



Forest management toolbox v1.1

Forest management is about which tree species we shall use, which structure the forest shall have, how dense the forest shall be, how we manage habitat trees etc. This forest management toolbox is a list of options for Europe's forests. The toolbox will be used by the stakeholders during the field visits in work package 5 (WP5) of the Climb-Forest project. The stakeholders shall select forest management options that they recommend, or prefer, to be used from now on.

Objective: The objective of this toolbox is to give a structured set of options, to ensure that all stakeholders follow the same structure and that we have sufficient information to model and evaluate how the forests will perform based on stakeholders' preferences.

Ecosystem services: The forests of Europe are expected to provide wood, to store carbon, to provide habitats for flora, fauna, and fungi, and also recreation for Europe's population. These goods are called ecosystem services. In the project we shall evaluate how good the stakeholders' preferred management options are in providing these services.

Idea: There is no "best" forest management. It is up to politicians and forest stakeholders to decide based on their preferences and on knowledge. The forest management options can be placed along two important dimensions. The first dimension is a range from nature protection to wood production. The second dimension of forest management goes from today's methods to methods that make the forests strong, or robust, or resilient towards climatic driven disturbance. Climate change can lead to large-scale forest damage and mortality in the coming years and can cause the ecosystem services to fail.

Dimension 1. Nature protection versus wood production: This dimension goes from a protected forest to bioenergy crops with 4 years rotation. These are the two ends of the scale, which we call passive and intensive forest management. In between we have low intensity forestry ("close-to-nature forestry"), followed by medium and high intensity forestry ("intensive even-aged forestry"). Today we see a conflict along this dimension, between environmentalists and foresters. One topic of conflict is whether we shall use continuous cover forestry or clear-cut, even-aged forestry.

Dimension 2. Forest resilience: This dimension ranges from conventional forest management to a management that shall make forests stronger in facing the increased pressures from fire, drought stress and weather events with heavy wind and wet snow. This is largely a matter of knowledge, rather than preferences.

Spatial scale: The stakeholders shall select management options for forest stands, which are spatial units having homogeneous growing conditions. Each stand can have a different set of options. However, in the field visits we will make categories of stands, and the stakeholders can set the same set of management options for all stands in one category. Inside a stand, we can have special management option for one tree, or for a group of trees (a "patch"). This can be useful for trees having a special quality or values, such as nesting trees for rare birds. For a larger area, we can cover the ecosystem services in two ways, either by producing all types of ecosystem services in all stands ("multiple use") or by produce wood in some stands and biodiversity and recreational values in other stands ("zoning").

Temporal scale: The management options shall be selected for the coming decades. This means that the stakeholders need to consider climate change and select forestry options that can fit to the climate in 20-80 years from now. In addition, possible changes in the demand for ecosystem services, for example increased need for bioenergy, shall be considered. In the project, we will run models where we assume that the forest management options were already implemented several decades ago and forecast the further development in such a virtual forest.

Select cells that represent your preference or understanding. Multiple options are OK.

Close-to-nature options		Intensive options			
1. Objective. What should be the objective of this forest stand, including any landscape level purposes?					
Providing multiple ecosystem services (<i>multiple use</i>)	Providing one ecosystem service only, specify:	Prevent the spread of forest fire (barrier)	Maintain special biodiversity or recreational value	Other, specify:	
2. Harvesting (forestry) type					
Continuous cover forestry (CCF)	Retention forestry	Clearcut	Other, specify:		
3. Age MGM					
Uneven-aged	Even-aged	Other, specify:			
4. Tree species (select one or more species in combination)					
Species 1, %	Species 2, %	Species 3, %	Species 4, %	Species 5, %	
5. Within-species genetics					
Natural	Breeding	Genetically modified	Large genetic variability	Small genetic variability	Other, specify:
6. Establishment and regeneration					
Natural	Seeding	Planting	Coppice	Other, specify:	
7. Density MGM					
Keep dense and carry out thinning one or more times		Keep sparse and do not thin	Not applicable (CCF)	Other, specify:	
8. Site management MGM options					
Soil scarification	Fertilization	Irrigation	Chemical weed, pest and disease control	Other, specify:	
9. Edge options (towards neighbouring stands, bogs, lakes, farmland, etc)					
Never harvest	Mix species	Multilayered	Other, specify:		
10. Single-tree or tree-group options					
Keep large, old trees	Keep habitat trees (birds' nesting etc.)	Veteranization (intentional vandalism)		Other, specify:	
11. Climatic stress. What will be the main climatic stressors when trees get old?					
Drought	Storm	Snow	Fire	Bark beetles	Other, specify:
12. How can resilience at high age be increased towards those stressors?					
Harvesting (forestry) type and age distribution (see 2, 3)	Trees species selection (see 4)	Genetics and breeding (see 5)	Density MGM (see 7)	Other, specify:	
13. Which other stands should get the same MGM type? Set some forest property variables that can be used to associate this stand to a category of stands)					
Variable 1:	Variable 2:	Predefined category:	Other, specify:		

