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# Deliverable D3.4 Overview report on generated digital teaching components, incl. webinars and MOOCs

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## Abstract

E-learning is not yet widely applied in forestry. The use of learning management systems (LMS), especially outside the university, is relatively uncommon. The ROSEWOOD4.0 project's work plan has foreseen the development of MOOCs for three defined target groups: forestry contractors, private forest owners, and new (urban), often female forest owners. Addressing these target groups, three MOOCs have been implemented, namely:

MOOC 1: Digital support for efficient harvesting operations (focus on data flow, Decision Support Systems (DSS) and resource efficiency in mechanized timber harvesting),

MOOC 2: Digital Tools for Climate-adapted Reforestation (focus on climate-stable forests – considering economic, social, and ecological aspects of reforestation), and

MOOC 3: Managing Hardwood – Perspectives for New Forest Owners (focus on basic knowledge and skills to integrate active forest management into the daily life of participants).

This report includes a short introduction to digital teaching, reflections on the experiences of the implementation team with these new formats, and the full content (all texts) of the MOOCs.

All three MOOCs are publicly available via self-registration of users on the project website or at:

https://wald-und-holz-nrw.elearning.de/ilias/login.php?client\_id=waldundholznrw&lang=en

## Deviations

No deviations.



## 1. Report on the development of e-learning materials

This report continues the previous D3.3 "Report on conducted training actions" and builds upon D3.2 "Course Concept Digitalization in Forestry and Wood Mobilisation". In D3.2, the concept for the ROSEWOOD4.0 MOOCs (Massive Open Online Courses), webinars, podcasts and their interaction with the practical on-site trainings has been presented in detail, including the analysis of target groups, explanation of training methodologies, teaching strategies and the didactic implementation.

As presented in D3.3, three trainings for three defined target groups (TG) have been developed by the teams of the ROSEWOOD4.0 Central Western Europe (CWE) hub, namely:



MOOC 1: Digital support for efficient harvesting operations. Focus on data flow, Decision Support Systems (DSS) and resource efficiency in mechanized timber harvesting (FBZ)

MOOC 2: Digital Tools for Climate-adapred Reforestation. Focus on climate-stable forests considering economic, social and ecological aspects of reforestation (FBZ, CNPF)

MOOC 3: Managing Hardwood – Perspectives for New Forest Owners. Focus on basic knowledge and skills to integrate active forest management into the daily life of participants (HCS, FAST Pichl, FBZ)

*Fig. 1. TGs and MOOCs developed by the Forestry education Center North Rhine-Westphalia, Germany (FBZ), the Centre Régional de la Propriété Forestière de Nouvelle-Aquitaine, France (CNPF), the Wood Cluster Styria (HCS) and the Forestry Education Center Styria, Auistria (FAST Pichl)* 

In this deliverable, we will focus on the e-learning part of the full hybrid trainings (see Fig. 1), i.e. the content development for the MOOCs to

- highlight the steps leading to the production of the contents and the setup of the learning management system (LMS)
- discuss some experiences with these new methodologies and media, and
- present the structure of the LMS, and the content of the lectures in detail.



Fig. 2. Hybrid trainings and their sequence

## **1.1** E-learning and hybrid learning

E-learning refers to any form of electronically supported learning and varies concerning online e availability of the training (internet, intranet or installed software), degree of interactivity, flexibility and didactic methodology. The common feature of all e-learning is a multimedia approach with a combination of visual, audio and text elements integrated as multimedia course contents. A learning management system (LMS) is



needed. Hybrid learning combines e-learning with face-to-face teaching into one didactic concept. Previous research on the topic has shown that blended formats (using the terms blended and hybrid interchangeably) improve the learning effectiveness, increase accessibility and flexibility, and have greater cost-effectiveness (Graham and Dziuban, 2018).

In the ROSEWOOD4.0 project, blended learning was established during a kick-off workshop in January 2020 as a teaching format preferred by consortium members. This is in line with the project's evaluation of available e-learning formats in 2020, where vocational forestry education institutes reported mostly blended learning approaches.

#### The Learning Management System

A learning management system (LMS) is the basis for a flexible approach to learners, allowing them to work with multi-media course contents at their own time and pace, and to interact with each other and/or teachers. The LMS allows lecturers to develop online courses without specific previous ICT experience or programming skills but needs some adaptation to its administration and user management features. A variety of open-source LMS have been developed, among them ILIAS (Integrated Learning Information and Working Cooperation System) which was developed at the University of Cologne, Germany, and has been chosen for the implementation of the ROSEWOOD4.0 MOOCs.

In contrast to providing teaching content e.g. on a website, the LMS requires user management with a differentiated administration of user rights, courses and their accessibility, it presents a protected and specially organized area within the world wide web environment. A further signifying feature is communication among users or between teachers and learners (chats, forums, email). This means that the access to the LMS has to be managed, either through the registration of users by the administrator,by or offering a self-registration option for specific areas/contents. The content is basically organized in a hierarchical way where access can be restricted on any level, as well as for specific time windows. Even with *publicly available* self-registration, the protected access to the system is building a trustful environment and relation between users and its administrator or instructors.

When fully used, the LMS allows a structured and well-planned online interaction between learners and teachers which can even include carrying out online exams. The three MOOCs developed in the project however do not aim at students who may be requiring certification but at adult learners. The objective of the chosen TGs is rather to raise awareness for digital decision support and/or new ways of forest management. The developed MOOCs, therefore, offer short multimedia lectures which allow organizing one's own learning process but do not require knowledge tests from learners. Forums for exchange with experts or among participants are embedded. For the ROSEWOOD4.0 hybrid trainings, participants had been informed about the sequence of MOOC, webinar and on-site event in advance and tended to discuss questions at the webinar or the face-to-face meetings instead of online interaction. For future use, a higher level of online communication between learners and teachers could be applied if needed, as it is technically supported by the LMS.

"E-learning is getting more and more important, this also in forestry education, especially in the basics ". This statement from a 2015 overview of the most important forestry training programs in Europe and North America (<u>Urs Schroff and Andreas Bernasconi, FOEN, 2015</u>) can be confirmed by the consortiums' experiences during the project, especially as the complex and elaborate set-up of the LMS and its contents was fuelled by the COVID-19 pandemic. As the ROSEWOOD4.0 evaluation results have shown that only 11 from 85 total responses reported the use of a LMS, the project has indeed offered a valuable first step into working with a fully equipped content management system and sharing this experience among the ROSEWOOD4.0 regions.



## **1.2** Concept development for three online courses (MOOCs)

Producing online teaching materials requires teachers to adapt their teaching routines and preparation of content. As the teams assigned to the task in ROSEWOOD4.0 had abundant experience in face-to-face vocational and adult teaching but so far none with the development of online courses or LMS set-up, professional support from the ProLehre department of the Technical University of Munich (TUM) was secured. To envisage and design the necessary implementation steps, the "language" of e-learning had to be understood by everyone – this first step should not be underestimated. For the following joint development process, expectations therefore had to be matched repeatedly between the support team and the vocational trainers as the addressed TG's age group, professional environment and general digital experience had to be considered, differing significantly from a university background.

The following steps were observed to implement the online courses:

- 1. Define the main topics to be integrated into the courses (ROSEWOOD4.0 kick-off meeting January 2020)
- 2. Understand the target groups, the e-learning formats and their sequence (Central Western Europe CWE hub meeting September 2020)
- 3. Define the learning objectives in detail
- 4. Develop a storyline for an online course (MOOC), webinar and on-site training based on the learning objectives
- 5. Produce the video lectures and other information elements (text, visual) for course content and navigation
- 6. Set up the LMS and implement the courses, creating a recognizable course design
- 7. Manage and support users

Steps 1 to 4 have already been described in detail in D3.2 and summarized in D3.3, here we would like to share some reflections and insights about the team's encounter with online teaching.

#### Interrelation of TGs and e-learning format

When discussing the TGs, a joint understanding not only of their needs but also of the specific interrelation of awareness-raising and teaching in the frame of the ROSEWOOD4.0 project had to be developed. The objective of the ROSEWOOD4.0 MOOCs was to raise the interest of the forestry-related audiences in digitalization through information, i.e. to encourage the "learners" in using digital tools (esp. MOOCs 1 and 2). In this context, the team decided to produce trailers (three in total) to advertise the content of the lectures on websites and even within the MOOCs, thereby creating a vision that encourages users to dive deeper into the details. This is important, as the project's MOOCs are not a part of an obligatory schedule but have to attract adult learners. Even with the objective of raising awareness, it has advantages to place a MOOC into a LMS and not just into a YouTube channel. This was confirmed by participants: when compared to other contents which are openly available on the internet, the MOOCs within a LMS owned by a public institution elicit more trust in the provided contents.

#### How to develop a teaching strategy

As an example, we present here how the storyline for MOOC 1 (forestry contractors) was devedevelopeded on the general business case of a harvesting operation. To plan and structure the online course development, the following procedure was applied:

(1) The European transferable business case "Logistics chain along with the highly mechanized timber harvest" was structured in a process-oriented approach in application scenarios with respective process steps.

(2) For each process step, the respective work activities for execution were listed.



(3) The associated learning content was defined and subsequently rethought under the aspect of digitalization, trying to answer the following question: Which digital tools or media are available to increase efficiency and to better demonstrate the content in the various training activities? Following this, we present the digital optimization potential available for the execution of each working step/activity. The focus was on the availability of digital tools in the European area.

The topic of MOOC 1 was to present an overview of the possibilities of digitalization in the wood value chain. To present the timber harvesting chain with a focus on data flow and decisions support systems (DSS) in mechanized timber harvesting, the business case "harvesting operation" was divided into application scenarios and their respective processes. Through the definition of the necessary activities and the related teaching contents, the team arrived at the attribution of (available) digital tools and media (Fig. 3).



Fig. 3 Business case harvesting operation with application scenarios

This preparation step helped teachers to overcome the habit of thinking in the frame of 45-minute lectures. The fact that lectures provided in the MOOCs focus each on one aspect and have a short duration of 2 - 4 minutes was explicitly appreciated by course participants and is probably one of the most important recommendations for the development of online teaching materials.



#### 1.3 Production and implementation of the online teaching contents

Filming of the video lectures for MOOCs 1 and 2 and the three trailers was done at the FBZ in North Rhine-Westfalia (NRW), Germany. As already explained in D3.3, the teams from the CWE hub from France, Austria and Germany could not join for filming due to contact restrictions in the COVID-19 pandemic, which is why the experts from the State Enterprise Forest and Timber NRW took care of most of the lectures for MOOC 1 and 2, while MOOC 2 lectures were produced in Austria with experts from FAST Pichl and HCS.

Filming of operations in the field by the team of the TUM did not present problems for the trainers who were willing to turn into actors to demonstrate their usual practical teaching. Practical work and the related movements and processes come natural and the camera is easily forgotten. Filming lectures with the green



Fig. 4 The "Making of" – production of video lectures and trailers for MOOC 1

Outdoor filming aimed at creating diverse images combining details (e.g. inside the harvester cabin) with drone videos (to show damaged forest areas and highlight the dimension of calamities and the need for reforestation. Process planning detailing experts needed, required machines and forest areas, etc. allowed to perform filming for MOOC 1 and 2 at the FBZ in 4 days, using the forest schools Easter break in 2021.

After filming, initial video lectures in the German language were produced (TUM), and the uploading of the videos on YouTube automatic subtitles was retrieved, edited and translated. English translations of subtitles and presentations were then delivered to TUM to prepare the English version.

#### Set-up of the LMS

The basic setup of the LMS started already in August 2020. This presented a huge advantage since the FBZ team had to learn how to use the system and received trainings from the hosting provider to ensure the correct administration. Navigation structure, design and texts of the MOOCs were developed by the LMS administration at





the FBZ (in the case of MOOC 3 with support from HCS) and further adapted according to the consortium's decisions to provide MOOCs (or MOOC elements) in further translations.

From September to October 2021, the German versions of the MOOCs were made available and participants registered for the MOOCs according to the planning of the hybrid events (Fig. 2). In parallel, English versions were implemented and partners registered to allow for checking and/or adaptation of the contents. After this first phase of restricted access, the three MOOCs in English and German were publicly accessible via the projects' website from November 2021, providing the "General Trailer" as an eye-catcher in connection with the registration link. In December 2021, the structure was adapted to enable the consecutive implementation of translated versions of the MOOCs (Fig. 5).



## **1.4** Replication of the MOOCs in local languages

The consortium's motivation to translate the online trainings into local languages has been described in detail in D3.3. It should be pointed out that partners applied considerable efforts to make this additional result of the ROSEWOOD4.0 project possible: not only texts in the LMS and the video lectures' subtitles have been translated, but also *all presentations shown* in these lectures. As these presentations do often contain screenshots from forestry apps and sosoftwarefurther added value lies in making e.g. insights into the structure of a regional forestry information web portal available in other regions.

So far, 149 video lectures have been made available in translated versions (subtitles), and more than 100 of these videos have been reproduced with translated content. An overview is shown below:

Language	Торіс	МООС	Status
French	Reforestation, hardwood management	15 video lectures from MOOC 2 & 3	available
Spanish	Harvesting	18 video lectures from MOOC 1 & 3	available
Italian	Harvesting / reforestation	40 video lectures from MOOC 1 & 2	available
Portuguese Harvesting / reforestation		46 video lectures from MOOC 1, 2 & 3	MOOC 1 & 3 available
Croatian, Greek, Slovenian	Reforestation, transport	8 video lectures from MOOC 1, 2 & 3	available
Polish	Reforestation	32 video lectures from MOOC 2 & 3	available
Ukrainian Harvesting / reforestation		32 video lectures from MOOC 1 & 2	To be completed in June 2022
Romanian	Reforestation	12 video lectures from MOOC 2	available
Slovakian	Hardwood management	6 video lectures from MOOC 3	available

Table. 1 Overview on the translation of MOOCs into local languages

Reports of replication events carried out after D3.3 was submitted:

#### Northern Europe Hub

*Date:* 7<sup>th</sup> May 2022, Sweden (9-13h)

*Place:* Sweden: Södra Viken forest school, Sunne, at the "Södra Viken dagen"

Language: Swedish

*Participants*: Approx. 100 visitors at the stand (forest owners, foresters, forest owner association, forestry contractors, research, public administration, students)

*Summary:* In the spring of 1947, forestry education was started in Södra Viken by the Swedish Forestry Board in Värmland. As of July 2003, the school is run by Sunne municipality. Today, Södra Viken is an upper secondary school adapted for today's and tomorrow's students.



Södra Viken dagen (Södra Viken day) is once a year gathering a broad range of forest actors. This year on the 7th of May Rosewood4.0 and Paper Province had a stand showing project results, best practices and digitalization solutions. A PC was set up to discuss best practices and the MOOC with participants.

https://sodraviken.se/sodra-viken-dagen-7-maj-bilder/

#### Southwestern Europe Hub

Date: Tuesday, May 24t,h 2022, between 4:30 and 5:30 pm,

Place: Online, some participants met physically in Italy, in the main facilities of the University of Padua.

#### Language: English

*Expected no of participants:* 20-30 stakeholders of the South-West Hub from the forestry and wood industry value chains and in particular: students of the Forestry faculties at the involved Universities.

*Topic(s):* Presentation of the training courses and learning materials developed by ROSEWOOD4.0 to promote innovation in the EU forestry sector and to bring to different stakeholders all the tools to acquire new skills and help to consolidate the transformation of the wood value chain.

#### Summary:

Main objectives: In the framework of the south-west Hub of the Rosewood Network, it was expected to organize the official presentation of the training courses and learning materials developed by the ROSEWOOD4.0 project, with the aim to promote innovation in the EU forestry sector and to bring to different stakeholders all the tools to acquire new skills and help to consolidate the digital transformation of the wood value chain.

The workshop has been organized by AIEL (Italian Agroforestry Energy Association), in collaboration with Cesefor (Hub Manager), the rest of SWE Hub's members and, as external advisors, the University of Padua and CONAIBO (the Italian steering committee of forest enterprises).

This initiative was addressed to all the stakeholders of the South-West Hub from the forestry and wood industry value chains that, during the project lifetime, contribute someway to its implementation. In particular, the webinar has been dedicated to the students of the Forestry faculties in the involved Countries (Portugal, Spain, France and Italy) and Universities.

After the welcome to participants and introductions of the moderator, Mr. Andrea Argnani from AIEL, Riccardo Castellini from Cesefor presented a short overview of the ROSEWOOD4.0 project and its main results.

The first part of the webinar has been dedicated to some technical interventions from expert advisors: Stefano Grigolato from the University of Padua talked about the innovative contributions of research to the training of forestry operators. Then, Alberto Cadei from Conaibo, after introducing its entity, argued about the importance of training in the forest enterprises' qualification process.

The second and last webinar was conducted by Marie Charlotte Hoffmann from the Wald und Holz NRW. She presented in detail the ROSEWOOD4.0 MOOC Training Programme & the Learning management system "ILIAS", clarifying the terms to use the material and inviting the interested parties to spread the information and disseminate to invitation to join the program.

The meeting was fruitful and full of content. Live participation, both physical and online, was low (due to the overloaded period for everyone). The organizers, aware of this fact, recorded the event and then proceeded to upload the video to YouTube, to facilitate a targeted dissemination campaign, in order to reach a large number of potential users, in the various countries involved.



