INVESTING IN YOUR FUTURE

Climate change mitigation potential of trees in shelter belts of drainage ditches in cropland and grassland

Nr. 1.1.1.1/21/A/030

Implementation period3/01/2022 – 30/11/2023

Latvian State Forest Research Institute SILAVA

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Ltd "Latvian Rural Consultation and Education Centre"

Deliverable 5.3.

REPORT

Decision support tools and guidelines for biomass production and transformation of buffer zones around drainage systems into “biomass factories”

Salaspils, 2023

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Comprehensive guidelines for planning, establishment and management of the shelter belts

Measuring and literature study analysis according to what the “Site types” and the “crop communities” elaborated are used for compiling of guidelines for decision makes at property, municipality and policy making level.

Main chapters of the guidelines– (general principles, site characteristics, crop communities, site preparation and establishment, management, harvesting and biomass production, sustainability criteria, instructions for the spreadsheet tool) are elaborated as deliverables - reports:

- “Crop communities”, “site types” and management systems suitable for different “site types” in the shelter belts;
- Examples of maps of site types in buffer zones around drainage ditches and GIS tool for identification of growth conditions and other characteristics of the shelter belts;
- Guidelines are supplemented with recommendations for application of the elaborated GIS tools including values of calculation parameters and step by step instructions which are supplemented by screenshots;
- Soil GHG fluxes and carbon turnover in the shelter belts;
- Nutrients retention capacity of the shelter belts in farmland;
- Productivity and costs of recommended (“site type” and “plant community” specific) mechanization solutions for shelter belts;
- Calculator for system analysis and optimization of mechanized management of shelter belts, including energy efficiency and GHG emissions assessment of the proposed solutions;
- optimization of assortment structure and climate change mitigation effect of HWP and bio fuel produced in shelter belts;
- implementation of sustainability criteria in management of the shelter belts and their inclusion in voluntary carbon trading systems;
- monitoring of tree growth and carbon stock changes in “biomass factories” using LiDAR and radar data.

The guidelines are currently in the preparation stage, the information contained in the reports is being processed as chapters of the guidelines. Findings and results expressed in the project implementation period are arranged in a didactically logical sequence.

Guidelines are going to be published under subsections of LSFRI Silava web page:

- https://www.silava.lv/en/research/projects-archive;
- https://www.silava.lv/petnieciba/petijumu-arhivs;
- https://www.silava.lv/pakalpojumi/informacijas-materiali-monografijas.

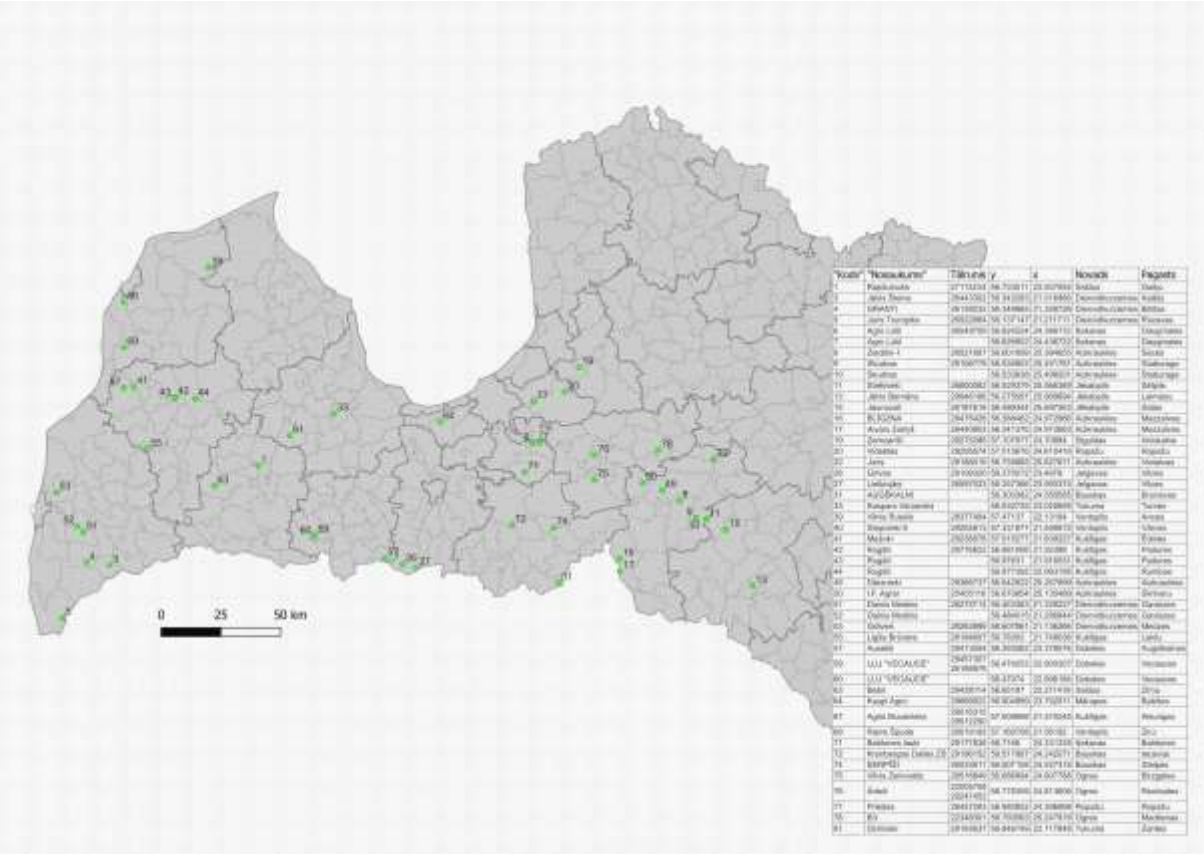
Socio-economic assessment of the project impact and policy - brief summarizing of current situation according to the existing regulation

