landowners and institutions with a socio-economic analysis of the measures implemented. Although both models are based on data related to potential implementation of climate change mitigation measures, their target audiences differ. While Simulation model serves as a tool for policy planning and decision-making at regional and national level, the PPC model provides site specific calculations, and its main target audience is landowners.

SIMULATION MODEL FOR POLICYMAKERS

The simulation model is a policy planning / decision support tool for projections of GHG emissions and socio-economic consequences of selected management options and initial conditions. The simulation model is designed to reflect activity data, emission factors and socio-economic estimates. It includes geospatial information layers with data on soil, water and land use related indicators in all target countries.

- Simulation model is developed as a data-based support tool for policy planning and decision-making at a regional and national level.
- It evaluates the impact of climate change mitigation measures on socio-economic benefits of various land-management approaches and gives preliminary GHG emission reduction potentials (which need further validation and consideration of uncertainties) at national level for the Baltic States.
- Results of Simulation model also demonstrate potential locations of the GHG emission reduction measures.
- The model can and should be further developed and validated when additional data become available from future research.

Simulation model is available here:
https://bioekonomika.lbtu.lv/orgbalt/

PUBLIC AND PRIVATE SECTOR COOPERATION MODEL

The public and private sector cooperation model (PPC model) – a functional land management model as a tool for climate change mitigation and sustainable soil management. The aim of the model is to suggest innovative land management practices. The model demonstrates how these important territories can be managed while ensuring that economic, social, and climate mitigation benefits are achieved.

The PPC model is created to examine the benefits and costs of proposed CCM practices, financing opportunities, institutional arrangements and enabling conditions that could motivate the implementation of CCM measures. This model is a support tool for estimations of the economic benefits of the CCM land-management measures on multiple levels – national and individual farm levels.

Primary target audience

- Landowners
- Rural support services
- Farmers' and/or foresters' associations

The model provides landowners with helpful specific financial and socio-economic indicators for each CCM measure implemented in the project relating them to a specific land plot which is entered by users based on the current characteristics of their land.
Achieving a balance between productivity and climate mitigation in organic soil management demands 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.

Microeconomic model to be used for:

- Business planning on a farm level
- Employable together with macro-economic assessment for optiming public funding schemes

A tool to help understand:

- Implementation costs of the chosen measures
- Required loan amount
- Period for reaching return of investment
- Amount of public investment required

THE PPC MODEL IN PRACTICE

Users can choose the type of land (e.g. agricultural land, forest land) and, after which they are asked to enter a series of relevant data. The model returns economic and financial data to evaluate the return on investment and the potential GHG reductions of the selected scenario.

RESULTS

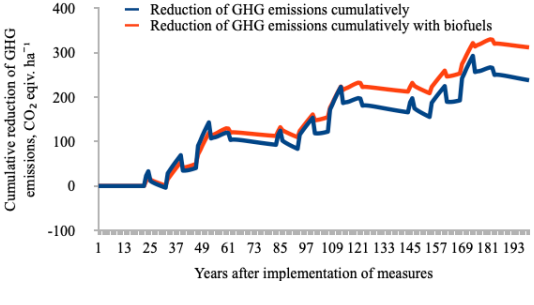
Model shows that all afforestation measures bring significantly bigger cumulative reductions of GHG emissions than other sets of measures due to more significant changes in land use. Investment costs and financial return differ significantly due to growth rate of selected species and lengths of rotation 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 with planting of black alder and excluding the maintenance of drainage systems (*please see the project disclaimer above).

The financial return from agriculture CCM measures is larger and payback period is shorter than that of forestry measures.

EXAMPLE

Application of wood ash after commercial thinning in spruce stand

Demonstrated GHG emissions reduction in spruce stands on organic soils and lowered ground water table (drainage) by implementation of wood ash after thinning thus enhancing stand growing conditions.



The PPC model is available at:

CAPACITY BUILDING

LIFE OrgBalt organised two workshops and training sessions in each Project participant countries – Latvia, Estonia, Lithuania, Finland, and Germany, engaging more than 500 participants. The activities were designed to disseminate the research findings, introduce significance and influence of policy initiatives on organic soil management and enable practical use of supportive tools developed for the sustainable management of nutrient rich organic soils. National workshops included external expert presentations who gave the participants an insight on organic soil management good practices in partner countries for knowledge exchange. National workshops and Training sessions were focused on main Project target groups – landowners and managers, farmers and foresters, NGOs, rural and forestry advisors, scientific organizations as well as policy planners.

PUBLIC AWARENESS

Various informative materials were developed – scientific publications (more than 37), e-newsletters (8), short documentaries (4). Educational and informational events were organised – seminars, training sessions for practical use of developed tools, meetings with target groups, lectures at universities, as well as an international conference (more than 30). Project experts presented the results achieved at important international events, including the UN Climate Change Conference (COP28) in Dubai, sharing and gaining knowledge on the project-related topics.

Total researchers involved in the project

ESTONIA	LITHUANIA
6	*10*
LATVIA	FINLAND
25	*17*
GERMANY	
2	

The project contributed to elaboration of 37 scientific articles and conference proceedings.

LIFE OrgBalt publication available here:
https://www.orgbalt.eu/?page_id=3620

LONG-TERM INVESTMENT OF LIFE ORGBALT PROJECT

- Proposals for national GHG emission factors were developed for nutrient-rich organic soils. This will aid in future review of the national GHG emissions in the national GHG inventory report, improving the GHG inventory methods used in assessment as well as the projections of GHG emissions and carbon sequestration in relation to the management of nutrient rich organic soils. Consequently, it is expected to lead to more accurate planning of national climate change mitigation policies and measures to be implemented in line with the actual situation.
- Proposals for improvement of sectoral strategies and action plans to reduce GHG emissions from organic soils are developed to provide comprehensive and transparent information to ensure a balance between environmental, climate and economic benefits in the long term.
- The decision-making support tool for policy planning and decision-making will provide with the opportunity to estimate the impacts of climate change mitigation measures on socio-economic benefits of various land management approaches and GHG emission reduction at national level for three Baltic States. It assists in planning of management measures, thus reducing the impact on climate change.
- Functional land management model as a tool for climate change mitigation and sustainable soil management will be a significant support for landowners, offering to examine the benefits and costs of proposed CCM practices, financing opportunities, institutional arrangements and enabling conditions that could motivate the implementation of CCM measures.
- Improved cross-sectoral cooperation between the parties involved in management of organic soils, bringing together landowners, farmers and foresters, policy and decision makers, entrepreneurs, experts and scientists of public and private sector contributes to an in-depth understanding of the interaction between land management, climate change and economic development.