## 2. Reflection on the e-learning implementation process

The project has enabled the consortium to build a platform that contains 21 online courses in 13 languages. CWE hub teams from Austria, France and Germany have gained first-hand experience with creating digital content and working with a LMS. The sudden need for distance teaching at the beginning of the pandemic encouraged the experts involved in the project, but the efforts for the implementation of e-learning should not be underestimated, as it requires a fully equipped team providing "comprehensive experience of didactics, informatics, course content and project management" (Lewark, 2004).

If considering including online teaching in the didactic portfolio, institutions should be aware of the fact that it probably does not directly save time or money (<u>Lewark, 2004</u>). However, investments of both, time and money, maybe reduced if courses (or the LMS) are shared. As already discussed, sharing courses will always need adaptation – not only in terms of local languages but also of local curricula and content. Courses can be copied, adapted and integrated into another LMS, or the LMS itself could be shared to reduce the cost of maintenance and administration.

Experience gained through the project has shown that the function of a central administrator is needed, not only to perform central tasks like user management but also to ensure an institution-wide general structure and layout, and to advise teachers in using the system. Like this, the LMS can grow and with it the knowledge of the whole team which can be condensed and passed on by an administrator.

The cost, therefore, arises on the one hand as direct investment in technology and hosting of the LMS, on the other as time invested, either as a service or by personnel. The digital creativity and willingness of teachers will vary individually, a younger generation e.g. of YouTubers proves that content can be produced with low-cost means. Good ideas for visual demonstration and explanation are probably more important than an expensive camera. But the time needed for these tasks has to be recognized not only by the teachers themselves but also by the management.

In forestry, the mindset is often determined by operating instructions that have to be exactly observed. An expectation that there is one "right way" of e-learning may in this environment act as a barrier to creative experimenting and adapting – in close contact with learners. The experience with the project has shown that the LMS is flexible and technically easy to handle – after overcoming initial doubts, teachers can realize that tutoring is not difficult. But at the same time, it has to be acknowledged that online courses are not ready at some time and then done with once and for all. If online courses run for a longer period and aim at a measurable qualification, the effort for teachers gets considerably higher due to the need for individual communication and interaction with learners. The quality can be constantly improved and the initial efforts start to pay off.

The ROSEWOOD4.0 MOOCs were very well received by the participants of the first hybrid trainings in Germany and Austria – a good start to the journey into e-learning. As already mentioned in D3.3, the forestry education centers from Austria and Germany have teamed up for a new project application coordinated by HCS to further explore digital teaching. The LMS developed in the frame of the ROSEWOOD4.0 project has gained full recognition within the State Enterprise Forestry and Timber North Rhine-Westphalia and will be maintained and further expanded. The ROSEWOOD4.0 area of the LMS will therefore stay publicly available at: <a href="https://wald-und-holz-nrw.elearning.de/ilias/login.php?client\_id=waldundholznrw&lang=en">https://wald-und-holz-nrw.elearning.de/ilias/login.php?client\_id=waldundholznrw&lang=en</a>.



## 3. E-learning materials as provided in the Learning Management System

The following chapters contain all text elements of the MOOCs:

- structuring the content and supporting navigation
- spoken texts (video lectures and webinars)
- embedded questionnaires

### **3.1** ROSEWOOD4.0 – general text elements for all three MOOCs

#### I. Start page

**ROSEWOOD4.0** harnesses digital solutions and boosts knowledge transfer to connect multiple actors along the forest value chain to reinforce the sustainability of wood mobilization in Europe.

ROSEWOOD4.0 builds on the ROSEWOOD **network of regional hubs**, extending this well-established network both in geographical reach and the breadth of tools and solutions shared with stakeholders across Europe.

ROSEWOOD4.0 focuses on digitalization and **digital tools for knowledge transfer**, training, and coaching, enabling practitioners to share know-how with a much wider impact.

ROSEWOOD4.0 gives actors in the **wood mobilization** value chain increased opportunities for **sharing good practices** in the field and provides access to a wider range of technological and non-technological innovations.



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Fig. 6 ROSEWOOD4.0 Training Programme – General Trailer

The focus on **digital platforms** and **digital training solutions** addresses an identified gap, where the forestry sector lags in terms of adaptation and spreading of modern ICT solutions.

This contributes to two main challenges in wood mobilization in Europe, namely access to primary resources and transparency of the market.

Three concepts and teaching materials for blended learning have been developed addressing **three different target groups** 



- Forestry contractors, who are interested in the optimization potential of digital solutions for mechanized timber harvest
- Private forest owners who face the challenge of reforestation in times of changing climate conditions
- New forest owners, often female, who seek forest management strategies that are compatible with their daily life

The MOOCs (Massive Open Online Courses), recorded Webinars and Podcasts can be accessed below.



#### General text elements included in the MOOCs П.

In the Course Guide below you will find some information about the online course. The Forum offers opportunities to discuss with other participants and experts. Contact persons can be found under Team.



#### **Guidelines** (Text Course Guide)

To obtain maximum benefit, please do the tasks in the order in which they are presented.

In the "Forum", you have the opportunity to ask for clarifications, in case you have any questions related to the content covered in the lesson.

If you have any questions regarding the content of the course, please do not hesitate to contact or need technical support, please contact: m-ch.hoffmann@projektkompetenz.eu



Experts for Experts: Trainers and experts from the ROSEWOOD4.0-network

Self-paced: Progress at your own speed

Flexible: Learn wherever you want

Modular Trainings: Additional formats available to deepen your knowledge



**Forum** (*Text Forum*): Questions for the experts. If you have any questions for our experts or issues for discussion, please post them here.

#### III. Pre- and post-course surveys

Before you start the courses, please take a minute to answer a few questions!

As we launch the online courses and want to learn more about your expectations, your participation in this short survey is very much appreciated! / Thank you for taking part in the survey!

#### Pre-course survey

#### 1. Background

How is your relation to the topic of forestry and timber industry?

- Forest owner
- Forestry contractor
- Forestry management
- Forester / Forest technician
- Research / Education
- Student / Trainee
- Not specified

#### 2. Information channels

How did you come to choose this course?

- Employer
- Mailing invitation
- Website, internet search
- School / Training
- On the basis of a recommendation
- Other

3. Age group What age are you? 18-24 / 25-30 / 30-40 / >40

#### *4. Current level of knowledge*

How would you describe your current level of knowledge regarding digital solutions in forestry? \*

- Very good I am an expert in this field
- Good I am already fairly familiar with the topic
- Satisfactory I have some knowledge about the topic
- Unsatisfactory I am uncertain about the possible applications
- Not at all I know hardly any digital tools that would support me in my work
- Other

#### 5. Knowledge areas

In which area would you like to increase your knowledge?

- Silviculture, forest management
- Digital solutions in the forestry and timber sector
- Strategies for adaptation to climate change
- Timber harvesting methods
- Resource-saving and increase of efficiency in forest machines
- E-learning formats in forestry



• Other

#### 6. Perceived threats

In which area do you see the greatest problems for profit-oriented, sustainable forest management?

- Timber market/price level
- Increase in the proportion of hardwoods as a result of adaptation to climate change
- Extreme events
- Decreasing stand stability
- Lack of trained workforce
- Other

#### Post-course survey

You have completed the online course. Please take a few minutes and help us to improve the course by answering a few questions! / Thank you for taking part in the survey!

#### 1.a Rate MOOC 1 content – How would you rate the parts of the online course?

	Very good	Good	Satisfactory	Rather unsatisfactory	Poor assessment	Don't know
Part 1: Introduction, data standards &						
harvester calibration						
Part 2: Digital solutions for efficient harvesting						
operations						
Webinar: Fuel saving						

#### 1.b Rate MOOC 2 content – How would you rate the parts of the online course?

	Very good	Good	Satisfactory	Rather unsatisfactory	Poor assessment	Don't know
Module 1: Forest site factors and site maps						
Module 2: Forest site maps online – the web						
portal Forestinfo.nrw						
Module 3: Silvicultural concepts						
Module 4: Climate scenarios and silvicultural						
treatment strategies						
Module 5: Forest development and						
regeneration forms						
Module 6: Reforestation - overview						
Module 6: Reforestation - overview						
Module 7: Pioneer forest						
Module 8: Introduced tree species						
Module 9: Private forest owners and resilience						
to climate change						
Webinar						

#### 1.c Rate MOOC 3 content – How would you rate the parts of the online course?

	Very good	Good	Satisfactory	Rather unsatisfactory	Poor assessment	Don't know
MOOC videos (planting trees, tending, and						
caring, a Sunday walk in the forest)						
Webinar presentations (timber auction, value-						
adding timber characteristics, production of						
quality hardwood)						



#### 2. Course navigation

How did you find the navigation of the course? Please take the opportunity to add comments!

- It was easy for me to find my way around
- It took me a while to understand the structure
- I would like to have had additional instructions (please specify)

#### 3. Relevance

- Were the topics presented in the course relevant to your interests?
- Yes, very much so Yes, most of them Yes, some of them
- No, mostly not relevant
- No, not at all relevant

#### 4. Role of e-learning

With which of the following statements do you agree? (Multiple answers possible)

- Online courses are very useful, especially in combination with practical on-site trainings. For some topics, online courses can also be useful as stand-alone offer.
- In forestry, all trainings should be practical online courses do not fit the purpose.
- Don't know

#### 5. Importance of digitalization in forestry

The Rosewood 4.0 project is concerned with digitalization in forestry. In your view, how important is digitalization in the forestry sector today and in the future?

- Very important
- Important
- Fairly important
- Slightly important
- Not important
- Don't know

#### 6. Additional comments

Do you have any additional comments or recommendations? What did you like or not like about the course?



## **3.2** MOOC 1: Digital Support for Efficient Harvesting Operations

The MOOC on Digital Support for Efficient Harvesting Operations aims to highlight the optimization potential of available digital solutions in the timber value chain with a focus on data flow and decision support systems.

Participants will learn more about the benefits of using digital tools and processes with regard to

- Organization of the entire timber harvest chain from planning to timber sales
- Data standards and interfaces, data flow
- Planning, preparation, and execution of the harvesting operation
- Timber measurement
- Transport navigation
- Fuel saving (Webinar)

As the online course is combined with an on-site event in North-Rhine Westphalia, Germany, and focuses on practical implementation, some of the presented digital tools and systems may be currently available only in Germany, However, they serve as examples of comparable solutions that are available in other countries or languages. For an overview of forestry apps, softwares and systems, please have a look at the repository at the end of the course.

Before we get started, please watch our trailer so you can get a better overview of the materials covered in the MOOC.



Fig. 7 MOOC 1 – Trailer

The course offers different learning formats which are available here on the platform



**Target group**: Forestry contractors and foresters, and a wider audience interested in available digital solutions or digital learning formats.

MOOC Welcome to the MOOC!



In the 10 lectures presented below, we start in the first part with an introduction to the practical benefits of using digital solutions in each step of timber harvest. We continue with the importance of international and national data standards and interfaces, and harvester calibration. In the second part, we present selected digital solutions for process optimization.

As some of these digital tools are available only in German, we have included additional information on the context (please click the green icons). After lectures, you will find further information sources.

#### **FIRST PART**

- 1. Introduction use of digital solutions in each step of timber harvest, from offer placement to sawmill
- 2. Data standards and interfaces short overview
- 3. Harvester control measurement and calibration
- 4. The German standard ELDATsmart

**Introduction:** For each step of the timber harvest, digital solutions are available which simplify information exchange, planning and documentation. In this dialogue between forest owner and contractor, we address the gain in efficiency through digitalization in harvesting operations - from order placement to down payment.

**Chapter 1:** In the first chapter, we talk about data standards and their role in the planning and execution of a mechanized timber harvesting operation. The importance of the international standard StanForD is explained, and we look at different data sets and their contents.

**Chapter 2:** Why is the regular calibration of the harvester measuring system necessary? You will get some information on control measurements and on adjusting the measuring system. Further information on harvester measurement is provided in the Skogforsk Guideline.

**Chapter 3:** Interfaces can interrupt the data flow and therefore the communication between different actors in the wood value chain. In this video, Olaf Müller explains why data standards are needed to bridge these interfaces, and how they optimize and simplify the information flow.



#### SECOND PART

- 1. How can the web portal Forestinfo.NRW help with preparing a harvesting operation?
- 2. From smartphone to the harvester the LogBuch app
- 3. Harvester control and information systems: TimberMaps and TimberManager
- 4. Photo-optical measurement of timber stacks the example of FOVEA
- 5. Control measurement with the crane scale
- 6. Timber transport truck navigation with NavLog

**Chapter 1:** In this chapter, we address the web portal Forestinfo.NRW, and where operators can find helpful information and site maps of the stand. The portal is available only in German and only in North Rhine-Westphalia, but the lecture may indicate how public online information can provide practical decision support. For more information, please click the icon below.







**Chapter 2:** From smartphone to harvester - LogBuch allows mapping of trees and specific site conditions with a smartphone in the forest and data can be sent directly to the harvester. More information on similar apps is given below and in the registry at the end of the lectures.

**Chapter 3:** Harvester manufacturers provide built-in control and information systems that include new digital tools to support the machine operator. Here, Robert Lehde explains the advantages of decision support using the example of TimberMaps and TimberManager. For more information, please click below or on the apps & software repository after the videos.

**Chapter 4:** How does photo-optical measurement of timber stacks with FOVEA work in practice? What conditions have to be considered, and what can be expected for the future? These questions are addressed in the current chapter, for more info on comparable solutions please click below or on the repository at the end.

**Chapter 5:** An alternative for the control measurement of timber in the forest is weighing the logs with the scale of the forwarder crane. Robert explains how the data is collected in the on-board computer and integrated into the display of the stack on the map.

**Chapter 6:** In the last chapter, we move from control measurement to the transport of the logs to the sawmill. In Germany, the national program for forest road navigation is NavLog. While the lecture provides practical information on the benefits for the users, you will find broader information on the features and development of NavLog below.









#### FURTHER INFORMATION SOURCES

#### Forestry apps and softwares repository (only available in the LMS)

The repository has been translated from the list of forestry apps, software, systems and services compiled by the Lower Saxony Chamber of Agriculture as part of the <u>GeProOptHolz</u> project. Please find the link to the original list (in German), which is continuously updated, <u>here</u>. Another valuable resource is the <u>ROSEWOOD4.0 best Practice database</u>.

#### Webinar

#### Webinar: Fuel Saving in Mechanized Timber Harvest

The aim of the webinar is to provide participants with tips on how to use machinery as efficiently as possible while conserving resources. Important aspects are highlighted and concrete approaches to diesel saving are developed on the basis of concrete examples.

#### Podcast

#### Podcast: Data flow in mechanized timber harvesting

- Episode 1: Development of StandForD
- Episode 2: File types used in StanForD 2010

You have completed the online course. Please take a few minutes and help us to improve the course by answering a few questions!



#### ADDITIONAL TEXT ELEMENTS MOOC 1

#### **StanForD**



#### What is it?

StanForD is a standard for communication between computers in forest machines (**Stan**dard for **For**est machine **D**ata and Communication). Today, StanForD is used in many countries and is accepted as a standard even though it does not have an official status. The standard applies to all types of data communications with forest machines.



#### Who offers solutions?

Skogforsk, the Forestry Research Institute of Sweden, is responsible for the development and Metsäteho (Finland) maintenance of the standard. Forest machine manufacturers and Swedish forest enterprises support the development financially and attend the StanForD meetings. Before these meetings, the individual countries usually hold their own meetings to discuss possible developments that could be put to the StanForD meeting. If new variables are needed, anyone may propose them by getting in touch with the secretary. New elements are considered at the meetings and, after approval, added to the schemas.



#### What is the benefit?

Forest machines (harvesters, forwarders, feller-bunchers, yarders, skidders etc.) produce a lot of data that can be used for control, reporting and monitoring/follow-up of logging production. The data standard ensures the interoperability and the exchange of the data between different machines and their computers. The new StanForD 2010 is simplified and better structured and uses an open interface (xml) which makes it easier to implement the standard in new applications.



#### Outlook and European perspective

StanForD has its role well beyond Europe as the generally accepted standard. Its open maintenance and development process as well as the open interface ensure that it supports innovation and new business scenarios.

Sources: <a href="https://www.skogforsk.se/english/projects/stanford/">https://www.skogforsk.se/english/projects/stanford/</a>

## **Harvester calibration**



#### What is it?

In Germany, the harvester operator is required to keep a calibration report on a daily basis to maintain dimensional accuracy. A control measurement is carried out to verify the accuracy of the measuring data collected by the harvester head unit during the processing of a log. The control measurement is a regular check of the harvester's measuring equipment on the basis of a random sample of logs. Comparison with manual measurement of the sample, if done correctly, helps to detect dimensional deviations. After control measurement, the measuring system of the harvester has to be adjusted if necessary.



#### Who offers solutions?

What is the benefit?

Control measurements are done manually following a defined procedure. There is an excellent free manual available from Skogforsk.se which you can download <u>on their website</u>. The manufacturer's manual of the on-board computer system provides information on the adjustment of settings.

Harvester calibration is a prerequisite for accurate assortments according to customer requirements.



## It is the basis for exact volume calculation and compliance with minimum requirements. In addition,



it helps to achieve optimum value through the processing of the logs and to form the basis for further dispositions of the timber data. Correct machine settings (pressure for delimbing knives and feed rollers) do not only improve measurements but also the operation workflow (less need for reverse and restart of the harvester head). And last but not least, ensuring correct harvester calibration helps to create mutual trust so the harvester measurement can be used as a sales or control measurement.



