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Preliminary site investigation aid planning of poplar SRC establishment

Heilig, Dávid[2], Heil, Bálint[1,2], Kovács, Gábor[1,2]

About the project

Dendromass4Europe (2017 – 2022) aims at establishing sustainable, Short Rotation Coppice (SRC)-based, regional cropping systems for woody biomass (dendromass) production on marginal agricultural land. The dendromass produced in SRC (ligneous biomass, bark and wood) is supplied to dedicated bio-based value chains that create additional income and job opportunities in rural areas. The supply chains will be tailored for optimum efficiency of supply logistics and for reducing CO_2 emissions. Innovative bio-based materials will help to replace fossil-based materials.

Introduction

Marginal arable land – where conventional agricultural use shows low ecological and economical potential – can host fast-growing trees with the aim of producing woody biomass for energetical or industrial use. In the aspect of ecological services, these plantations can achieve higher biodiversity than the former arable lands have provided since they are a more diverse habitat. The plantations seem to be a favorable land use form. The important question is if the sites are suitable for woody plantation cultivation or not.

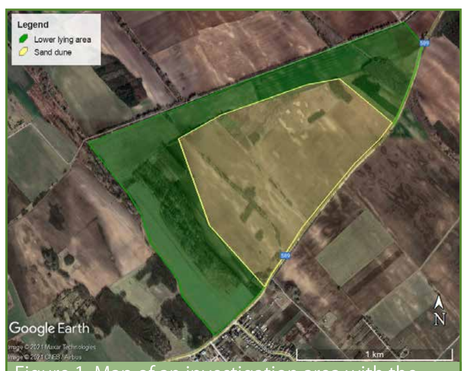


Figure 1. Map of an investigation area with the delineation of different soils


Figure 2. Diverse landscape of an investigation site

Task and challenges

Our task is to classify the sites according to their suitability to the potential dendromass production over a harvesting cycle (5 - 7 years). The yield of a plantation is the key factor at the decision of the plantation establishment. The growth of trees is affected by several environmental factors, such as climate and weather, groundwater availability as a water source for trees, and the soil, especially its water holding capacity and its nutrient supply.


Figure 3. Drilling auger profiles on the field


Figure 4. Soil profiles are opened with excavator in those cases, when the soil condition makes it impossible to drill

Materials and Methods

As a first step, the received borders of the investigation area along with descriptive data such as area, owner, etc. are surveyed. Then the topography, landcover of the sites based on satellite imagery, topographic maps and elevation models (Fig. 1) are assessed. The elevation, aspect, slope categories are determined, which is the base of landform and soil delineation. On the other hand, climate and weather data are collected from which monthly average temperature values and sums of precipitation are used, and a special focus is placed on the drought sensitive periods of the year.

The second step is the field investigation, in which auger soil profiles are opened (Fig. 3 - 4) at specific places (Fig. 2) of the investigation area, at least one in every 15 ha. The soil profiles are described and classified according to the guidelines of the World Reference Base for soil resources (IUSS Working Group WRB. 2015).

Final step is the synthesis of the different results, where the site is classified into one of the three categories based on the expected yield on the given area:

- recommended (REC), the yield is balanced and economically sound, actual yield is less weather-dependent due to favorable soil properties,
- success of establishment depends on the weather (DOW), the growth of the trees is highly weather dependent, i.e. dry years induce low yield, while the average or humid years can result in acceptable yields,
- rejected (REJ), the soils are not suitable for planting (e.g. high proportion of gravel or stone fragments, extremely low soil water-holding capacity) and the trees would struggle to survive even in humid years.

Results

About two thirds of the investigated area is dominated by oak forest climate category (T = 9.0 - 10.5 °C, P = 600 - 650 mm) (Tab.1) and more than 25 percent of the area is within the so-called forest steppe climate category (T > 10.5 °C, P < 600 mm). Under forest-steppe climate summer drought occurs often and the climatical condition are not suitable for the existence of closed canopy forests. Grasslands and forest areas form a mosaic pattern with each other. These are edge habitats for poplar plantations without groundwater effect.