Explanation for each setting

1. Objective. What should be the objective of this forest stand, including any landscape level purposes?

This setting covers the two landscape scale alternatives “multiple use” and production of one ecosystem service (“zoning”). Some stands may have a special function, such as stopping a forest fire from spreading or maintain a special habitat.

2. Harvesting (forestry) type

Here we have three main alternatives, and the difference between them is based on how much of the wood we leave after a major harvest. In “Clear-cut forestry” we leave less than 2% of the trees or the woody biomass. In Retention Forestry we leave between 2 and 30%. In Continuous Cover Forestry we leave more than 30%.

3. Tree age management

We have here two main alternatives. In “uneven-aged” where we have trees of all ages from seedlings to mature trees. In “Even-aged”, all trees have about the same age.

4. Tree species (select one or more species in combination)

Here you can specify one or more tree species to be used and set the fraction for each of them. Mixing species can increase the resilience by spreading the risk for forest damage.

5. Within-species genetics

We have two different aspects. The first aspect is about using seeds or seedlings based that are natural in the site, based on breeding or based on genetic modification. The second aspect is about the genetic variability, i.e. whether the variability should be wide (spreading risk for damage) or narrow and targeted towards certain aims.

6. Establishment and regeneration

Here we have options ranging from natural regeneration from nearby trees, via seeding, planting, and finally coppice (from stumps or roots of the previous generation of trees).

7. Density management

This setting is about the dense the forest shall be, or how close the trees shall stand to each other. We have two main options here. We can keep the forest dense and carry out thinning one or more times as the trees grow larger, and in this way produce wood with the special quality of few branches, narrow tree rings and almost cylindric timber. Alternatively, we can keep the forest sparse, and this can provide robust trees against climatic events like storm drought.

8. Site management options

Here we have several tools that are mainly used in intensive forest management. This includes soil scarification, fertilization, irrigation and protection of seedlings and small trees against competition from weeds, insect pests and diseases with chemical agents.

9. Edge options

Here we can specify special handling of forest edges towards neighbouring stands, bogs, lakes, farmland, etc. Edges can be important for recreational values, for forest resistance against wind and contain more biodiversity than inside the stand.

10. Single-tree or tree-group options

Inside a forest stand, we may take special management actions for single trees or groups of trees. This can be to never cut special trees, that have high value for recreation (“selfie-trees”) or for biodiversity (rare birds’ nests). We may also select trees for special treatment like intentionally damaging trees (“veteranization”), in order to generate habitats or increase the amount of dead wood.

11. Climatic stress. What will be the main climatic stressors when trees get old?

This point and the next one is about damage and stress on the trees due to climate change. Consider which types of damage or stress that can be severe in the coming decades.

12. How can resilience at high age be increased towards those stressors?

This setting is linked to the previous. How can we reduce this through the management options selected above in all the points above. You may want to reconsider your above settings here.

13. Which other stands should get the same MGM type?

We will visit some selected stands during the field visit, and here you can set which other stands in the forest should get the same type of management. For example, if you have decided to produce high amounts of high quality timber with intensive, even-aged forestry, you may here select the same option for all stands having high site productivity, smooth terrain and easy access from nearby roads. Or for example, if you here focus on recreational values, you may want to apply the same management to all stands being close to a city, or close to hiking tracks.