#### Outlook and European perspective

Forestry harvesters were developed mainly in Sweden and Finland and are the main system applied today in Scandinavia. A case study on four Eastern European countries shows that mechanized cut-to-length harvesting systems are only beginning to be introduced in some countries. In Germany, about 50% of the timber is felled using highly mechanized systems with a tendency to increase, while the share of logging with harvesters in Austria is even less, 17% in 2016.

In Germany, where harvesters are used more and more in recent years, the harvester data still are not used in the wood logistics chain as much as technologically possible. This is due to several factors, such as e.g. unclear ownership of the data across the actors of the value chain.

Correct calibration praxis is a prerequisite to use the full optimization potential of these data – and it is good to be prepared for the future.

#### Sources:

Integration of Harvester Production Data in German Wood Supply Chains: Legal, Social and Economic Requirements. Hartsch et al., Forests, 2021 Market information logging, Austria Challenges in Forestry and Forest Engineering – Case Studies from Four Countries in East Europe. Mederski et al., Croatian Journal of Forest Engineering, 2021

## **Data Standards & Interfaces**



#### What is it?

Data standards ensure that data can be understood by different systems which can then work together (interoperability). Technical interoperability means that the two systems can write and read the exchanged data. But standards also make sure that the two systems understand/ interpret the data in the same way (semantic interoperability). The data standards for forestry published in recent years all aim to optimize communication along the wood supply chain.



#### Who offers solutions?

Different national and international data standards are used in Europe. National standards, for example ELDATsmart or FHPdat for the exchange of data in the logistics chains of Germany and Austria, and international data standards, such as papiNET for the logistics of the European paper industry. The most important international standard in the preparation and execution of a timber harvesting operation is certainly StandForD. StandForD is an



Fig. 8 Data standards – adapted from:

Standpunkt\_Datenstandards\_Wald\_Holz40\_v1.0.pdf (source see below)

abbreviation for "standard for forest machine data and communication".





#### What is the benefit?

Without the interoperability ensured by open data standards, interfaces between actors or operating systems along the value chain will be barriers that make the transfer of information difficult. The more actors and processes use the same standard, the more efficient is the collaboration.



#### Outlook and European perspective

"When developing (new) software products, attention should be paid to compatibility with standards. Existing standards should also be checked for practical usability and adapted if necessary. In an increasingly globalized business world, standards should also be internationally oriented. A higher-level integration forms the basis for linking the existing standards along the value chains. This makes it possible to map the entire life cycle of a tree, from its origin to its harvest, logistics and use, using data standards."

Sources: www.kwh40.de/wp-content/uploads/2020/03/Standpunkt Datenstandards Wald Holz40 v1.0.pdf

## Web portal Forestinfo.NRW



#### What is it?

<u>Waldinfo.NRW</u> (Forestinfo) is a North Rhine-Westphalian web portal providing interactive maps on many aspects of forests. Forest ecology and management, forest nature conservation, recreational use, damage events, hazard prevention and other topics can be selected to search for specific information (forest types, functions, management, and use, as well as climate change impacts on forest management). Relevant climate variables such as soil, atmosphere (air temperature, precipitation) or land surface (photosynthetic activity, land cover, biomass, forest fire, soil moisture) are integrated. The service includes site-specific recommendations of appropriate tree species and mixed stands for different soil and climate conditions. As a comprehensive forest information system for the timber and forestry sector, the portal is aimed in particular at private forest owners and forest-owning municipalities and supports a wide range of evaluations and forestry planning.



#### Who offers solutions?

Waldinfo.NRW was introduced in 2018 and is the first web portal in Germany with this range of interactive site-specific services and forest information. It is part of the climate adaptation strategy for forests in NRW and integrates databases of the state enterprise Wald und Holz NRW, the State Agency for Nature, Environment and Consumer Protection and the NRW Geological Service.

All German states have so-called "", but Waldinfo. NRW is the first example of the added value achieved by the long-standing cooperation of the officials responsible for cadastral maps, for geological data and forestry.



#### What is the benefit?

The map-based decision support tool is an important part of the climate adaptation strategy of North Rhine-Westphalia. It offers selected information

to forest owners which is relevant to their area - also available in the field as a mobile app. Updates and continuous development ensure that the web portal offers the latest advice and information at any time. The next version will also strive to improve the usability by guided click navigation to make it easier for forest owners to find individually relevant information.



#### Outlook and European perspective



Forestinfo.NRW (Waldinfo.NRW) is a regional solution based on regionally available data. With its combination of map-based information and forest management recommendations, the web portal has served as a best practice example and has been discussed between partner countries. The ROSEWOOD4.0 MOOC on digitally supported reforestation offers more detailed information about the catalogue of maps and functions included.

## From smartphone to harvester



#### What is it?

LogBuch enables data aggregation in the forest, a simple evaluation of the data and further processing. The combination of voice recording and Bluetooth button enables the hands-free precise location of trees with simultaneous recording of important information about the tree, such as safety instructions or planning working procedures. The expected cut volume can be determined, and assortments planned. Foresters and harvester operators both receive detailed information (cross-linking with third-party systems is supported). Technology: An A 2-frequency GNSS-receiver is connected to a smartphone to estimate the current position. A Bluetooth button is used for language analysis. All spoken information can be recorded, automatically transcribed, and classified, and the actual position lodged. WLAN is used for data exchange between smartphones, web servers and other users. Data can be exported as a map or table in georeferenced or not referenced formats (xlsx, GeoJson, shp, GPX, map).



#### Who offers solutions?

Comparable solutions are offered by TRESTIMA (Finland, in English – no voice recording, but included measuring system), or MOTI (Switzerland, German), or Forest Metrix Pro (USA, English). For a better overview, please also check with the searchable repository of forestry softwares and apps at the end of the lectures (source: Chamber of Agriculture of Lower Saxony).



#### What is the benefit?

Preparation of timber harvesting, the establishment of a digital "inventory", area mapping (also planting) by connecting recorded corner points, mapping of skid trails by the line function (harvest control or certification basis), and remote navigation via Google Maps. In addition, recording of habitat trees, etc., support for hunting organization (high seats, driven hunt stands, stalking routes, etc.) and traffic safety measures. Voice recording is a special feature of LogBuch which simplifies the practical handling.



#### Outlook and European perspective

Smartphone apps to support forest inventories are an emerging market that is expected to grow with the increasing digitalization of the forestry sector.

Sources: <u>http://www.moti.ch/</u> <u>https://www.trestima.com/w/en/forest-inventory-system/</u> <u>https://logbuch.xyz/forst.html</u>

## **Harvester control and information systems**



#### What is it?

Many harvester manufacturers provide built-in control and information systems that include new digital tools to support the machine operator.



Integrated maps allow the visualization of important information about the area, specific conditions (wet soil, obstacles, slope) and production data. On the map in the display of the on-board computer, they can see not only the routes of the harvester, but also which timber assortments are stored in which quantity in which skidding lane. With this information, they can plan their routes better than before. The data is provided by the harvester, which feeds its production data into the program and determines the GPS positions of all sections. The data is updated in real-time via a cloud service from John Deere, which can be accessed by all drivers at a harvesting site.

The drivers can mark on the map which logs they have already cut. Wet sections or other obstacles can also be displayed to simplify the forwarders' route planning.



#### Who offers solutions?

The solution TimberMatic Maps presented in the video is available in John Deere harvesters, other comparable solutions are offered by Komatsu (Sweden) – launched in 2019, or Ponsse (Finland).



#### What is the benefit?

The benefit of all built-in information systems is that they help to make working in the forest more efficient, safe, and precise. They do not replace the decisions of the machine operators but support them by providing tools to plan and monitor logging operations. Harvester and forwarder driver can coordinate their work efficiently. Ponsse and Komatsu Forest expect an overall time-saving in backlogging, which Komatsu Forest puts at around 10 to 15%. The included detailed area maps enhance work safety and sustainability (proximity alarms for power lines or biotopes) and reduce the carbon footprint and fuel consumption through efficient planning of driveways.

Data for efficient transport of the stacked timber are provided and coordinated with the office management software (Timber Manager).



#### Outlook and European perspective

Creating and using digital planning and monitoring tolls in logging operations is an important step towards precision forestry with the potential to enhance efficiency and sustainability at the same time. Current research is analyzing the application of AI and machine learning to improve the processes and data flows (e.g., predicting the trafficability of soils). Comparison of machine and forest inventory data can help to develop new procedures to save fuel while keeping the working speed.

Sources:

<u>https://www.agriexpo.online/agricultural-manufacturer/forestry-harvester-6122.html</u> https://www.deere.com/sub-saharan/en/forestry/timbermatic-manager/

https://www.ponsse.com/products/information-systems/product/-/p/harvester\_systems#/

https://www.komatsuforest.com/media/newsroom/komatsu-forest-launches-maxivision

Using the harvester on-board computer capability to move towards precision forestry. Olivera and Visser, New Zealand Journal of Forestry, 2016

Towards dynamic forest trafficability prediction using open spatial data, hydrological modeling, and sensor technology. Salmivaara et al., Forestry 2020

## **Photo-optical measurement – example Fovea**



#### What is it?

Roundwood measurement in the forest serves as a control for the mill measurement. Sorting and measuring roundwood is a matter of trust. In the European Economic Community, the marketing of felled timber was regulated with a directive (68/89) that defined national in Germany and other



member states. When the directive expired, voluntary agreements of the wood and forest sector were established on a national level (RVR, Swedish wood measurement Act, Öhu, etc.) that define sorting and measuring procedures. In the current version of the framework agreement for roundwood trade in Germany (July 2020), electronic measurements taken in the forest (single roundwood stems or piled stacks) are still not accepted. The reason is that most electronic measuring devices for application in the forest can up to now not meet legal calibration requirements.



#### Who offers solutions?

In Europe, several mobile solutions for smartphones and tablets are available: AfoRS (DE), Fovea (DE), HD Silva (DK), Logsize (BE), Timbeter (FI), and Trestima Stack (FI), sScale (DK) is a car top solution.



#### What is the benefit?

Electronic measurement is easy, less time-consuming and provides digital data that are available for planning and organizing the wood logistics chain.



#### Outlook and European perspective

Studies show that measurements are principally reliable and consistent, especially when compared to manual measurements by different persons. Against exact immersion measurements, manual and photo-optical measuring both show deviations, measured volumes tend to be too high with the photo-optical and too low with the manual measuring procedure, and log stack quality and size affect estimation accuracy.

Measuring the accuracy of photo-optical measuring devices is currently being studied. *Sources:* 

Estimating the accuracy and time consumption of a mobile machine vision application in measuring timber stacks. Kärhä et al., Computers and Electronics in Agriculture, 2019

Reliability of photo-optical measurements of log stack gross volume. Berendt et al, Silva Fennica 2021

## **Timber transport navigation – example NavLog**



#### What is it?

NavLog is a routable data set that classifies forest roads throughout Germany for use by timber transport vehicles. It builds upon a qualified data set of forest roads that has been first assessed by NavLog GmbH with local experts in 2009, complemented by topographical maps, aerial views, and road maps, and is continuously maintained.



#### Who owns it?

The German Forestry Council (DFWR) and German Timber Industry Council (DHWR) are both (with their organizations) shareholders of NavLog GmbH, thereby safeguarding the interests of all stakeholders. Several German states have acquired state licenses for NavLog which means that private or municipal forest owners or small and medium-sized enterprises in these states can use NavLog free of charge.

Other clients have to pay a three-year fee based on their annual turnover in solid cubic meters. The fee is reduced for partners, e.g., forestry communities).

NavLog works with several IT partners, who offer different apps (e.g., for android tablets and smartphones) for different sectors, as forest road data are also important for rescue operations, disaster response and e.g., management of energy supply disruptions.



What is the benefit?



The NavLog WebGIS (Java) NavLog WebGIS can be used to visualize forest road data as well as background maps, such as topographic maps and aerial photographs. Transport maps can be created, printed, and e-mailed.

The NavLog WMS (WebMapService) integrates NavLog data into existing GIS applications (forest information systems of different providers)

The data show:

- Standard and other truck routes, other routes
- Restricting bearing capacity of the soil, slopes, bridges, passages, or turning possibilities



#### Outlook and European perspective

In 2014, testing and discussion of the Navlog navigation data with experts from Austria and France have not led to a joint cross-border solution. Up to now, forest road navigation ends at country borders. This may not often disturb forestry operations, as forest ownership will follow national borders. But for other, important, and potentially life-saving uses of these data, such as for rescue, wood fire, or breakage of power lines a cross-border solution is crucial. On the European level, only local cross-border solutions are currently developed.

Sources:

<u>https://navlog.info</u><u>https://navlog.info/images/pdf/NavLog\_Nutzungsm%C3%B6glichkeiten\_BOS.pdf</u> <u>http://simwood.efi.int/uploads/Publications/SIMWOOD\_handbook\_2017.pdf</u> <u>https://www.newfor.net/wp-content/uploads/2015/02/DL24-Logistic-methodology.pdf</u>



## **3.3** MOOC 2: Digital Tools for Climate-adapted Reforestation

Climate change with its drastic effects in recent years presents us with great challenges - storms, drought and beetle infestation have damaged many forest areas. Forest owners or those responsible for forest management have to adapt their stands to changing conditions at their forest sites. When reforesting towards the generational goal of "climate-stable mixed forests", they will face many questions.

The ROSEWOOD4.0 teams aim to provide support with information on how to choose suitable tree species, and some principles of climate-adapted stand development and maintenance. The potential benefits of digital support through public information web portals are addressed using the regional example of Forestinfo.NRW (original website available only in German).

We hope to encourage you to see the challenges of reforestation also as a chance - forest protection is climate protection!

Before we get started, please watch our trailer so you can get a better overview of the materials covered in this MOOC.



Fig. 9 MOOC 2 – Trailer

The course offers different learning formats which are available here on the platform.



**Target groups**: Private forest owners and forest managers, forest owner associations, and anyone interested in online learning

#### MOOC Welcome to the MOOC!

The 9 modules presented below contain 26 short video lectures on silvicultural adaptation to changing climate conditions. Special topics support forest owners through map-based online information, forest development types and recommendations for introduced tree species, as well as recommendations for private forest owners faced with climate change.



#### MODULE 1: FOREST SITE FACTORS AND SITE MAPS

In this module, we are discussing how to better understand the growing conditions of a forest site. After a brief overview of the most important site factors, Heiner Heile looks into some more detail about precipitation, temperature and soil types. The maps available in NRW are briefly explained and looked at in more detail using a practical example.

- *Chapter 1-1:* Forest site factors and site types
- *Chapter 1-2:* Site-specific precipitation totals
- Chapter 1-3: Soil types
- *Chapter 1-4:* Map systems describing site factors
- *Chapter 1-5:* Practical example of a site map in the Arnsberg forest



#### MODULE 2: FOREST SITE MAPS ONLINE –THE WEB PORTAL FORESTINFO.NRW

After the brief introduction to site factors and available map systems, the second module provides a deeper insight into the Forestinfo.NRW internet portal. The use of the interactive platform is presented as an example. Planning of a forest area with support from the web portal is highlighted.

- *Chapter 2-1:* Forestinfo.NRW (Waldinfo.NRW)
- Chapter 2-2:Presentation of specific functions of<br/>Forestinfo.NRWChapter 2-3:Forestinfo.NRW: Summary and outlook





#### MODULE 3: SILVICULTURAL CONCEPTS

In the third part of the course, the silvicultural concept of NRW is briefly introduced. In particular, it is explained how important it is to describe the so-called forest development types on the basis of the site types prevailing in NRW. The forest development types recommended for each site are available in Forestinfo.NRW and are a valuable aid for forest owners to make their forests more resilient to the consequences of climate change.

- Chapter 3-1: Presentation of the silviculture concept for NRW
- *Chapter 3-2:* Site factors and forest development types



#### MODULE 4: CLIMATE SCENARIOS AND SILVICULTURAL TREATMENT STRATEGIES

In this module, weather extremes and calamities are presented as consequences of climate change and the possible climate scenarios are explained. Based on the assessment of future climate scenarios, the

importance of silvicultural treatment strategies for the future of forests is clarified. Possible adaptation measures are then discussed in more detail in the next chapter.

Chapter 4-1:Climate scenarios and silvicultural<br/>treatment strategiesFurtherForest damage after hurricane FriederikeDemonstration:Bark beetle calamityDemonstration:Drought stressDemonstration:Climate scenarios and silvicultural<br/>treatment strategies



#### MODULE 5: FOREST DEVELOPMENT AND REGENERATION FORMS

Climate change and adapted reforestation are the topics of the fifth part of the course. Building on an understanding of the forest development phases, you will learn more about how to work with different forms of regeneration. How to minimize the silvicultural risks in climate change by paying attention to the site potential in your area and mixing tree species appropriately is the concluding message of this module.

- *Chapter 5-1:* Forest development phases
- Chapter 5-2: Reforestation with different forms of regeneration
   Chapter 5-3: Experiences with an admixture of foreign tree species
   Chapter 5-4: The silvicultural concept NRW



#### MODULE 6: REFORESTATION - OVERVIEW

The sixth module of the course concerns the practical implementation of a reforestation measure. Legal and operational framework conditions and funding opportunities are briefly explained. Practical implementation of reforestation and how to assess and observe important principles is the topic of the second video.

