Analysing the site and choosing tree species

www.agforward.eu

Looking at remainders of hydromorphy in a wet soil is essential *(S. Gaudin - CNPF)*

Not every tree will be suitable for a given area of agricultural land. An important first step is to conduct a biophysical assessment to identify the potential suitability of a site for agroforestry.

This should include a detailed analysis of the environmental conditions (climate, soil, topography, surrounding vegetation and game presence) carried out with a technical advisor familiar with the project area. This enables the best choice of tree species and identifies the best soil preparation possible before planting.

Investing in unsuitable tree species is likely to lead to low tree growth (vigor and productivity loss), sanitary problems and potentially dieback - all of which will reduce return from investment.

Using an auger to collect soil cores as part of an agroforestry assessment *(Ph. Gaudry – CNPF)*

Meeting the needs of trees

As with crops, **tree species have specific ecological requirements** in relation to the soil (rooting depth, acidity, water holding capacity, etc.), climate (average temperature, rainfall requirements, tolerance of exposure to frost or droughts) and topography (wind and sunlight exposure, slope). Understanding and meeting these requirements is essential for successful establishment.

These variables can often change over the area of the farm. **Being aware of your chosen trees species requirements and identifying the climate and soil limiting factors** across the farm are important to enable **the best growth conditions possible for the selected trees.**

Environmental factors

Temperature and rainfall are the two critical variables that strongly influence trees growth.

Air temperature moderates trees' biochemical reactions and is important in some life stages (germination, budburst and bud development, flowering, fruits and seeds maturation). Rapid increases or decreases can cause the death of the tree. Therefore, it is important to assess the occurrence of frost (in winter or in spring) and droughts risks.

Rainfall is important for trees metabolism and regeneration. Trees can be big water users and some species are vulnerable to intense droughts. Too much water may also lead to tree death or slow growth when the roots suffocate due to a lack of oxygen in the soil.

Potential evapotranspiration is the evaporative power of the atmosphere, which is important for understanding **the water balance.** If the water balance is negative then this indicates a depletion of soil water reserves. When it is positive, we are seeing a recharge of groundwater. Trees can impact on the water balance.

AGFORWARD Agroforestry for Europe

Produced by the AGFORWARD research project funded by the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement No 613520

Why call an agroforestry advisor?

An agroforestry advisor helps farmers to undertake their development projects. Their role consists of:

- identifying farmer's goals, needs and technical skills;
- identifying regulatory issues, fiscal policy and potential grant schemes that will influence farmer choices around implementation and maintenance of their agroforestry schemes;
- producing a diagnosis about the bio-physical characteristics of the plot to determine the potential for agroforestry;
- assisting with the development of agroforestry schemes with the farmer.

In a practical way, he is able to:

- identify suitable locations;
- propose a list of trees species and assist with the planting design;
- identify potential problems and propose solutions;
- advise on ground preparation and materials for maintenance and tree protection;
- teach farmers tree pruning techniques.

For the visit of the advisor, the farmer can help by:

- gathering the deeds for the farms (to confirm ownership);
- identify potentially suitable locations areas;
- dig soil observation pits.

The advisor is at the service of the farmer and gives him agronomical and agroforestry knowledge *(B. Petit – CNPF)*

Farmers have to take into account the topography of fields, which strongly modifies the effects of the local climate on the surface of the soil. South facing hillsides are sunnier and are often warmer and drier than fields with northerly aspects. Similarly cold air is more likely to accumulate in valley bottoms and frosts are more frequent in these areas.

The movement of water downslopes is another important factor to consider. Water travels downslope it willoften bring soil with it (including soil minerals). As such up slope areas tend to have shallower drier soils and where the soil settles at the bottom of slopes we find both richer soils but also areas with wetter conditions (prone to water logging).

Last spring frosts can burn the newly formed leafs of oaks planted in valleys bottom *(S. Gaudin – CNPF)*

Overexposed sites can have a detrimental impact on tree architecture

Do trees and crops have different needs?

Trees generally require a deeper soils with a good water supply (i.e. wet soil conditions). However, soil with too much nitrogen can lead to a massive branching. Crops can be satisfied with a topsoil, about 30 to 40 cm deep and easy to work with (excluding for example a high content of flint or heavy clay).

Analysis of the soil

A number of soil attributes have a significant impact on tree root development. These include soil depth, the amount of stones present, soil type and texture (clay, silt and sand proportion) and potential for waterlogging. The factors need to be assessed prior to establishment to ensure successful planting. These factors can be assessed either by digging soil pits or by using augers.

Identify restricting factors

Shallow topsoil: the soil is a reservoir of water, nutrients and air. The deeper is the soil, the greater the availability of these three elements. A soil with a depth of 80 cm or more has good potential for tree growth. Shallower soils (>40 cm) are only suitable to certain trees species that are adapted to restricted conditions and with powerful rooting. In soils of less than 40 cm the potential for establishment is limited.