Table 1: Distribution of investigated sites among climate categories

Climate-class:	beech	hornbeam-oak	oak	forest-steppe	Total
Area: (ha)	75	763	7 380	30 94	11 312
%	1	7	65	27	100

The elevation of the investigated sites ranges between 100 and 635 m a.s.l. 86 % of the total area is under 250 m which represents that most of the sites are located on plans or on lower hills. The most recorded landforms are plains (65 %) and 29 % of the profiles were obtained on hill-sides (Fig 5). This is also represented in the groundwater availability. 71 % of the total area is not affected by groundwater (there was no groundwater level found within 2 m from the soil surface).

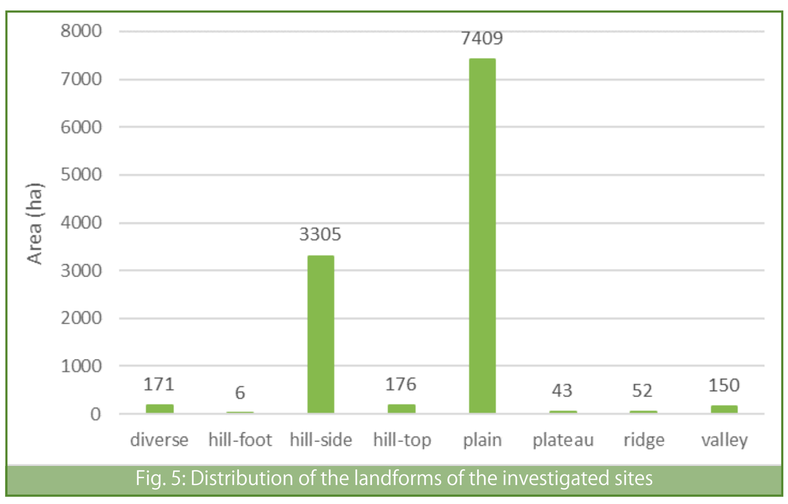


Fig. 5: Distribution of the landforms of the investigated sites

The most frequent soil groups are Cambisols, Gleysols, Arenosols, and Phaeozems (Fig. 6). Cambisols are typically located on hills and hill-sides, while Gleysols and Arenosols are found on Plains. Phaeozems mostly occur at the edge between plains and low hill-sides. Arenosols without surplus water are drought sensitive due to their poor colloidal system. They can hold low amount of plant available water and they lack nutrients. Cambisols and Phaeozems are well supplied in nutrients in general, the limiting factor of growth is the amount of precipitation. Gleysols have plenty of nutrients accumulated and the groundwater levels are usually close to the surface which can even form a barrier for root development.

The depth of the potential rooting zone is in average 80 cm. Medium or deep soils (rooting zone at least 60 cm) are found in 73 % of the total area (Tab. 2). If the rooting zone is shallower than 60 cm and there is no groundwater access, the site is rejected since there is a high risk of mortality. Loamy soils are found in 32 % and 21 % is the proportion of sandy texture. Both clay and clayey loam texture has 12 %. 8 % of the soils were described by coarse sand texture. The best aeration and structure is expected on loam and sandy loam texture.

References: IUSS Working Group WRB. (2015) World Reference Base for Soil Resources 2014, updated 2015 International Soil classification system for naming soils and creating legends for soil maps. World Soil Resources Reports No. 106. FAO, Rome. https://www.fao.org/3/i3794en/I3794en.pdf

Table 2: Distribution of root zone depth categories of the investigation

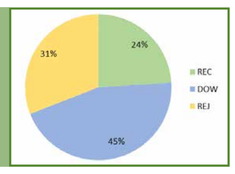
Rooting depth:	shallow	medium	deep	Total
Area: (ha)	3 126	5 407	2 779	11 312
%	27	48	25	100


Gleysol Phaeozem Cambisol Arenosol
Fig. 6: Typical profiles of the most common soil groups

Summary

Until 2021, altogether 11 312 ha have been surveyed (Fig. 7). 45 % of the area belongs to the DOW (establishment depends on the weather) category. 31 % of the surveyed area have been rejected (REJ category) for SRC establishment. 24 % of the area can be recommended (REC category). Thus, 2 715 ha of the surveyed land have been found to be optimal, and further 5094 ha have been found to be suitable – with lower yields – for poplar cultivation.

Fig. 7: Distribution of the suitability categories of the investigated area



[1] Ökoforestino Kft. (Hungary) [2] University of Sopron, Institute of Environmental Protection and Nature Conservation (Hungary)

Project Coordination:
Technische Universität Dresden
Forest Policy and Forest Resource Economics
Pienner Straße 23
D-01735 Tharandt

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