Chapter 6-1:General conditions of a reforestation<br/>measureChapter 6-2:Practical implementation of a<br/>reforestation measure



#### MODULE 7: PIONEER FOREST - AN ECONOMICALLY INTERESTING REFORESTATION APPROACH

In the seventh module, Norbert Tennhoff would like to make you aware of the immense advantages of reforestation with pioneer forests. Why is pioneer forest interesting from a silvicultural point of view, what does stand maintenance and later wood use look like - from planting to options for wood processing, concrete practical recommendations are conveyed here.

*Chapter 7-1:* Reforestation with pioneer forest

*Chapter 7-2:* Stand maintenance





- *Chapter 7-3:* Tasks and functions of the pioneer forest
- *Chapter 7-4:* Pioneer forest conclusion

#### MODULE 8: INTRODUCED TREE SPECIES

In this module, you will find an overview of introduced tree species. Portraits of the most important introduced broadleaved and coniferous tree species, from site requirements and preferred mixtures to wood utilization, will help you to make a suitable choice based on the site factors that apply to your area.

- *Chapter 8-1:* Introduced deciduous tree species
- Chapter 8-2: Introduced coniferous species
- *Chapter 8-3:* Conclusion





#### MODULE 9: PRIVATE FOREST OWNERS AND RESILIENCE TO CLIMATE CHANGE

In the last two chapters, Henri Husson, Deputy Director of the Regional Department Nouvelle Aquitaine of the French private forest owners' association Centre national de la proprieté forestière (CNPF), will present you with possible developments in climate change and corresponding approaches to solutions. Can reforestation measures that have become necessary due to climate-related damage also be seen as an opportunity?

- *Chapter 9-1:* Private forest ownership in climate change
- *Chapter 9-2:* Climate change as a chance?
- *Chapter 9-3:* Voices from Austria, Germany, France and Switzerland – the impact of climate change on Central European forests and forestry



#### Webinar

#### Webinar

The webinar included below has been recorded at the FBZ on September 14th, 2021. After the on-site event 2 weeks before, participants had been asked to provide questions concerning their own forest operations. Based on these inputs the webinar was held around the topic: "Selected native and introduced foreign tree species and their specific use, strengths and weaknesses and treatment of plants to secure the plantation".

#### Podcast

Podcast

How to use apps for assessing climate vulnerability and which species to plant": the French example of BioClimsol. Please check also the YouTube video on BioClimsol (in French).



### **3.4** MOOC 3: Managing Hardwood – Perspectives for New Forest Owners

This MOOC is understood as a "starter kit" on hardwoods management for new types of forest owners, with a special focus on female new forest owners and their experiences.

Challenge: The transformation of single-tree dominated stands, e.g. spruce stands, into mixed stands of coniferous and deciduous trees. Introducing hardwoods in managed forests may significantly contribute to stand stability, biodiversity and carbon sequestrations in the light of climate change. However, a rapid transformation of private-owned forests requires also economic incentives in addition to environmental arguments for sound decision-making on future stand compositions.

Participants will learn to speak the "language of hardwoods" by gaining practical knowledge of silvicultural essentials and a sound understanding of hardwood marketing. By the end of the course, you will

- Know the hardwood market and the basics of hardwood quality requirements
- Understand the impact of silvicultural measures on hardwood quality
- Apply silvicultural measures for growing high-quality timber
- Apply hands-on examples for introducing hardwoods in existing stands dominated by coniferous trees
- Get guidelines for low-level silvicultural measures from planting to pruning and tending of hardwoods

The information on hardwoods provided and silvicultural measures presented in the learning material is based on Austrian forest practices and stand conditions. Although the learning material may not be 100% applicable to forest ecosystems in other European countries, it definitely serves as a good knowledge base and blueprints to carve your own course on hardwood management.

The course offers different learning formats which are available here on the platform.



**Target group**: The MOOC addresses new types of forest owners, and, in particular, female forest owners with little to no knowledge of forest management, but who actively strive for the establishment of climate change adapted forests. The course pays special attention to the structural and demographic change in forest ownership and provides basic knowledge and skills to integrate active forest management into the daily life of course participants.

The new type of forest owners typically

- works outside the forest or agriculture sector,
- lives and/or works in urbanized areas
- is detached from forest practices and silvicultural knowledge
- has emotional ties and interest in doing something good to their forest plot

#### MOOC Welcome to the MOOC!

The videos and the podcast below catch the perspective of Kathrin van Zeist, a young forest owner in Styria who has inherited a forest from her grandmother and has taken this opportunity to give her life a new direction. Today, Kathrin is working as a trainer at the Forestry Education Institute in Pichl, Styria (Austria) and has received her certificate as a master forestry technician.



The **training videos** below deal with the following topics

- 1 Planting Trees: Set container trees in cell bond with a cross hoe.
- 2 Tending and caring: Protect and care for young trees
- 3 A Sunday walk in the forest: Topiary and future maintenance measures

#### 1 - Planting trees

Hands-on information on planting hardwood trees for new types of forest owners with no to low knowledge of forest management.

#### 2 - Tending and caring

Hands-on information on how to take care of seedlings during the first ten years.

#### 3 - A Sunday walk in the forest

During one of her typical forest walks, Kathrin van Zeist gives practical tips for simple forest management measures like effective tree protection, cutting future trees free and doing first pruning and cultivation activities.



## Podcast: Planting, stand maintenance and shape cutting + personal challenges from the point

of view of Kathrin van Zeist

#### Webinar

#### Webinar Presentations

Part 1: Timber auction

- Part 2: Value adding timber characteristics
- Part 3: Production of quality hardwood

#### Speakers (top to bottom)

- Maximilian Handlos (Moderator), Forest Owner Association Styria
- Josef Krogger, Chamber of Agriculture Styria
- Bernd Poinsitt, Forest Owner Association Styria
- Andreas Hofer, Forest Owner Association Styria
- Background Team (processing questions)
- Andreas Gaugl, Forest Education Center Styria FAST Pichl
- Gebhard Paul, Forest Owner Association Styria



## **3.5** MOOC 1 – Spoken Text (video lectures and webinar)

#### 3.5.1.TRAILER

In the age of digitalization, it is important and makes sense to use new and innovative tools to optimize work processes. Throughout the entire wood supply chain, information is passed on partly in analogue and partly in digital form. Within the individual process steps, this information flow repeatedly comes to a standstill. These interruptions must be reduced.

Here we offer companies in various training formats such as MOOCs, webinars, podcasts, and face-to-face events to help them expand their competencies with a view to the future. With modern requirements for user-oriented training, forestry companies and foresters are provided with technical and scientific knowledge about the optimization potentials of highly mechanized timber harvesting.

#### 3.5.2.Introduction

#### - Use of digital solutions in each step of timber harvest, from offer placement to sawmill

Hello, good day! I can inform you that I have decided to accept your offer and place the order with you. You can find more information for planning your harvesting operation on the internet portal Forestinfo.NRW. The address of the responsible forester is also stored there, and she was so kind and just provided me with the data of the signed trees with LogBook, and I could make this geodata available to you in the cloud if you like. That's nice of you, it really makes my work a lot easier. In preparation for my work, it would help if you could send me the assortments you want me to cut so that I can then pass the paper on to my harvester driver. I'll email you the stock list of my sawmill for the ATP files today, preferably directly on the machine. Thank God they all have StanForD these days. Yes, well, don't worry about that, my harvester driver will get it right with the cutting lengths. Trust is good, but control is better. I would ask you to print out the calibration records of your machine and send them to me. I would like to make a small request: even if we use the factory measurement for the final invoice, it would be good if I could get an advance payment beforehand, as the final invoice with the sawmill takes quite a long time and I have my costs to consider. We can talk about that if the work is of good quality, after all I have a reputation to lose, and my forest is PFC certified. I assume that your forwarder has modern software for route optimization. In this respect, it will save my forest soil and your wallet. For the down payment, we can take the measurement from my harvester. Even if your harvester delivers good data, it would be good to have an additional forest control measurement. That way we can both be on the safe side in case of possible timber theft or difficulties with timber transport. And on the basis of this forest measure, I could also make an advance payment to you, if you like. As far as I know, there are ways to easily determine the volume of wood by photo-optical means. Have you already found a buyer for the wood? I know a sawmill owner with whom I was in the football club... Thank you very much for your support! However, I have already sold the wood via a cloud-based market platform. The transporter has a navigation system based on the NavLog standard. Please provide me with the GPS coordinates for the individual timber piles for transport. All right, I'll do my best. Thanks to good logistics, the sawmill removes the wood quickly, and thanks to the ELDATsmart interface, invoicing by factory input measurement will also be possible quickly, and then you will also get your money quickly for your good work. Yes, that sounds good! So, you really are a fair business partner and I look forward to working with you!

#### 3.5.3. Data standards and interfaces - short overview

Welcome to our course on digitalization in the wood supply chain. We will discuss various issues that arise in the planning and execution of a highly mechanized timber harvesting operation up to the raw wood logistics chain. Let's ask ourselves what interfaces and data standards mean in the forestry industry?

Data standards are a language for the transmission of electronic information between individual actors in the wood supply chain. They represent a specification of the data structure, which is used by both the sender and the receiver. The receivers can then use the generated data sets in their own database via a digital interface and use them further. The graphic shows that different national and international data standards



are used in Europe. National standards, for example ELDATsmart or FHPdat for the exchange of data in the logistics chains of Germany and Austria, and international data standards, such as papiNET for the logistics of the European paper industry. The most important international standard in the preparation and execution of a timber harvesting operation is certainly StandForD. StandForD is an abbreviation for "standard for forest machine data and communication".

The aim of StandForD is to ensure that all stakeholders, from the forest owner and the logging contractor to the sawmill operator, can work with the same data standard. This enables a smooth and flexible control of all processes in the modern timber harvesting chain. The use of StanForD makes communication between the individual actors more transparent and barrier-free with regard to data processing. StandForD 2010 structures the data within a number of messages for machine control, production reporting, quality assurance and machine monitoring. It is the worldwide standard for processing and exchanging information on and with forestry machines and is used by all major manufacturers.

The StandForD classic was developed in Scandinavia in the 1980s and has been further developed from 2006 until its introduction in 2010 as the StanForD 2010. Depending on the machine type and age, it is still possible to use one or also the other data standard.

Let's take a look at the process of planning and executing a mechanized timber harvesting operation. We see that companies work with different file types in their board computer software.

The control files for the cutting file APT according to StandForD classic or according to StanForD 2010 contain all the necessary information about the planned timber harvesting operation, such as order number, forest owner information and information about the logging contractor. Other contents of the APT or ENV cutting file include information on tree species, assortment-specific information, and price matrices.

When the felling operation is completed, the PRD or HPR file is generated in the board computer software. PRD or HPR files contain production data. They do not refer to the individual tree but use the production unit "assortment" as a basis. The production file is generated by avoiding assortment-related order data but using the data of the individual tree. It provides the assortment-related information on the length, diameter, and volume of the assortment piece according to the stored price matrix.

Another data set, which is generated during the processing of trees, is the STM file, which contains individual tree data. In this data record, all values that occur during the processing of the individual tree are recorded. The measured individual values and section measures for length and diameter are assigned to the individual tree and stem sections.

This data set is required by the contractor when - during the running harvesting operation - he controls or adjusts the measuring system of his harvester using an electronic caliper. After such a control measurement and the evaluation of the collected tree data, the KTR file is created for the quality control of the measuring system. In this KTR data record, machine data of one or more control trees are sorted by machine value M1 and measurement data M2, which the operator collects during the control measurement, and are stored and documented.

#### 3.5.4. Harvester control measurement and calibration

What is the meaning of checking or calibrating a harvester measuring system? In practical harvesting, the harvester operator is required to keep a calibration report on a daily basis. Now let's take another look at what this is about. The regular checks of the measuring accuracy are necessary because of the obligation to maintain dimensional accuracy. It is a prerequisite for accurate assortments according to customer requirements, the basis for exact volume calculation, to ensure compliance with minimum requirements, to achieve optimum value creation, and to create mutual trust so the harvester measurement can be used as a sales or control measurement. It forms the basis for further dispositions of the timber data. With the control measurement, the contractor verifies the accuracy of the measuring data collected by the harvester head unit during the processing of a log.

During the process of measurement control, a distinction is made between control measurement and adjustment of the measuring system. The control measurement is a regular check of the harvester's


measuring equipment on the basis of a random sample to detect and, if necessary, correct dimensional deviations. Adjustment is the setting of the harvester's measuring device on the basis of a random sample to achieve the best possible dimensional accuracy.

In other words, if the operator wants to produce a harvester measurement that he and the other parties involved can use for further planning, he has to master this process and has to carry out this work once a day. In a follow-up event at the Center for Forestry and Timber Industry, this topic will be covered in more depth. If you want more information, follow the link below the video.

## 3.5.5. The German standard ELDATsmart

What does the ELDATsmart data interface mean for the processes in raw wood supply? Let's take a look at the entire process of the wood supply chain, and then look into the ELDATsmart interface. The graphic shows the possible data flow of the different actors in the wood value chain. Each actor generates or processes partly analogue or partly digital data sets.

StanForD or ELDATsmart, for example, are intended to create a unified data standard and thus bridge the possible interfaces, which often cause interruptions because conversions are needed. Data is transported faster, and flexible control of the timber harvesting organization can be achieved. While the data standard StanForD is the international standard in the preparation and execution of a timber harvesting operation, ELDATsmart is a data interface in the area of timber logistics.

If you take a closer look at the process of timber logistics, it is divided into five modules: cutting and processing, transport order, delivery note delivery bill, measurement protocol, and invoicing. Between the actors in the raw wood logistics process, the forest owner, the haulage contractor, the truck, and the sawmill, the data and information on the order-related timber data are passed back and forth, partly by e-mail, but also partly by telephone. This procedure has a high potential for rationalization. The use of the process can now be significantly simplified by using ELDATsmart to digitally enter metadata and timber information, and thus be carried out more efficiently.

### 3.5.6. Preparing harvesting operations

### How can the web portal Forestinfo.NRW help with preparing a harvesting operation?

Hello all. Let us now take a look at Waldinfo.NRW and what it is about. The internet portal Waldinfo.NRW offers comprehensive public information about the forests in North Rhine-Westphalia. This primarily includes digital maps on various aspects of forest management and the use of forests by the public. The topics covered by the various maps range from forest cover and forest ecology, forest management and forest nature conservation, recreational use hazard mitigation to forest management. Important info needed for highly mechanized timber harvesting can be found here: who is the contact person on the site, how large is the site, how does the terrain run, are there steep slopes or valleys, what type of soil, do I have to expect heavy waterlogging, where is the nearest rescue point, am I in an FFH area or bird sanctuary? With this freely accessible portal, one can obtain important information about the stand to be worked on at any time. This data can be instrumental in the decision-making process, whether and how a stand should be treated.

### *3.5.7.From smartphone to the harvester - the LogBuch app*

What does LogBuch provide us within highly mechanized timber harvesting? With the cloud-based LogBuch application, the step towards digitization in tree and forest management is easy, intuitive, and efficient. Via smartphone app and web portal, LogBuch enables the mapping of damaged trees, biotopes or even sources of danger in the forest. Via GPS, the respective location where a note was recorded via voice control, is stored. With this app, the machine operator can insert various geographic points into the geoinformation system of the machine and display them on the map.

*3.5.8. Harvester control and information systems: TimberMaps and TimberManager* 



TimberMaps - TimberManager - what is it? On the map in the display of the on-board computer one does not only view the routes of the harvester, but also in which logging road which assortment of wood is stored in which quantity. With this information, you can plan your routes and loads better than before. This minimizes the need to drive over the area and thus protects the stand. It also saves fuel, which reduces CO2 emissions. The data is provided by the harvester, which feeds its production data into the program and determines the GPS position of all sections. The data is updated in real-time via a cloud service that can be accessed by all drivers in a logging area. Additional data which can be generated and queried at any time by any participant in the program are, e.g.: recording routes, mapping current production, displaying the position of each individual cut, recording timber piles, transferring timber from the area into these piles, entering biotopes and special features, proximity alarms for hazards such as power lines. While TimbermaticMaps is running on the forestry machine's on-board computer, the dispatcher in the office uses the program TimberManager. It provides the same information as TimberMaps. However, the dispatcher can call up the work progress of harvested and forwarded timber and has further evaluation options. The volume of information on the harvested timber makes it easier for him to plan the transport.

# 3.5.9. Photo-optical measurement of timber stacks - the example of FOVEA

Why Fovea and how does the program work? In the past and still, today stacks are often measured by hand in a time-consuming and cost-intensive way in order to achieve a forest control measurement. This takes a lot of time and often leads to serious accidents. For the forest owner, the measurement of the stack is made easier by small programs that can be used on almost any smartphone or tablet. One of these apps for counting sections in the stack is Fovea. The goal of photo-optical measuring is to save time. In the future, stacks should no longer be measured by hand. By integrating a camera into a corresponding calculation program, the timber masses are measured much faster. From the stack, we take several approximately 60% overlapping photos. The app combines many photos into one large image. The delineation of light and shadow is used to identify a single log, thus the number of pieces is determined. The app generates an image from the coordinates "number of pieces" and "stack number", which can be used for sale. What must be noted: Stacks must lie flush, ground growth must not cover any stem, the number of layers of the stack must be known, and the lighting conditions considered. And buyers must accept the method of measurement.

