CLIMATE CHANGE MITIGATION SCENARIOS INVOLVING IMPROVED FOREST MANAGEMENT PRACTICES

The introduction of specific tree species and the use of alternative felling methods can bring climate change mitigation benefits for the management of nutrient-rich organic soils and kickstart greenhouse gas emission (GHG) reduction from these lands. In LIFE OrgBalt, 6 demonstration sites are dedicated to demonstrating the effects of the introduction of altered forest management practices – application of wood ash in spruce stands, continuous forest cover as a forest regeneration method in spruce stands, regeneration with black alder or spruce after regeneration felling without reconstruction of drainage systems, strip harvesting in pine stand and riparian buffer zone in forest land planted with black alder. The practices are demonstrated on both forestry and agricultural lands. 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.

To test the effect of **introducing a riparian buffer zone in forest land planted with black alder** (demonstration site LVC311), regenerative felling is done, followed by the establishment of deep furrows. Black alder seedlings are planted in 20 m stripes along the river, and spruce seedlings are planted in the rest of the site. Afterwards, help-planting and tending are done if needed. The projected reduction of GHG emissions is related to groundwater level reduction caused by the establishment of deep furrows, decreasing CH_4 emissions. Increasing CO_2 removals are expected in living biomass because of significantly enhanced tree growing conditions in the riparian zone.

The site for demonstrating the impacts of **semi-natural regeneration of reconstruction-felling sites with grey alder without reconstruction of drainage systems** (LVC309) is set up by regenerative felling and soil preparation. Then, black alder seedlings are planted. In the following years, help planting and tending is done if needed. The projected reduction of GHG emissions is related to groundwater level stabilizing during the forest regeneration phase, better growth conditions, and increased CO_2 removals in forest biomass and other carbon stocks. Stabilized groundwater levels will decrease CH_4 emissions, but mounds will ensure better growth conditions for forest regeneration during the first decades after planting. Moreover, improved planting material ensures considerably better forest increment and stand resistance to environmental conditions during the whole rotation period.

The implementation of demonstration site where **forest regeneration without the reconstruction of drainage systems** (LVC312) was tested is done by regenerative felling and establishment of deep furrows and soil preparation with mounding method. Then, spruce seedlings are planted in the whole site except the wet part of the site, where black alder seedlings are planted. In the years following, help planting and tending is done if needed. The projected reduction of GHG emissions is related to groundwater level reduction, related to the establishment of deep furrows - as a result decreasing CH_4 emissions. Same as for demonstration site LVC309, the increasing CO_2 removals in living biomass is expected because of enhanced forest growing conditions.

To implement the climate change mitigation measure of **continuous forest cover as a forest regeneration method in spruce stands** (LVC308), the following work is done in the demonstration site. Drainage ditches are cleaned to ensure water runoff. Selective felling is done, with residues placed into technological corridors. Then, the maintenance of the drainage system is done to ensure a good technical condition. The projected reduction of GHG emissions is related to the increase of groundwater level in an alternative – regenerative felling scenario. In the case of selective felling the increase of groundwater levels should be smaller, thus also increase of GHG emissions is smaller.

Another climate change mitigation measure in spruce stands on organic soils is by **application of wood ash after commercial thinning** (LVC307). Implementation of this measure requires mapping of technological corridors with a distance of 20 m from each other. It is required to disperse 5 tons of carbonized (hardened) wood ash per hectare. Reduction of GHG emissions is related to lower groundwater levels due to increased water consumption for transpiration and increased increment of the stand.

The climate change mitigation measure using strip harvesting in pine stands (LVC313) is implemented by marking of technological corridors and strip felling (strip width – 20 m) in 1.1. ha of the area and regenerative felling in 1 ha of the area. Soil preparation with the mounding method is done, followed by planting of pine seedlings. In the years following, help-planting and tending is done if needed. GHG emissions reduction in pine stands by replacing regenerative felling with strip harvesting. Similar to the demonstration of selective felling, the projected reduction of GHG emissions is related to the increase of groundwater level in an alternative – regenerative felling scenario. In the case of strip harvesting increase of groundwater levels should be smaller than for regenerative felling, thus also increase of GHG emissions is smaller.

More information on the demonstration sites of climate change mitigation measures can be found on the LIFE OrgBalt project website (https://www.orgbalt.eu/?page_id=2375).

We asked the expert – Dr.silv. Andis Lazdins, Senior researcher of Latvian State Forest Research Institute "Silava" – about the practical implications of these climate change mitigation measures involving afforestation.

Why are the impacts of stabilizing or reducing groundwater levels in the demonstration sites linked to the reduction of GHG emissions?

There are multiple reasons. First of all, stabilization of the water regime and ensuring water flow in soil improves aeration of the soil and makes nutrients located in deeper soil layers accessible to plants (most plants cannot access nutrients in the non-aerated zone) so that trees and shrubs can grow faster, produces more biomass and litter, which substitutes decomposing organic matter. Secondarily, water flow ensures the input of nutrients stored in deeper soil layers and distributes nutrients across the site. Thirdly, drainage reduces natural disturbances, e.g. disease of tree roots during the snow-melting period, when groundwater level can remain high for long period, thus the trees are growing better after drainage and are less vulnerable to different disturbances including shortage of nutrients. At the same time, reduced groundwater level decreases methane and nitrous oxide emissions in spring, while in summer, when the emissions of carbon dioxide reach their peak, groundwater level drops in drained, as well as in pristine areas, and both areas create about the same amount of emissions.

What are the benefits of strip felling and selective felling compared to regenerative felling?

In our study, the increase of greenhouse gas emissions after selective felling in the spruce stand was smaller than in the regenerative felling site; however, to extract the same amount of logs, the selective felling area should be 3-4 times bigger than the regenerative-felling site, and the benefits at local scale are diminished if extrapolated to the necessary felling area. A significant increase in risk of natural disturbances, especially in forests with peat soils, is another drawback of selective felling. We did not recommend selective felling as a climate change mitigation measure. Strip felling or creation of openings is another story. It is beneficial due to smaller emissions from soil after harvesting; however, we don't yet know the optimal size of openings for different species (most probably, between 0.5 and 0.1 ha), ensuring a sufficient amount of light and nutrients and keeping groundwater low. This type of felling can be recommended for implementation; however, further studies are necessary to optimize the size and configuration of openings.

What are the key differences in pursuing afforestation measures on lands previously used for agriculture and forest lands?

The biggest difference is, in fact, that during afforestation, new carbon pools are created, but during forest regeneration, existing carbon pools are substituted. In the case of afforestation, everything – an increase of carbon stock in living and dead biomass in soil and harvested wood products is accounted as additional removals, as well as reduction of emissions rom the soil is counted as a benefit. In the case of forest management, the additional removals can be achieved by improvement of growth conditions, e.g., spreading of wood ash, mineral fertilizers or drainage, planting of more resilient and adopted tree species during forest regeneration or shortening of rotation period to enhance accumulation of carbon stock in harvested wood products. Every next generation of trees can increase CO_2 removals by 15-20% just by using better planting material and proper management conditions.

More information on project results can be found on the LIFE OrgBalt website (https://www.orgbalt.eu/?page_id=3620).

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