Dry soil: the risk of reduced water availability is greater on shallow porous soils (e.g. sandy soils, fissured lime stone, or stony soils), soils without any clay layer to retain water (i.e. low water holding capacity), or in conditions where groundwater is not easily accessible by the roots during summer. This risk is also greater on sloped fields, particularly those with southerly aspects.

Waterlogging: waterlogging creates anaerobic conditions and can reduce the tree rooting depth. All tree roots need oxygen to respire and the more extensive and shallower the waterlogging is, the greater the constraint on root development.

Excess water is traceable in the field through observation of the soil profile. A soil prone to temporary waterlogging (a pseudogley soil) will usually be dry and compact during summer and starved of oxygen during winter and spring; which is problematic for tree growth.

Waterlogging is characterized by the presence of a whitish-gray layer dotted with oxidized iron rust. A layer saturated with water all the time (a gley soil) is anaerobic and unavailable to all but the most flood tolerant tree species; gley soils are greenish-grey or bluish.

The presence of rust spots is characteristic of a temporary congested soil with water *(S.Gaudin – CNPF)*

Compact soil: compacted soils limit root development. The compactness of the soil can be estimated in the soil pit by assessing resistance to the pull of a pocket knife through the soil horizons. The soil is compact if, in the first 40 cm, a knife encounters resistance. Compaction will sometimes manifest as a single layer (for example, plow pans on soil with a silty-clayey or clayey texture which will be broken by subsoiling).

Calcareous soil: a big quantity of active limestone content in soil can block the uptake of other nutrients essential for trees. This can cause leaf discolouration, tree branches to dry out, or even tree mortality. The presence of limestone can be detected in the field by using a simple chemical test with diluted hydrochloric acid (looking for effervescence in the first 40 cm of soil).

Soil profile analysis

Digging a soil pit enables the technician to evaluate the physical and chemical properties of the soil. The deeper the soil pit, the more complete the soil observations. Ideally you will need a pit of 80-100 cm. Soil pits provide valuable information on the composition of the soil horizons; the homogeneous layers distinguished from each other by their color, texture and structure.

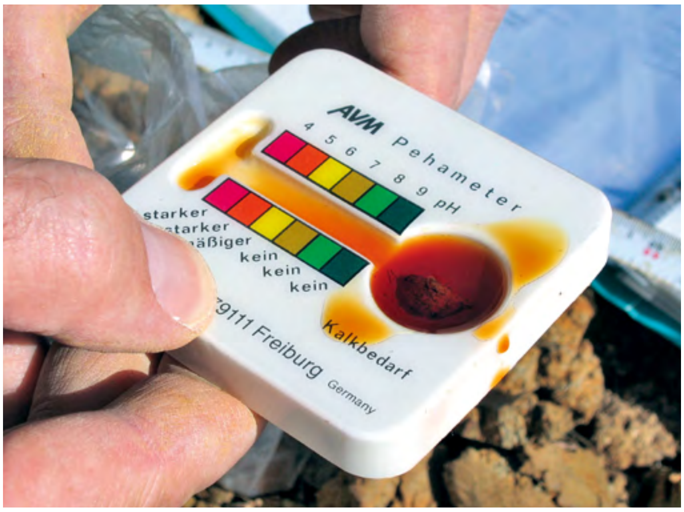
Choose the location: before launching an analysis, you have to dig the soil pit but not anywhere! You need to take into account topographic variations, soil color and your local knowledge to identify the appropriate location for the pit. Avoid idiosyncratic areas of the farm (such as localized depressions) and areas disturbed by human activity (roadsides or field edges where vehicles have left tire tracks).

Soil core samples are collected by auger from the surface down. The whole soil is reconstituted by juxtaposing the successive soil core samples

The soil pit enables a carefully observation of soil horizons and makes possible soil sampling for laboratory analysis, both chemical and physical

Auger: an auger is a useful tool to check how variable the soil is across the farm (and can help in seeing if more than one pit is required). This tool extracts a 20 cm soil core sample. However, many critical parameters cannot be evaluated with soil core samples alone (such as the structure and soil horizons, rootedness, abundance and empty spaces nature, etc.), all of which can be assessed with a soil pit.

Function of the soil pit: the main parameters to be evaluated are soil depth and horizon thickness, humidity, color, signs of waterlogging, fine earth texture, presence of coarse materials (like rocks, gravel...), structure and soil compactness, abundance of the roots, limestone presence, acidity (pH measure), type and distribution of organic matter in the soil, signs of biological and human activities. A soil analysis in laboratory can be done to supplement information gathered in the field.



On the field the soil acidity is measured with a colorimetric pH-meter. If the soil is too acidic, it will be more difficult for the trees to capture the minerals. A high pH value usually indicates the presence of active limestone content

Philippe VAN LERBERGHE
The Institute for Forestry Development (IDF)
philippe.vanlerberghe@cnpf.fr
www.agforward.eu

Special thanks go to Fabien Balaguer (French Agroforestry Association) and to Dr Tim Pagella (World Agroforestry Centre) for their work as technical editors and translators.

23 October 2017