### *3.5.10.* Control measurement with the crane scale

Another possibility to collect a forest control measurement e.g., industrial timber is the crane scale on the forwarder crane. The timber quantities are weighed with a scale on the tongs during each crane lift. The data is collected in the on-board computer, where it is combined with an assortment of data. In addition, a weight per solid cubic meter can be inserted. Together with the weighing result, the solid cubic meters in the stack are determined. Connected with the GPS data, a timber stack can be displayed on the map together with its weight. This makes it easier for the forest owner to plan the transport and also enables a down payment for the entrepreneur.

### 3.5.11. Timber transport - truck navigation with NavLog

In the meantime, we have learned several ways to create a control measurement in the forest. This data is used by the forest owner, to enter the coordinates into a GIS application or communicate them to the hauling company. A program for displaying and processing stack coordinates is Navlog. The Navlog program organizes the merging and processing of the data, it organizes data maintenance, data transfer to authorized persons, it licenses the forest road data of the forest owners, it licenses the background data - for example, the public road network, topographic maps, aerial photographs, open maps (Onmaps), and it provides a geographic information system and a web map service. Thus, transport maps and other thematic maps can be created. Navlog cooperates with several IT service providers who integrate Navlog route information into their software solutions for wood logistics and enterprise resource planning systems. Through Navlog, the



rationalization potentials within the logistics chain can be realized. Navlog is a joint project of the forestry and timber industry.

# 3.5.12. MOOC 1 Webinar Fuel Saving in Mechanized Timber Harvest

Welcome to today's webinar on the topic "Resource-saving use of forest machines"! Basically, many of you, like me, are involved in some way with using forestry machinery. Due to the many influencing factors in forestry practice, it is often difficult to establish generally applicable principles for saving resources when using machines. With this webinar, we would like to encourage and motivate you to think about this topic and to discuss different possibilities and solutions with us.

Slide 2: I would like to start my talk with a recommendation that is attributed to Paul Watzlawick.

If you keep doing what you have always done, then you will keep getting what you have always got. If you want something else, you have to do something else! And if what you are doing is not getting you anywhere, then do something completely different instead of more of the same wrong thing.

Slide 3: Our topic today will be fuel as a resource. We start by asking ourselves the following questions:

- How can forestry machines be used as efficiently as possible and in a way that saves resources?
- Which aspects are important for developing concrete approaches to diesel saving?

I think, one of the most important aspects to start with is the determination of one's own actual fuel consumption! In addition, we have to consider further factors that influence fuel consumption, such as:

- The technology of the machines, maintenance and, of course, the settings that can be made individually on the machines.
- On the other hand, work methodology and work organization.
- Furthermore, people and their motivation are also an important aspect.

Ultimately, however, it is also the indications we receive on learning success monitoring and performance evaluations among the operators of these mechanical systems.

**Slide 4**: So, the principle applies: "Saving fuel is good for your wallet and the climate". Even though fuel costs have dropped for a while in the last year, energy costs are an important financial factor for success in mechanized timber harvesting. In addition to the cost savings, other benefits are achieved such as the reduction of the CO2 footprint of timber harvesting.

**Slide 5:** This is supported by a quote from a forestry contractor from Finland:

"The key factor in forestry is low fuel consumption! Even small savings make a big difference, as fuel becomes more and more expensive, and we can not pass the higher costs on to our customer".

**Slide 6**: I would now like to give a brief overview of the climate protection strategy in NRW. In this strategy, adaptations of forestry technology, innovative training and qualification of personnel are integrated as political goals and measures.

The following aspects are worth mentioning here:

- NRW was the first federal state in Germany with a climate protection law
- The state enterprise forest and timber is environmentally certified according to ISO 14.000
- Forestry machines are predominantly used by contractors
- NRW has the highest business density with 0.7 forestry contractors per 1000 Ha forest, the national average being 0.5.
- That means that around 600 entrepreneurs are active full-time
- According to a survey, around 190 harvesters, 170 forwarders and around 900 forestry tractors are used

Slide 7: Let's take a look at some figures regarding fuel consumption in highly mechanized timber harvestinginGermanforestry.

We have calculated the following figures:



- approximately 1.34 liters of diesel are used for processing per cubic meter of timber
- around 0.66 liters per cubic meter of wood for short logging
- And fuel costs have almost tripled since 1992

Assuming a degree of mechanization of 50 % and the current annual fillings in normal years without calamities, this results in total consumption of 120 million liters for Germany, of which 4 million liters of fuel per year are used in NRW alone.

**Slide 8**: If we relate these figures to the harvester deployment in NRW of around 190 harvesters, the optimization and savings potential is as follows: In this state alone, 332.500 liters of fuel could be saved, which would lead to carbon savings of 874 tons, while production could be increased at the same time by 332.500 solid cubic meters.

Slide 9: It was also found that when using a harvester, even simple measures can achieve a

- Fuel reduction of 7% per year
- and simultaneously lead to an increase in productivity of 7%.

This means that, with an assumed annual production per harvester of approx. 25.000 cubic meters of timber, a reduction of approx. 1750 liters of diesel and 4.6 tons of CO<sup>2</sup> can be achieved. And, by implementing such measures, annual cost savings can reach up to 3000 euros!

**Slide 10**: Let's take a look at the current situation in Germany:

- Highly mechanized harvesting machines are well established, at least in coniferous wood.
- We are currently talking about a filling volume of approx. 50 %
- In principle, the CO2 balance in highly mechanized timber harvesting is favourable
- However, there are high costs for the entrepreneur/machine operator due to diesel expenses
- We all know that many factors influence fuel consumption in different forestry operations.
- And that the savings potential always depends on the respective conditions on-site.

**Slide 11**: Because of all these aspects, and if we want to develop and improve, it is important that we also look at all decision-making levels of a company with regard to resource consumption.

Here you can see the typical hierarchical structure of a company with its 3 levels:

Level 1: where overall management influences all aspects of fuel consumption with their decisions.

Level 2: here, decisions are made by the strategic management or the operations manager

And level 3, is where decisions are made in the tactical use of the machines, by the machine operators, such as how they set their systems, how the handling and maintenance of the machines are carried out, and also what can be improved in the overall operation.

**Slide 12**: From our point of view, it makes much more sense to sit down with all levels and discuss all necessary decisions together. Only by doing this, all possibilities to achieve optimal resource efficiency will be used. And this has to be done continuously. I have another suitable quote for you, this time from Confucius, he said: *"Where we disagree in principles, we can't give each other advice!"* 

**Slide 13**: In a past EU project, the various savings potentials were investigated in both agriculture and forestry. We were involved in this project, Efficient20, as a partner together with the Board of Trustees for Forest Work and Technology KWF.

The following potential savings in terms of fuel consumption were identified.

- Adapted driving and working methods: 10 20 %
- Adapted equipment: 5 8 %
- Optimal unit setting: up to 30 %
- Engine maintenance: 5 -10 %
- Training of machine operators: up to 30 %
- Use of driver assistance systems: up to 15%



This includes for instance the use of modern logistics programmes, modern timber harvesting simulation tools or price-optimized cutting files based on master forecasts.

Slide 14: So, what questions do we need to ask ourselves in order to successfully optimize resource efficiency?

- Is a 20% reduction in fuel consumption realistic?
- What are the main parameters that influence fuel consumption?
- How can fuel-saving be verified?
- How do we determine the consumption of fuel?
- How can we help practitioners to save fuel?
- What is the level of knowledge about your own fuel consumption?
- How can we adapt the information to the individual target groups?
- How do you organize trainings to reduce fuel consumption?

It is important to know your own fuel consumption!

Slide 15: Let's take a look at the basics of the calculation of fuel consumption!

- Which basis is relevant for the consumption figure?
- Are we talking about consumption of liters per cubic meter of wood, of liters per hour, or liters per day...?
- Or are we talking of consumption according to quantity of m<sup>3</sup> with bark, m<sup>3</sup> without bark, m<sup>3</sup> according to price type...?
- And with consumption according to time by engine hours, by effective working time.....?
- It is important to consider consumption in relation to the amount of work done.

A pure consideration of the consumption per hour is not very meaningful here.

**Slide 16**: In the project Efficient20, an entrepreneur survey was carried out in which it was asked how often people check the consumption of their machines. Regularly? Only at the end of the year? Or never?

In the graph you can see the results:

- 58 % carry out controls rather regularly
- 15% only at the end of the year
- 27% never control consumption, so there is no control of their own fuel consumption at all.

Slide 17: What options do we have to determine our own consumption?

What is important to note is that knowledge of the fuel consumption of one's own machine is the basis for possible savings! As we can see in the graph, the average price per liter of diesel has risen steadily. What can we do?

We can control consumption by refueling. Generally, machines today indicate diesel consumption via the standard on-board computer. There is also the possibility to determine the actual consumption by retrofitting special measuring devices.

Slide 18: Let's take a look at these different options.

Determining consumption by refueling seems to be a simple possibility: Easy to determine – fill up before and after work. Here, however, one should record the consumption with a protocol of the activity performed. In any case, the tank must have the same filling level each time. But this type of control is only practice-oriented for longer intervals.

We have also had the occasional problem of air bubbles falsifying the results when refueling. The accuracy has therefore been rather variable here, there is an approximate 5 % measurement accuracy specification by the ADAC (Automobile Club Germany) for cars.

Slide 19: Then we have the determination of consumption with on-board computer software:



Modern timber harvesting machines are usually equipped with on-board computers and depending on the version, this offers extensive possibilities for displaying and evaluating machine data, as can be seen in the graphic. There have been experiences in this regard for some time in the area of passenger cars: There, the goal is to motivate people to save fuel.

Meanwhile, the systems in the forestry machines work via the CAN bus and determine the fuel consumption via the injection quantity. The accuracy determination here resulted in a deviation of up to 5 % from the real value.

**Slide 20**: Now we come to the use of on-board computer software. However, these are often only available as an option, and are often not available at all on smaller tractor types.

There are also differences in the display functions, the options being

- Instantaneous consumption
- Average consumption
- Total consumption
- Special functions as the consumption per area, per cubic meter, or tree.

As you can see, many options are available in these softwares.

**Slide 21**: And if there is no on-board computer installed, there is finally the determination of fuel consumption via retrofitted systems. At the forestry education center, we decided to use such a diesel flow measurement system and measured the consumption in different working situations.

Here as well, different solutions are available. In some cases, consumption values can be determined by connecting to the machine's CAN bus network or by using sensors.

With the device we use, the measurement is done by ultrasound, contactless. The picture on the left shows the sensors attached to the diesel line. The values are visible and recorded on a separate module that is carried in the cabin during operation. The devices must be calibrated before use and then offer accuracy of +/-1.5%.

**Slide 22**: Now let's look at the factors that have an influence on fuel consumption. Here we should mention, on the one hand, the characteristics of the terrain: the slope, or the soil conditions. The question may arise: Will the use of support or traction belts be necessary when operating the machine in the respective terrain?

Then there are the different stand characteristics, for example, the type of tree, the dimension of the trees, the knottiness, the distance from the logging path, the number of stacks and many other factors that influence consumption. And then we have the weather factor, which also has an influence on consumption in some regional conditions.

Other factors to consider are the condition of the machine, the behaviour of the driver, the right choice of machine and the technical equipment of the machine and, of course, the preparation and planning of the timber harvesting operation.

**Slide 23**: Let's take a look at a few examples of influencing factors in detail: Let's take a look at maintenance, remembering the information from the project Efficient20, where a savings potential of 5-10% was found. In this context, investigations have shown additional consumption due to a clogged and dirty air filter. Then there is a study within the framework of a diploma thesis on the effects of blunted delimbing knives on consumption. The same applies to the decreasing cutting performance of the saw chain of a harvester. We will look at a few more figures in a moment.

It is important to point out that maintenance and inspection should be carried out promptly and regularly. Proper and needs-oriented maintenance also prevents expensive consequential damage.

**Slide 24**: Now I would like to show to you a small video of an air filter that we checked during the lunch break on a forwarder in dusty terrain. Here you can clearly see how the filter clogged up during only one day of operations which will of course affect fuel consumption.



**Slide 25**: Let's have a look at some figures on the decreasing cutting performance of saw chains: The study found that the cutting performance of all the saw chains examined had already deteriorated after 51% of the time they were used. This resulted in an increased sawing time by 4%. This impact of the drop in cutting performance resulted in additional fuel consumption of 4% on average and is thus relevant in terms of costs.

Slide 26: It was further noted that this would require 39,2 more working hours per year for reprocessing. The annual additional costs for fuel amount to 773 €. Annual additional costs for saw chain oil amount to 261 €.

The total additional costs per year, therefore, come up to 1,035 Euro. But it doesn't stop there! Because the working time of the machine is now extended by 39.2 hours, assuming an hourly rate of 185,-€, this results in additional costs of 7.252 Euros due to extended working time per year. This means that by exchanging the saw chain after 51 % of the working time, and correctly sharpening the chain, a saving of 8,286 Euros is possible. So, it is worthwhile to check the machines regularly.

**Slide 27**: There is also great potential in the area of machine setting. Here it depends on which parameters are used for the individual machine components and can be influenced by the operator. This concerns especially the adjustment of the boom, the travel drive, and the aggregates. Different pressure settings for the holding pressure and the feed pressure are possible and should of course be adapted to the different situations in processing the timber.

If we look again at the potential savings, we have already listed and identified many things. The areas we have dealt with a lot here at the Forestry Education Center are the training of machine operators on the one hand and the use of various driver assistance systems on the other. Here again, I would like to show you two videos.

**Videos**: In these video sequences, we can see in the right field a machine operation that we have often found with operators. In the left field, you can see the optimized working process after training.

**Slide 28**: We have already seen that different saving potentials are possible and which parameters can be determined. In the video, we have seen the effect of machine settings on the use of the individual boom elements. And especially for the boom, the drive, and the aggregates, it is important to check for correct machine settings. Looking at the different savings potentials we have already mentioned many aspects. From our experience, the training of the machine operators, also in the use of driver assistance systems is very important.

**Slide 30**: If we stay for a moment with the machine operator, we have calculated the savings potential. Assuming we take the figures given here as an example. We have determined that if there is a time delay of 10 seconds in the tree preparation, this time delay results in additional costs of  $15.120 \in$  per year. In addition, there is a loss of revenue of around  $\in$  8,000 per year because this extra time is lacking within the annual production time. That means a plus in working time of only 10 seconds per tree already has a huge impact on the additional working time and of course as well on the production time.

**Slide 31**: The potential savings are also comparable when using route optimization programmes. Here, using map-based information, harvesters and forwarders are networked with each other and information is exchanged in real-time.

Production, route, the position of each individual section, as well as area information on the stand, soil conditions and hazards can be generated and viewed at any time. In this way, work processes can be optimized, and resources can be used more sparingly.

For example, searching the felling areas for certain assortments is no longer carried out by axis, as is often the case. Instead, these assortments are shown on a map-based information system with pinpoint accuracy and the routes can thus be planned. Double or non-sensible multiple driving routes are thus avoided.

**Slide 32**: Another possibility is the use of planning tools. So-called decision support systems can help to highlight important aspects in the sequence of implementation. And they help to recognize their advantages



and disadvantages in the run-up to a timber harvesting measure. In this context, we are provided with information on working methods and equipment.

**Slide 33**: An example of this is the decision of where and how many places for timber stacks are optimally needed. Here, all possibilities are compared on the basis of various parameters and mapped in a result, which is then also represented in a time and monetary value. Based on this, optimal planning and organization can be carried out. In the example shown we can see that the fuel efficiency is more favourable when planning two stacks.

The coloured representations of the logging paths and tracks to be used show red lines on the left-hand side, while on the right-hand side these parts are no longer red. This means that the load on these paths is significantly better – major repairs are not to be expected and the passability of the logging paths is maintained.

**Slide 34**: We find further savings potential in the use of driver assistance systems, such as intelligent boom control. Here, processes in the boom movement are supported by the use of sensors. The sequence and the correct timing of the use of the various elements are often decisive for efficient work with the machines. Various manufacturers have developed these driver assistance systems for their machines and have already successfully established them on the market.

**Slide 35**: In this film sequence we see the differences with and without such an intelligent boom control. In the right field, we see a working procedure that does not achieve its goal, in the left-field the optimal and more efficient way to use the boom elements.

**Slide 36**: Since not all machines have such an operator assistance system, it is important to enable the operators to perform this optimal sequence in crane/boom operation through operant learning with feedback.

**Slide 37**: Innovative training options in specially created exercise situations offer operators the opportunity to deepen their skills and knowledge and to achieve the optimum individually.

**Slide 38**: Ultimately, we all have the goal of making forestry machines use more resource-efficient and effective. A key factor in this regard is fuel consumption in forestry.

Conclusion for today:

- Key factor for resource efficiency is fuel consumption: fuel-saving measures require knowledge and motivation of the driver
- Knowing your own consumption is the basis for savings
- As far as possible, consider consumption in relation to the quantity produced.
- Willingness for regular further training required
- Successes motivate the implementation of further measures
- Further training measures serve as documentation for clients, authorities, certifiers, etc.
- Large machines in the forest are always under special observation:

We all have a role model function! I thank you for your attention.