Productivity and economic analysis are going to be elaborated in Action 3 and 4 and GHG models (Task 5.2) incorporated into a mathematical decision support tool, as management plan for selected “crop community”

Socio-economic assessment of the project impact and policy provide recommendations for implementation of the project results within the scope of the Rural development program (2021- 2030), as a climate change mitigation an greening measure.

Decision support tools for identification of growth conditions and other characteristics of the shelter belts

Tool elaborated by measurement of overgrowth of ditch sides in central and west art of Latvia.



Approach and method for monitoring of development of woody crops in shelter belts

The Latvian State Forest Research Institute “Silava” had been developed spatial tool for monitoring of woody crop development and biomass estimation (process described in D.5.1.). Method is based on high resolution LiDAR and photogrammetric point clouds to help land owners, companies, researchers and policy makers with monitoring of the shelter belts around drainage systems for biomass production and implementation of climate neutrality targets. Since the UAV data acquisition has become more accessible and potential area of the shelter belts in Latvia is about 0.12 mill. ha, stretched in narrow strips, such automated and remote sensing based tool will be less time and resources consuming than manual surveying.

Main principle developing this tool was to create a robust approach for woody crop development monitoring at a local scale. Later on history of monitoring data could be used for modelling of potential biomass accumulation in time scale. Data initial processing software depends on what data source is being used – LiDAR or photogrammetric point cloud. When LiDAR or photogrammetric point clouds are used, initial processing and digital elevation (DEM) and surface (DSM) models can be done using CloudCompare. To create point cloud from surface to motion (SfM) photogrammetry it is recommended to use software Agisoft Metashape Pro or any open access software, such as Meshroom or Regard3D. Further data processing is performed in the QGIS 3.22. environment and the following were used as an input data (1) DEM with horizontal resolution of 0.5 m; (2) DSM with horizontal resolution of 0.2 m; (3) vector layer with ditch network. Using DEM and DSM, canopy height model in horizontal resolution 0.2 m, as well as buffers around ditches are created. After that, shelter belts are classified in two groups

based on crop median height in the plot: lower and higher than 5 m. After that, in shelter belts where median canopy height is higher than 5 m, algorithm which identifies individual trees and their parameters from CHM is applied. In belts where median canopy height is lower than 5 m, median and maximal canopy height and covered area is calculated. In the next step, equation for biomass calculation, based on regression analysis from field measurements, in both groups are applied. Using repeatedly obtained data from same area, an increment of above ground biomass and height of woody crops in shelter belts, as well as disturbances can be calculated.

Technology features

- Affordable data sources and fast data acquisition in large areas;
- Open source solutions can be used in all steps of calculation;
- Technology can be applied at different scales depending on data availability;
- Other data sources, such as multispectral imagery can be implemented for additional information;

Resulting in the following customer benefits

- Broadly applicable solution for development monitoring and biomass estimation in ditch shelter belts;
- Robust approach for different conditions and types of shelter belts;
- At least 90% accuracy on height of the crops and 75% accuracy for biomass calculation, depending on species composition and canopy height;
- Improvement potential by adding other data sources;
- Possibility to automate ditch shelter belt monitoring.

Potential applications

- Planning of shelter belt management by land owners and companies;
- Monitoring of crop development;
- Identifying disturbances in crop growth and drainage ditch condition;
- Climate change mitigation potential calculation by researchers and policy makers;

Testing status

- Methodology is tested in 45 objects throughout Latvia;
- Validation on the results and development of biomass algorithm is done using precise field measurements;
- Methodology demonstrates sufficient correlation with biomass calculated using field measurements and biomass equations and very high correlation with canopy height;

Further development is possible by adding more measurements from shelter belts with different crop composition.