# 3.6 MOOC 2 – Spoken Text (video lectures and webinar)

# 3.6.1. MODULE 1: FOREST SITE FACTORS AND SITE MAPS

# Chapter 1-1: Forest site factors and site types

Dear forest owners, today I would like to take you on a walk through our soil and site maps. These soil and site maps have been put together by the Geological Service of NRW based in Krefeld, Germany, and are developed using their data. They form the basis for our silvicultural recommendations when it comes to assigning the right tree species combination to a specific site. Now the question is, what actually is a site? The forest site is defined by several so-called site factors. The factors such as location - i.e., the altitude above sea level, the local climate with light, warmth, and precipitation, and also the water and nutrient supply of the soils are of great importance. These site parameters form the so-called site type. In this overview, we see the structuring of a site type. It can be seen clearly that heat, water, and nutrient balance characterize the site type, supported by the location, the local climate, and the soil conditions. How this looks on the map, I will show you now.

# Chapter 1-2: Site-specific precipitation totals in NRW

Let's start with the observation of the precipitation sum in North Rhine-Westphalia. Here we can see that there is a diverse distribution of the yearly precipitation in NRW. Especially in the Siegerland, the Sauerland and the Bergisches Land, for example, we still have relatively high precipitation. Also, in parts of the Eifel, while in other areas of North Rhine-Westphalia, such as in the Cologne-Bonn area, in the Münsterland, or parts of the Ruhr area we have significantly lower precipitation totals, which can lie below 600 or 800 mm per year, the trend in climate change decreasing even more. Let's take a look at the temperature. Here, too, the respective precipitation totals match with areas in NRW with lower or higher air temperatures as we see them here, i.e., same as before in the areas of the Siegerland, the Sauerland, or the Eifel we have lower temperatures of six, eight, nine degrees, while temperatures in the areas of Cologne/Bonn, the Ruhr area, or the Münsterland are higher, on average between ten and twelve degrees. In the next video, we have a look at the overview of the soils.

# Chapter 1-3: Soil types

The soils in North Rhine-Westphalia are just as varied as the climatic conditions. This means we have a wide range of soil types in NRW. Here, the most important are brown earths or parabrown earths, or podsols, which are influenced by seepage water. These soil types, which I have just mentioned, are those that are particularly sensitive to climate change. They react sensitively to a reduction in precipitation and an increase in the annual mean temperature. The other soil types, such as pseudogley or gley soils, or also the peat areas, which are characterized by backwater or groundwater, are not as susceptible to climate change or are not as negatively affected as, for example, sites characterized by seepage water. Here it is very important to point out the water storage capacity of the soil. There are great differences, primarily due to the skeleton portion, i.e., the stones that are present in the soil. As mentioned, a very important factor in climate change is the water storage capacity of the soils: let's take a look using the prime example in NRW, the brown earth. On the left, we see that the soil is almost skeleton-free, that is, with a water storage capacity of 250 millimeters, and on the extreme right-hand side a soil that is very skeletal, it has a lot of stone content, which holds only 25 mm of water in the first few meters of soil. Here you can see very clearly how the water storage capacity of these soils varies, and we must adapt our choice of tree species accordingly. Besides the almost skeleton-free, i.e., stone-free, variant on the left, we see on the right brown earth with a very high percentage of stones and therefore unfortunately only a water storage capacity of just ten percent of that of the stone-free variant, and that, of course, means significantly lower water availability also for our forest soils. We will show you how the whole thing looks cartographically in a moment.



# Chapter 1-4: Map systems describing site factors

With regard to the cartographic representation, we have two options in NRW. On the one hand, the socalled BK50, a map representation at a scale of 1 to 50,000, which is available NRW-wide and allows regional planning, and then the so-called BK5, which we see here, at a scale of 1 to 5,000, which already permits locally differentiated recommendations. At the same time, it also offers the possibility of viewing all site factors and information directly on-site: from the soil unit, or soil type, to the humus form, all possibilities of information are available for the forest owners. Especially when it comes to important site parameters such as heat, water, and nutrient balance. This is once again decisively presented in the so-called site report. In particular, the total water balance depending on "normal location", "shade" or "sunny slope" can be queried by the forest owner. The same applies to the nutrient balance and the temperature. Here we see both map systems side by side. On the left is the so-called BK50 for regional planning and on the right is the BK5F, which offers the possibility to do local inventory planning as well. Let's summarize again: the site parameters used for the BK50 are soil layers, the base content of the soil, the soil water storage capacity, groundwater, and waterlogging, but also slope water and, of course, the climatic water balance, e.g., during the growing season. The water balance during the vegetation period gives us indications of the extent to which deficiencies occur, especially during the growing season for our forest trees. We will now show you what the information looks like on a practical stand.

# Chapter 1-5: Practical example of a site map in the Arnsberg forest

If we use the example of a stand in the Arnsberg Forest, we see that a very heterogeneous representation of the total water balance is necessary. Between, for example, the very fresh areas, which are marked in dark green here, the backwater-dominated gley areas, which are marked here in blue near the valley ground, or, for example, the seepage-wet areas, marked here in light green, which are shown in the moderately fresh area. This map allows the forest owner a quick overview, of where we have, for example, site factors such as warmth, water, or nutrient balance. Let's take a look at the legend. So, we have here on the one hand the possibility of viewing the water balance between levels very dry to wet, the nutrient balance from very nutrient-poor with the code number 1, up to very nutrient-rich-limestone-oriented with the index number 6. Further, the heat balance for example, in four steps less than 130 days symbolizes the upper montane to montane range up to more than 160 days in the planar range. Here, is the total overview of the forest location map in NRW. Important is: the assignment of forest development types is only possible with the help of this map material, and thus enables a site-appropriate tree species selection in climate change. Additionally, nature conservation issues are covered. Work is still in progress, for example on the inclusion of climate scenarios and maps regarding the suitability of forest development types of tree species. And we focus on an update, respectively a further specification of the forest location map based on the BK5F. In addition, we have the option, via the internet portal Waldinfo, to show cartographically corresponding recommendations for further development, but we will come back to this in a moment when we get to the representation in the forest info area. Let us now take a look at the availability of the soil and site maps within NRW. We notice at once that a large part of the BK5F for NRW is already available, i.e., about 63 percent. In some areas of NRW, this mapping is now being completed by the geological service, existing analogue maps will be integrated accordingly. After completion, the BK5 will be available for most areas in NRW, whereas the BK50 is already available today.

# 3.6.2. MODULE 2: FOREST SITE MAPS ONLINE – THE WEB PORTAL FORESTINFO.NRW

# Chapter 2-1: Forestinfo.NRW (Waldinfo.NRW)

Welcome to the second part. We would now like to show you what has become of the digital maps of the geological service and how we have implemented them in the internet portal Waldinfo. Here you can see that we have a cloverleaf: with the site maps from the geological service provided in the internet portal Waldinfo.NRW in combination with the silvicultural concept, something really good comes out of it, namely



the corresponding information for the forest owner on the site-appropriate choice of tree species. How the internet portal Waldinfo supports us, we will show you now. The data basis is important. Here we have central access to selected forest-relevant public data and services, (the) so-called Open Data NRW, for example, data from the German Weather Service, the State Office for Nature Conservation, or the state enterprise Forestry and Timber, are stored here accordingly, and the forest owner now has the option to access all maps and map layers at once. Let's take a look at the topics that are stored in the forest, for example, but also areas of forest ecology, forest functions, as well as information on forest nature conservation, forest damage, recreational use and last but not least on cadaster and administration. The forest owner also has appropriate tools available, to work on the map material by measuring, printing, drawing, and also to share corresponding maps. The simplest thing is of course first of all the location search, with which we will begin immediately.

# Chapter 2-2: Presentation of specific functions of Forestinfo.NRW

Now let's take a look at the performance of the map application on the Waldinfo Internet portal. In the center is the start button, simple access to the map material. In addition, the Internet portal also offers the display of other information, such as the silvicultural concept, for example, under the heading of publications, which can be downloaded free of charge. To start with the map application, we use the green start button, then we get to this overview field that shows the NRW area in its total view. On the top left, we see the corresponding display with the main topics. Furthermore, at the top center, we see the location search. Here we have the option of simply entering an address, or also - who prefers - the appropriate cadastral data, to access one's own forest area. On the top left, we see the toolbars, which allow the user to work digitally on the maps, or to distribute the maps to other interested parties. Here below we can see the legend, in this case, the representation of forest areas and non-forest areas, for example. And down here we have the option, at the bottom left, to work with so-called background maps, geographic maps, or aerial photos for example, and to vary the views. After the input of the location in the location search, there is now the option to call up further detailed information. The specified location is indicated here by the blue dot in the middle of the forest stand and we can now select different background maps, in this case, the aerial photo. Furthermore, there is the possibility, in particular, if reforestation has to be done in specific areas, to get area dimensions or detailed background information. Here for example the option to mark parts of the stand with the toolbar "Draw" or "Draw Polygon". Furthermore, the digital elevation profile can be accessed. Based on a shaded map, the terrain relief, for example, and the slope inclination can be seen very well. As you can see in the area below, the lower lying path can be viewed here as a clear notch. Further, it is possible to call up different information in the main groups, for example here in the area of forest ecology. The entire map material is stored there, in the area of forest function, for example, the forest function mapping and the like. Let's take a look at the topic of forest ecology, for example. Here, the corresponding maps are provided, for example, the BK5 Forest at a scale of 1 to 5,000 or the forest location map FSK50 at a scale of 1 to 50,000. The soil map BK5 Forest offers in particular the option to access the total water budgets. If we take a look at the selected surface area, we can see very clearly that, in addition to the legend, we have differentiations within the selected forest stand, for example moderately alternating humidity, the gray area for example, or fresh areas, which are marked here in light green. Very important information for forest owners, enabling them to make a site-appropriate tree species selection in climate change. Furthermore, it is possible to open a popup menu by clicking on it or to display a report that shows all important information on the spot at exactly this place for the forest owner. The mouse click opens this area or rather report, the standard information of the BK50 or the BK5 is then supplied accordingly, and we have the option to access all information. We see here the report in a large view, which shows, in particular, the total water balance, nutrients and the base content. This information is not only available for the forest owner in the indoor area at the home PC, but we also can directly access this information by cell phone in the stands if a WLAN or GSM (4G) connection is available.



## Chapter 2-3: Forestinfo.NRW: Summary and outlook

Waldinfo.NRW means bundling and integration of all public forest-related information. Access is free and open to all interested parties, the use is simple and intuitive, and it is also interactive, as tools for individual editing and sharing are available. Furthermore, there is the possibility to use mobile devices, especially cell phones, as long as Internet access is available. Furthermore, there is support for forest management and provision of information to the public for example also in recreational questions, because of corresponding layers, especially to forest recreation and forest functions. Of course, Waldinfo is constantly being adapted and expanded, and how the interaction between the geological Waldinfo.NRW geological maps and the NRW silvicultural concept, we will show you in a moment.

## 3.6.3. MODULE 3: SILVICULTURAL CONCEPTS

## Chapter 3-1: Presentation of the silviculture concept for NRW

Welcome to the new tool for forest owners in NRW, concerning the recommendations for sustainable forest management in climate change. Now we are talking about the silvicultural concept NRW. The NRW Silviculture Concept was developed on the basis of the NRW Climate Adaptation Strategy with the aim of advancing a recommendation for sustainable forest management in climate change. It has been conceptualized as a specialized concept on federal- and province standards, to be suitable for and also be co-designed by all forest owner types in NRW. The most important thing for us was to provide risk minimization for forestry operations and at the same time support climate protection against climate change. The development of site-appropriate and structured mixed stands is the be-all and end-all. Long ago, Friedrich Wilhelm Pfeil has already applied the "iron law of the site" that we have based our choice of tree species upon. He just said that not "general rules", but the site conditions should be the drivers of forestry action. Accordingly, we have taken the site factors of heat balance, water balance, and nutrient balance as the basis to define our 72 site types for North Rhine-Westphalia. Important to us is the reference to the forest soil maps and site evaluations of the geological service.

# Chapter 3-2: Site factors and forest development types

Let us now take a look at the heat balance on a cartographic representation for all of NRW. Then it becomes quickly clear that by far the greater part here is at a temperature of greater than ten degrees, which is synonymous with leaf sprouting, that the area here of more than 160 days of vegetation prevails in NRW, with an upward trend in climate change, while the areas in the Sauerland, the Siegerland and partly also in the Eifel still have a less than 140 days vegetation period. Based on the vegetation period, we have defined our site types accordingly. This means that, in addition to the dynamic criterion of leaf sprouting, we also include the overall water balance and the nutrient supply. The nutrient supply is defined in three stages, from eutrophic to mesotrophic to oligotrophic, while the overall water balance ranges from moderately dry to moderately fresh, fresh to moderately alternating humid, humid slopes to waterlogged. This means that we have a total of 3 times 6 site types, all presented in 4 site overviews. Accordingly, we were able to define 72 site types in NRW. Now it was a matter of adding forestry expertise. This means that we have now tried to implement so-called forest development types, i.e., tree species combinations that are ideally suited for climate protection, and risk minimization. The idea was to adapt these forest development types to the respective site types. As an example, mixed oak forests, 3 in number, and mixed beech forests, 6 in number, beech forests, for example, 6 in number, mixed deciduous forests, 5 in number, and last but not least the mixed conifer forests, 9 in total, making a total of 23 forest development types in NRW. I will discuss the colour scheme of light blue, dark blue and violet in more detail later on. For example, I have chosen the forest development type 12 oak-beech-hornbeam, to show that all 23 forest development types are built up in the same way, only with different contents of the course. All forest development types have a so-called guiding principle, where the viewer, respectively the reader, should already have the stand in mind. We have included extensive information on the site into the forest development type, in order to differentiate



between, for example, different oak forest development types. In addition, of course, information on forest functions is included. We would like to maintain the combination of forest protection and recreational function. This means, for example, information on the logs when used for valuable timber, example, but also protection and recreation. For example, which forest communities are important, which nature conservation information is important and last but not least especially for urban forest design, for example, enrichment of the landscape, or the autumn colouration. Last but not least the so-called stand target is important. Here in this case with 70% oak, 30% beech-hornbeam and 10% other accompanying tree species. Here it is important to note that this stand target is modular, i.e., the tree species proportions can also vary. If we now look at the allocation of forest development types to the site overviews, it becomes clear that there is no model solution. The forest owner is offered all possibilities, but the choice lies solely with the forest owners themselves. We have assigned between 4 and 16 forest development types to their respective site type, including information on nature conservation, silvicultural information, and soon growth information. This means that with all forest development types, we can minimize risks and protect the climate, but that we also have to take into account conservation information especially when it comes to forest habitat types in FFH areas. This information is in the coloured markings, that means in this case the turquoise marking, for example, indicates types that are completely forest habitat type compliant, the medium blue types are compliant with slight modifications, and the purple forest development types are not forest habitat type compliant because they consist mainly of coniferous or introduced tree species. Information on forest growth science is added, the forest development types in bold are of particular interest from the point of view of forest growth. Here, the possible increases, respectively the performance of these types on the respective sites are emphasized. Of these site overviews we currently have four, here you can see very well that we have differentiated vegetation periods: less than 130 days in the montane, respectively upper montane area, then between 130 and 145 days in the submontane area, between 145 and 160 days in the colline area, and greater than 160 days in the planar range. By assigning the forest development types to the corresponding site types, the forest estate, or its future stand, is equipped to respond to the climate scenarios of the years to come. We'll show you what these look like in a moment.

### 3.6.4. MODULE 4: CLIMATE SCENARIOS AND SILVICULTURAL TREATMENT STRATEGIES

### Chapter 4-1: Climate scenarios and silvicultural treatment strategies

After we have dealt with the Internet portal Waldinfo and its climate and site maps, we now come back to the importance of the climate scenarios, or rather the correct matching of site-appropriate tree species to the site. We will once again address climate scenarios, which look as follows: this overview shows us very clearly which attack we can expect on our forests in the coming years and decades. On the one hand, contamination with pollutants, on the other hand, climate and weather influences, but also biotic damage. This illustration shows clearly that - especially in the summer months - significant temperature rises are to be expected, which on average - depending on the scenario - can lie between two and three, but also between three and four degrees, especially in the second half of this century. This means massive drought stress for our forest trees, especially in the summer months. With temperature increase and the associated drought stress, we can see the corresponding change in the vegetation period, and it becomes very clear that depending on the intensity of the climate scenario - keyword RCP 4.5 = moderate scenario, RCP 8.5 = harsher scenario - we will have to deal with an increase in the vegetation period of between 30 and 56 days in NRW. This means a corresponding adaptation for silvicultural treatment strategies, which we will come to in a moment. The consequences of climate change on stands will become very clear in the next two videos. Weather extremes are often followed by calamities and the fact that calamities do not stop at coniferous stands such as spruce, as can be seen very well, since beech stands are also affected.

### 3.6.5. MODULE 5: FOREST DEVELOPMENT AND REGENERATION FORMS

# Chapter 5-1: Forest development phases



These film sequences illustrate the intensity of the climate change that is approaching us or in which we already find ourselves. The challenge here is to counteract climate change through strategies of silvicultural treatment. It is important to note that we currently still have one-age-cohort patterns, which means that we have to help forest owners to identify their position with regard to the forest development phase, young growth, to the maturity and regeneration phase, so that they know exactly where they are. Based on the stand top height, intervention times and intervention intensities are defined accordingly, and maintenance measures and instructions are adapted. The following overview of the forest development phases shows clearly where we are in the one-age-cohort forest. The forest development phases range from bloom to maturity and regeneration phase. For better classification or identification, we have also included the natural forest development stage, which ranges from young growth to heavy timber. And we have integrated the first necessary measures, so forest owners can ideally find their way to their own forest development phase. This picture shows a typical one-age-cohort forest, single-layered, hardly structured, often unstable, with no mixture of tree species, as we know it. At the same time, that means a significantly increased operational risk, whereas this silvicultural vision shows a mixed spruce forest that is multi-layered, structured, stable and provides a well-balanced tree species mixture. This means more security, more liquidity, climate protection, biodiversity, and ultimately more intact forest stands. Then, hopefully, we will not be left with this silvicultural reality of a one-age-cohort forest after Kyrill, which is clear-cut, but also labor-intensive and after all costs. These stands may offer a silvicultural opportunity, but they are finally not our goal. How to respond to these calamities, we will see in the next video.

## Chapter 5-2: Reforestation with different forms of regeneration

One answer to the calamity areas just shown, respectively their reforestation, would of course be the regeneration of forest stands. The silvicultural concept offers particular information on regeneration objectives, on regeneration forms such as planting or sowing, on forest reproductive material - keyword origins of planting and sowing material - but also in particular on how to deal with calamity areas, and their reforestation. Basically, we recommend tree species admixtures and the development of site-appropriate stands, if possible, under the canopy, if still available. The integration of successional elements is particularly important to us. Here we refer especially to the pioneer-forest stages, which make it possible to mitigate the climate conditions on open spaces for the new forest generation and thus make the site suitable for all. Working with natural regeneration is particularly recommendable, especially if the initial stand was of sufficient quality and suitable for the site. This natural regeneration should be supplemented with plantings where necessary. Here, quality management is particularly important, especially when it comes to the quality and provenance of planting material and seeds.

### Chapter 5-3: Experiences with an admixture of foreign tree species

At this station, we present 14 different tree species from different parts of the world. Conifers and hardwoods, with which we have already gained experience over several decades in North Rhine-Westphalia on experimental plots. For example, there is the tree hazel. The tree hazel is a tree species that tolerates drought very well. It originates from southern Europe Iran, Iraq, Syria, Turkey, and Afghanistan, it thrives on a wide variety of soils and forms very valuable, very usable wood, has a very good litter decomposition, and shows an excellent growth performance with fast young growth. The tree hazel is a very good replacement tree species for the ash, which has failed over a large area due to ash dieback and will probably continue to fail. There are many misunderstandings about foreign tree species. Many people believe that - now that the spruce is on its way out - we want to plant alien tree species everywhere, but this is wrong, it is exactly what should not happen. No, we recommend a maximum admixture of foreign tree species, optimally several species of it, to a maximum of 20 %, and the rest, i.e., 80 % - which means the majority - should consist of native hardwoods and conifers, because we don't know what climate change will bring, so we simply have to shy away from the risk.



## Chapter 5-4: Mixing tree species and other topics from the silvicultural concept NRW

The following overview shows how complex the design options are with regard to the tree species mix. Here, the stand objectives by tree species for the forest development types are indicated. The respective forest development type is on the left side, 23 in number, and as an example, I have taken a closer look at the mixed spruce forest, forest development type 82. Here, it would be quite possible, to add to the basic stock - the basic percentage of spruce of about 50%: for example, proportions of 20% Douglas fir, 20% silver fir, or possibly also larch. That is, it would be possible in this case to stabilize the spruce stands with four coniferous species. Regarding the envisaged maintenance of healthy soil, or rather the soil composition, it is advisable that we do not only focus on the conifers, but that we also integrate deciduous trees, and that would be first and foremost in this type of forest development 20% beech, for example, or 20% sycamore maple. In this way, it is possible to create these structured mixed stands with the help of light and shade tree species and a mixture of coniferous and deciduous species. Important here is the proportion of 10 % of the so-called accompanying tree species. Here, experimental introduced tree species as described in an earlier lecture can make an important contribution to stabilizing the stands and making them climate resistant. The silviculture concept offers further supplementary specialist topics: these include, for example, biodiversity in nature conservation, wildlife management, forest protection, or also urban forest use. Further interesting links and sources can be found in the appendix. In order to minimize forestry risk successfully to climate change, it is essential to always pay attention to local site potential, even in a small area. We aim to create structured mixed stands from light and shade tree species, as well as deciduous and coniferous species and to promote regular maintenance and management of the stands. And last but not least, adapted wildlife populations are important to achieve this goal. The silviculture targets in NRW are supported by adapted wildlife populations. In this case, the principle proves true again: less is sometimes more.

# 3.6.6. MODULE 6: REFORESTATION – OVERVIEW

### Chapter 6-1: General conditions of a reforestation measure

Let us now turn to the framework conditions and principles in practical implementation. Important here are primarily legal requirements or operational criteria. The legal requirements include, first and foremost, the reforestation obligations according to the state forestry law, and further the nature conservation law, especially if a FFH scenario exists and forest habitat types are affected. It is also important to observe the laws on forest reproductive material if seed and planting material from other forestry operations are transported and used. And, last but not least, of course, the aspects of soil protection, especially as an area-wide driving is not recommended. The regional and operational criteria include, for example, the availability of suitable forest reproductive material, the availability of forestry experts, and also of forestry personnel to competently place seeds and seedlings in the ground. In addition to adapted wildlife populations, the financial possibilities of a forestry operation are of course of primary importance. Here we would like to address the funding, especially the funding guideline "Extreme Weather Consequences" in NRW. Furthermore, social acceptance is important, especially when it comes to forests in urban areas. How to proceed with the practical implementation, we will show you in the last video.

### Chapter 6-2: Practical implementation of a reforestation measure

Let's get to the practical implementation of reforestation in the final video. Here it is important that highyield sites have priority, since here there is only a limited time corridor for reforestation, especially if rich competing vegetation such as bunch grass, eagle fern, or blackberry are to be expected on the site. Marginal-yield sites, on the other hand, can be used for natural succession. Under no circumstances should particular shade tree species, such as beech or silver fir, be introduced into deforested areas without a pioneer forest, because these tree species do not feel at all well there without a pioneer growth. In addition to intensive hunting and mechanical plant protection, it is important not to plant or sow tree species in the climatic border zone of the site. We would automatically bring these tree species to their physiological edge



in climate change and create risks. A tree species selection of primarily native tree species is important. And so is the integration of recommended introduced tree species. These include, for example, tree species such as Douglas fir, red oak, sweet chestnut, etc. The most important message, however, is to implement the four tree species principle in the area, i.e., the combination of as many as possible site-appropriate tree species in the area with a share of at least 10%, which can still survive in the following generation. Furthermore, it is important to establish intact forest edges. The state of NRW supports its forest owners in a variety of ways, for example by providing information in the internet portal Waldinfo.NRW, or through further advisory services provided by the Regional Forestry Offices of the State Administration Forest and Timber NRW, or the Center for Forest and Timber Management. In addition, trainings are available, for example, in the forestry training program and last but not least, of course, funding opportunities. First and foremost, the funding guidelines for private and communal forests and municipal forests should be highlighted, and the funding guidelines for extreme weather impacts. I hope you enjoyed our walk through the new instruments for forest management in North Rhine-Westphalia. I am keeping my fingers crossed for the practical implementation in your area.

# 3.6.7. MODULE 7: PIONEER FOREST

## Chapter 7-1: Reforestation with pioneer forest

(Pioneer forest – an economically interesting reforestation approach)

Good afternoon, ladies and gentlemen, I would like to welcome you all. We will now take a closer look at reforestation with pioneer forest and its silvicultural treatment. I will briefly give you an overview of the tasks and functions of the pioneer forest. Pioneer forest is possible from sand birch, red or black alder, aspen, balsam poplar and black poplar. Regarding the actual stand maintenance: how do I have to deal with it? What possibilities do I have for pruning, and what are the advantages? What possibilities do I have to plant other tree species under the pioneer forest, what is the later use of the wood? And finally, a short conclusion and summary.

### Chapter 7-2: Tasks and functions of the pioneer forest

Regarding the tasks and functions of the pioneer forest: it is first and foremost protection against frost, because even in climate change, the danger of late frosts remains, also important is drainage especially on strongly groundwater- or backwater-influenced sites i.e., gley sites, or pseudogley sites. The pioneer forest contains competing vegetation through the shade effect. Eagle fern, blackberry, and bunch grass cannot establish themselves as densely or as strongly. Bunch grass in particular always means danger to mice. If there is no grass, the danger of mice is also not as strong. Pioneer trees act as activators and fillers and are characterized by interesting wood production. To anticipate, birch and alder are not softwoods. And depending on how the sites present themselves, pioneer forests are important for erosion control, due to the relatively dense rooting. Sand birch: Optimally suited if it comes from natural regeneration and thus free of charge. It can also be sown as snow seed, but natural regeneration is the usual procedure for large areas. The birch, an extreme light tree species, is characterized by a complete insensitivity to frost. Snow pressure and snow breakage can become a risk factor in the absence of stand treatment. But we will come back to that later and see how to treat it. Explicitly on base-poor or moderately base-rich, moderately fresh to periodically humid sites, it is the tree species of choice for the forest canopy. Red and black alder: the usual procedure is planting. In places, it also occurs as natural regeneration in the pioneer forest, if planted as a pioneer forest, the planting space is 2,5 by 2 m or in wider spacing up to 4 by 4 m. Also, an extreme light tree species is also insensitive to frost. Here, a better nutrient supply must be available, whereas the water supply can also be in a rather wet range. Clearly distinguishable: Red and black alder, one and the same tree species, please not to be confused with the gray or white alder - there the wood quality is by far not as good, and we may have problems with root sprout. From aspen, European aspen, planted in 4 x 4-meter spacing: Regarding the site, in terms of nutrient supply, quite adaptable, and grows well also in the moderately dry



area. Certain clones have proven themselves, but here we have the same problem as with the white alder: root sprouting can occur. The balsam poplar: clearly stronger growth, but wants better sites, at least a medium to good nutrient balance. To be planted in 6 by 6 or 7 by 7 m spacing. Here as well special clones, which have proven themselves, and it has to be considered if investing in a pruning should be done to get higher-quality products. Next, we come to the black poplar. This is the tree species with the highest nutrient requirements of the pioneer forest tree species. It wants alkaline or very alkaline sites with a good to the very good water supply. Certain clones have proven themselves, and in contrast to all other tree species, as you can see, it is planted in very wide associations of 10 by 10, 10 x 12 up to 12 by 12 m. All this will pay off, especially if you prune the lower 6 to 8 meters because then you will produce much higher-quality wood. In the next video, we'll take a closer look at stand maintenance.

## Chapter 7-3: Stand maintenance

The most important point in the maintenance of the stand is first of all the fine structuring of the area. In order to gain an overview, we lay out maintenance roads with a width of 1 to 1,5 m at intervals of 20 to 25 m. These should be laid out in such a way that they can later be used as skid trails, i.e., the distance, as well as the angle to the truck road, should be considered. As equipment, we just use alignment sticks, compass, small chainsaw, or spacer and clear the maintenance roads that way. The cost is usually 4 hrs. per hectare, or 35 € per linear meter. If we combine the young stand maintenance, which comes sometimes afterwards, with the simultaneous planting included, then we are at 20 to 25 hrs.', we'll get to that later. After the maintenance roads are created, we select the future, so-called F-trees in the blocks, because we want to focus on these with maintenance measures for the value of wood production. This is done at growth to a top height of nine to ten meters, 8 to 10 cm diameter in the breast height range. And a dry branch zone of 4 to 5 m is usually already provided by the density of the natural birch regeneration. We select according to vitality, quality, and distribution, and if we find 50 to 80 trees per hectare, then that is more than sufficient, assuming a mean crown diameter of about 7 to 8 m for a mature birch. This crown generally has to be completely greened and exposed to light, so the full growth potential is utilized. Every two to three years, we intervene for the benefit of the F-trees and remove the trees in their immediate vicinity. We have to start carefully because the stability of the stand must remain and for cost reasons, we omit the intermediate areas. We concentrate only on the F-trees in the number of 50 to 80 pieces per hectare. The timing should be such that we can be sure that no wet snow or ice accumulation can cause damage anymore, so the Ftrees can use a full growing season after maintenance to develop the crown and stabilize. Equipment for this purpose is hand saws with AS teeth or also the spacer. Costs, as already mentioned 20 to 25 hrs. if I do this including the creation of the maintenance roads. I can also create maintenance roads first, wait for 2 to 3 years and then intervene in the blocks with the young stand maintenance and support the F-trees. Regarding the pruning, as already mentioned, the first stage up to 2.5 m can also be done with a handsaw, i.e., we use the same tool. As a rule, the lower branches are so thin and so dry that we can even knock them off with a walking stick. Then, several years later, the pruning is done up to a height of 6 m. We don't have to go higher than that at all, using a pruning saw with a pole or the thistle ladder system if available. The cost is about 8 minutes per tree or 4 to 5 € per tree and that is enough to make the birch grow to a target diameter in 55 to 60 years, or the alder in 60 to 70 years and produce valuable wood. Very, very important must always be to leave 50 % of the crowns green, because that is the driving force behind the growth in height and thickness. Under the birches, we can exploit the holes if the natural regeneration of the birch or the pioneer forest is not dense enough and holes have simply appeared. And depending on the site, on the nutrient or water supply, we can introduce site-appropriate mixed tree species under the protection of the pioneer forest tree species. On weakly to moderately nutrient-supplied sites, it is beech, as shown in the picture, under birch, Douglas fir, chestnut, coastal fir, red oak, or on better nutrient-supplied sites also again beech but also silver fir, Norway and sycamore maple, the tree hazel or also the wild cherry.



## Chapter 7-4: Pioneer forest – conclusion

What conclusion do we draw from the pioneer forest? We can produce high-quality birch and alder wood, which is used for furniture, saunas, the special application also for sports equipment and musical instruments, completely underestimated as cross-laminated timber and glued laminated timber, and for glued beams, special use in casting molds, but also traditionally for woodturning and carving. That's it so far, in the next lecture we will talk about the reforestation with foreign tree species, in the first part with introduced alien hardwoods, in the second part with introduced alien conifers.

## 3.6.8. MODULE 8: INTRODUCED TREE SPECIES

## Chapter 8-1: Introduced deciduous tree species

Regarding the introduced alien hardwood species, I would like to introduce you to the tree hazel, also called Turkish hazel, the sweet chestnut, the lime-leaved birch, the well-known walnut, and the tulip tree. The tree hazel stands out already by the fact that it has these disheveled, clumped fruits, usually quite abundant, and in many cities in the streetscape, as seen here, well recognizable. But there are also different forms. On the left, we see the annual seedling, the typical height or assortment is 80 to 100 centimeters, and on the right is a tree hazel over a hundred years old in Cologne - they are beautiful trees. So, it is not, as often said, a tree second-orderder, but they can reach up to 30 meters in height. Where does it come from? Balkan Peninsula, Turkey, hence the name Turkish hazel, to Afghanistan, a tree species of southern or south-eastern Europe. It is a semi-shade to light tree species, heat loving. Thrives on a wide variety of substrates, on calcareous as well as on acidic soils, moderately fresh to fresh - what it does not like are stagnant and groundwateraffected soils. The biggest threats it faces are mainly mice. They are extremely fond of gnawing in the area of the root neck and can cause massive damage. The tree hazel is very patient, can be mixed very well with wild cherry, sycamore, and field maple, with the two native species of linden, and just as well with the wild service tree or even with lime-leaved birch, which we will have a closer look at in a moment. What makes it so special? The extremely fast young growth and extremely good litter decomposition. Regarding the use of wood: mainly in the veneer and furniture industry, it is a very much sought-after wood, also in woodturning and woodcarving. Sweet chestnut, edible chestnut, also known as Maroons to many. Many beekeepers swear that in spring, when the chestnut blossoms, a very high honey yield is possible. The fruits, just mentioned, are known to us all as chestnuts. Forms beautiful stems, heights of 30 to 35 m possible. In the ring pattern very similar to the native pedunculate and sessile oak, the wood is similar in structure and possible uses. The natural habitat of the sweet chestnut is in southern Europe and around the Mediterranean. It is a light tree species that like warmth. It likes slightly acidic to acidic soils, it does not like lime, and it also does not like waterlogging. It is endangered by late frost, it sprouts late, but there is always a certain danger. It is also often bitten by deer and other cloven-hoofed game, and sometimes swept. You can mix it with both oak species, Douglas fir and red oak, Beech, European lime, European larch, or silver fir. A special feature of this tree is its very fast young growth, you have to select future F-trees already at the age of 10 to 15 years and promote them, as the reaction within the crown growth then decreases very, very quickly. In terms of wood use, it is practically oak without medullary rays. As construction timber, as furniture wood, as veneer wood extremely weather-resistant, even better than our native oaks, therefore also suitable as shingles, fence posts and vineyard poles, and of course in inferior qualities sought-after firewood. The lime-leaved birch: the name comes from the leaf, that you can see there: three, four, or five times larger than that of the native birch species. It originates from Japan. Very fast-growing, extremely fast juvenile growth, and at the same time able to get very old, much older than our native birch species, up to 280 years. It is a light tree species, it would like to have well-rootable, moderately nutrient-supplied to well nutrient-supplied, fresh, or very fresh loamy soils, it does not like acidic sands, acidic moor soils and waterlogging. It can be mixed, as the location already indicates, with actually all deciduous species, i.e., wild cherry, sycamore and Norway maple, elm species, small-leaved linden, red oak, as well as with beech or even with the tree hazel, which we have already discussed. It is used as a veneer and furniture wood. The trade



name cherry tree already indicates that the wood can also - because of its special hardness - be used for flooring. The walnut is known to many, at least the fruits, here on the tree with the green shell still visible. Its natural habitat is eastern Turkey, Iran, Afghanistan and India. Likes well aired, warm, moderately alkaline to alkaline-rich soils, the water supply does not have to be so good. And it always wants full light. As a heatloving species, the walnut suffers from winter and late frosts. It is mixable with the sweet chestnut that we just discussed, or with the two native oak species, the pedunculate and sessile oak. It is planted relatively wide, 2,5 by 2 m. And a special feature, if you want to achieve knot-free, valuable shafts, it is necessary to prune them, and here the green pruning in the summer is recommended, not dry pruning in winter, but green pruning during the summer months. Use as veneer and furniture wood, special use for rifle stocks, parquet flooring, musical instruments, and selected woodturning products. The tulip tree: a North American native from eastern North America, known in some gardens for its flower, which also gives it its name. The tulip tree is a light tree species that loves well rootable, well to very well nutrient-supplied, fresh to very fresh soils, with no waterlogging. On these soils, it is of course mixable with all deciduous species, wild cherry, sycamore and Norway maple, sycamore and fluttering elm, black walnut, and lime-leaved birch. It is characterized by straight, largely knot-free shafts, and very good litter decomposition. Another special feature of the tulip tree is its use of wood. It has very light wood, which is filled with air chambers and thus achieves particularly favourable values in terms of insulation: insulation against cold, against heat, or also against sound. Therefore, special uses are always possible. Otherwise in doors, windows, in model making, or even in musical instruments. In the next part, we will deal with the imported alien softwoods, and I say: see you in a moment.

## Chapter 8-2: Introduced coniferous species

I would like to introduce five selected foreign introduced coniferous species, the western red cedar, the Atlas cedar, the Lebanon cedar, the coast redwood, and the western hemlock. The western red cedar, Thuja plicata, is native to North America, from the West, from the Rocky Mountains, and the coastal mountains, stretching up to Alaska. It is an extreme shade tree species, it likes moderately alkaline to poorly alkaline, fresh, and very fresh soils, the water supply is more important than nutrient supply. Very fond of foggy sites, i.e., sites with high humidity and no waterlogging. As a shallow-rooted tree, it tends to become windthrown with waterlogging. In its natural habitat, the greatest danger is presented by ground fires, as it has a relatively thin bark. It always occurs in the mixture, in mixture with the large coastal fir, in Central Europe it can be mixed very well with beech or silver fir. It is characterized by a very good litter decomposition, a highly durable heartwood, which is easy to split, which is why it is used for shingles and exterior and interior paneling, for windows and it is also known as fragrance wood, traded in Europe under the name Western Red Cedar. The Atlas and Lebanon Cedar, for laymen at first hardly to distinguish: the Atlas Cedar, Cedrus atlantica, comes from the mountainous regions of Morocco and Algeria, whereas the Lebanon cedar, as the name suggests, comes from Lebanon, where it also appears in the national flag, and it occurs as well in Turkey and Syria. Both are semi-shade tree species, they like base-poor - especially Cedrus atlantica - to base-rich sites - Cedrus libani. Moderately dry to moderately fresh soils are preferred by both, with no waterlogging or ground water. The Hallimasch is a threat, mice are quite keen on them, and deer or red deer also like to sweep them, when they can get to them. They can be mixed with black pine but also with native species like English oak and field elm. If we experiment with these tree species, we must expect to have high failure rates, especially if mice get at them. We still have to plant them in wide spacings, 3 by 2 m, because these trees tend to have very large, wide overhanging crowns. In order to produce valuable timber, it is imperative to gradually carry out pruning. The wood is very valuable, it finds use in the interior and the exterior, in shipbuilding - the Phoenicians already knew that-, in furniture making, but also as paper wood. The coast redwood: again, a North American, again from the coastal mountains, here are two photographs from the arboretum Burgholz near Wuppertal, and you will see 47-year-old trees with 10 m in length and 65 cm in center diameter, they already achieved revenues in 2015 between 132 and 206 €, which are values to be appreciated. It is a beautiful wood, this rust-red colour remains for a long time. It is a shade tree species,



which also does not allow any other mixtures. It gives a lot of shade, it needs a lot of shade and under it or next to it does not tolerate companions. An unsatisfactory scattering of branches means that, if we want to produce value wood, it is absolutely necessary to prune them. Known to many of you by the trade name Redwood. This is the Redwood, which is used as veneer wood in external and interior paneling, in hydraulic engineering - because the shipworm does not affect it, nor termites, that's why this wood is also very popular for selling in the tropics. Due to its extremely high durability, it is used in fence construction, windows, and roof shingles. The Western Hemlock, again a North American from the western part of North America, Washington, British Columbia, and adjacent states, fructifies extremely early and extremely often, as you can see well in the picture here. And here is a photo from the snow: the entire ground is full of these small seeds. The Western Hemlock wants fresh, humus-rich, well-aerated, low-base soils. Windthrow and drought are problems that occur - since it has especially shallow roots, drought affects it immediately and also its stability is not given. Furthermore, there are many root and stem rot pathogens that can very quickly lead to wood decay, as the wood is not durable. Mixable as in its natural habitat with Douglas fir, western red cedar, and the large coastal fir. Special feature: extremely fast growing, intolerant to many other tree species that are planted with or come up next to it. It casts a lot of shade and overgrows many tree species next to it, and they die. There are already several European countries that have classified it as invasive. You certainly have to keep an eye on that, it is a considerable threat. The wood is used in sauna construction and interior paneling.

# Chapter 8-3: Conclusion

Let's get to the conclusion. We all do not know what else climate change will bring. The use of introduced alien tree species broadens the tree species spectrum and thus also the silvicultural possibilities in Central Europe. We have the possibility to use specific wood properties, and here and there also to increase wood production as such, so that we can continue to provide the renewable raw material wood. The admixture should be limited to a maximum of 20 percent of the area, and the foreign tree species should be established in groups to clusters in the area, they should also be mixed. It is very important to maintain a distance of several hundred meters to biotopes or to rare forest communities that are worthy of protection. Further information on introduced foreign tree species can be found at www.waldwissen.net, and short profiles of the alien tree species you are looking for. I say thank you, and we look forward to seeing you for more information on reforestation in our classroom events, webinars, and podcasts.

# 3.6.9. MODULE 9: PRIVATE FOREST OWNERS AND RESILIENCE TO CLIMATE CHANGE

### Chapter 9-1: Private forest ownership in climate change

Hello, I'm going to talk about forest owners and the resilience of our forests to climate change.

The challenge of climate change is direct for our forest owners, who are facing two risks: a direct risk and an induced risk. The direct risks are the hydric risks in summer, with a lack of rainfall and heatwaves, also flooding in winter, frost, and phenological changes linked to the adaptability of species in the forest. Induced risks can be storms, calamities, fires, forest health problems, insects and also the change in biodiversity linked to climate change.

What are we talking about? We see here on this map a trend from 1901 to 2000 in the evolution of temperatures in France. The mean increase in temperature is 0.9°C and we see in Aquitaine and in the south-west a higher increase of 1.1°C, which is important for the forests.

On this map, we see anomalies and the potential impact of climate change on the productivity of maritime pine (*Pinus pinaster*). If we compare the years 1990 to 2070, we can see that the New Aquitaine area is impacted by up to 30% in the anomaly.



For beech, and broad-leaved trees, consequences can also be very important, and we can see here the regression of beech budburst area, in the 1960s compared to the 2070s: we can see that budburst may not occur on the entire Atlantic coast.

For the needs of a study, we interviewed forest owners, and out of 43 forest owners, 47% had observed the impact of climate change on their forest. So, the owners are well aware, but unfortunately, they often do not take action.

We can see on this diagram that 29% of them have not acted on this observation. On the other hand, 62% have acted mainly by favouring mixed species in their plantations, which reduces both the risk of fire and also by replanting species known to be more adapted and more resilient.

We can also see how owners react, (from AcclimaTerra report), from a report from the Aquitaine region, where 44% of foresters reported not seeing climate change as a major problem. They think that the trees will be resilient and will be able to evolve and adapt to this new climate. But 41% of owners postponed implementing their solution until later, so you see, only 13% of Aquitaine's owners declared that they are really taking action.

So, taking action seems difficult for forest owners. Why is this so? In fact, we can explain this because we have different profiles of forest owners. We can see that on this diagram, there are owners who are rather gatherers, who simply harvest dead wood for firewood, mushrooms, for self-consumption, and others who are neophytes, without much forestry knowledge, who are not concerned about the future of their forest. Others who are more interested in the sustainability of their forest and mere conservation of biodiversity, others who are not so involved, who do not necessarily live in the area, opportunists who want to buy forest and pursue rational investments, and therefore watch over their investments, and others who are simply wealth curators. These are the different types of private forest owners.

The constraint for owners concerning adaptation to climate change is more a lack of information and knowledge than a lack of interest or capacity. We can see in this diagram, from a survey that was carried out in 2016, that it is rather the lack of information and the lack of knowledge of owners that is limiting actions.

Similarly in Europe, in the various surveys that have been carried out, we can see in Belgium that 71% of forest owners expressed concern about climate change but only 32% said they had modified their practices.

In Sweden, the adaptation of forest owners depends more on their concerns about the future climate, and the main changes observed are mostly more frequent insect attacks, droughts and also some windthrow.

In Austria, funding has little influence on the decision making of owners who often reject forest management with the use of highly advanced technology such as the digitalization of forests. The same is true for owners in Europe, with the use of the word "adaptability" instead of "resilience". Let's define the adaptability of forests to climate change again: it is the capacity of systems, institutions, and forests, to adjust to potential damage, to take advantage of an opportunity, or react to its consequences. So, the question arises: do we adapt our forests, or do we leave our forests resilient to climate change?

So additional questions arise, underlying questions: What species to plant, where, and from where to get them from, is there a balance between hardwoods and softwoods, hardwoods which are in the majority in France, but the market is for softwoods, so we must also adapt the forest to tomorrow's market. What type of silviculture is best suited: short silviculture, irregular silviculture, silviculture different from the one currently practiced? How can we adapt the management objectives and how can we integrate the sustainable management of our forests in the management documents in France, and what is the evolution of the landscape? These are many questions that need to be answered, and we also need to collect data.

Resilience to climate change requires, firstly, better documentation of existing stands and more and more field assessments, as we can see in the photo with the forest owners, taking into account the soil, the water



stock of our soils, the vitality of the stands, how they react and, thirdly, of course, to have vulnerability maps of the stands.

Secondly, we need to use indicators and vulnerability maps, so here you can see forecast maps concerning the chestnut tree and the ink disease. You can see that the risk is currently not very developed in regions like Brittany, Aquitaine, Occitanie and the slightly arid areas, and we can see the increase of the regions likely to be at risk in 2100 or so.

Thirdly, we need to gather as much information as possible, and here we are participating in a European project called Reinfforce, covering four countries: Portugal, Spain, France, and the United Kingdom, where we have set about 38 arboretums, each with more than 2,000 trees, on which we are going to look at and test the adaptation of these species to global warming. We are currently collecting data from these 41 demonstration sites since they were set up 10 years ago to test different adaptation managements.

How can we take action? As we can see, we need to take action because in Aquitaine there are more and more decaying or dead stands that can be restored with species better adapted to the constraints of the environment, and we can see the results of the 1999 storm and the coppices of chestnut trees that have become entangled, it's impossible to walk in, and which are now at risk of fire and which destock carbon.

In conclusion, the main challenge for the forester and the private forest owner is dealing with uncertainty in their forest management. Vulnerability maps and other diagnostic tools can help, but this uncertainty cannot be modeled. We have to adapt and be humble about this major issue. Secondly, this uncertainty must not create inaction and expectation or even despair but lead to reasoned action with thrifty and diversified forestry.

Thank you for your attention, and in the next presentation, we will look at possible actions and solutions for resilience to climate change.

### Chapter 9-2: Climate change as a chance?

Hello, I'm going to talk about forest owners and their actions regarding forest resilience to climate change, "Possible actions and solutions for resilience in the privately owned forest".

Forest owners have observed the effects of global warming on their forests but taking action is often difficult. Most of them are aware of the threats to their forest and the need to act, but they do not know how or where to start. So how do we motivate our forest owners to adopt new solutions?

We cannot do anything. In Western Europe, our owners tend to prefer an ecosystem-based management approach. A study on 1140 European forest owners showed that their conception of forest management was: first, preserving the forest for future generations, followed by caring for their forest and maintaining its resilience.

So, it is important to think in the long term, with the natural heritage and future generations in mind. Action is mainly triggered by professional sources (forestry advisors, cooperatives, advice from a forestry professional), especially for the owners who have large areas of forest. For small owners (less than 10 ha) the change is more widely defined on the occasion of the renewal of a management document. This diagram shows the proportion of owners who have changed their practices according to different triggers.

The level of action is different at local and global scales. That is to say that, at the plot level, for example for the management of an existing stand, we focus on the evaluation of the vitality and resilience of the forests, and on the reforestation side it is rather the choice of the species that are best adapted to the station.

At the landscape level, for the management of existing stands, it is the field and soil assessment that is important and at the reforestation level, the interest is to encourage biodiversity and participate in the local economy. At the regional level, what is important is the vulnerability maps of the stands, and when it comes to reforestation, the additionality of carbon storage is important.



How to see climate change as an opportunity: the French government is encouraging the adaptation of forests to climate change by implementing communication actions and by offering subsidies to forest owners, through different organizations. We can see this with the FOREDAVENIR project, which is financed by ADEME, the energy agency of the Ministry for Energy Transition, as well as the Low Carbon Label, and at the level of the Ministry for Agriculture, the Recovery Plan (France Relance), for the revival of the economy.

At the local level, there are regional funds to help with forest assessments, management documents and reforestation. We can see in a practical case how climate change can be an opportunity for forest owners who are faced with a dying stand, as shown on the slide. So, this is a study case: restoring a dying stand in northern Gironde and how to move from an abandoned forest to a cultivated forest. As you can see, it was a coppice of deciduous forest that was dying, and so we were able to cut down these trees and replant with species that are more adapted to the soil, move to a cultivated and managed forest, and anticipate the development of the replanted species in 30- or 40-years time.

So, we can see that the wood that has been sold was mainly for energy wood and little quality wood, and we can see from the economic analysis that the owner benefited from a subsidy from the Agency for the Environment and Energy Management, which depends on the Ministry for Energy Transition, which covered 40% of the reforestation. So, if we make this calculation, we see a balance between the reforestation expenses and the income from the wood, so  $668 \in \text{of}$  income from the wood. With the cost of reforestation, which was around  $1000 \notin$ , this subsidy allows us to balance expenditure and income, and to have a slightly positive final balance, which enables us to pay for insurance or taxation costs, or union membership in some form of grouping.

So, we can see that the economic balance is beneficial. The value of the stand (the value of the wood) was about  $668 \in in$  year N-1, a poor stand that would have yielded about  $900 \in in$  30 years, with risks of fire and very low valuation, whereas here, thanks to this reforestation and dynamic silviculture, we can obtain between  $5500 \in and 10,000 \in in 30$  years, or even more if we plan longer term management, and have quality timber, and therefore a potential profit that will be largely superior to the initial stand 30 or 50 years after the reforestation.

There are three types of strategies for action. The first one is to know your forest better, for optimal action. This means using digital tools to help owners in the process, and in documenting their forests. These tools also allow them to be put in contact with forestry professionals and forestry services for forest thinning or planting. Several countries offer such platforms, as we have seen in Rosewood, and in France, the CNPF has set up LaForêtBouge: a digital platform that firstly allows you to list and provide information on the woods, the species, and the history of the actions to be taken. Secondly, it allows owners to access a directory of professional and forestry companies. Thirdly, you can register management documents (simple management plan), in digital version and keep up to date with the operations to be carried out. Four, it allows owners to know the price of wood in order to be better informed about the value of their forest.

The second type of action is to gather together with other forest owners for a stronger impact. Grouped management allows a reduction in costs (economy of scale) and the mobilization of more wood. Forestry actions are more coherent on a landscape scale and have a greater impact on certain problems such as fire, and phytosanitary attacks. Moreover, grouping owners together offers the possibility of developing new activities, such as resin collection in New Aquitaine.

You can see on this map, different grouping structures according to the needs of the owners and local objectives. There is no miracle solution, each form of grouping is different: free, profit-making associations, forestry groups, ecological and forestry economic interest groups. The third strategy for action is to invest in carbon storage: forests can help to reduce the effects of climate change: they can be a driving force and a dynamic force thanks to the sequestration of atmospheric carbon during photosynthesis, and also through the use of wood products.



Our forest owners are invited to choose a better approach to manage the carbon potential of their stand (high ecological value stand to preserve, weakened stand to renew).

We talk about the three "S" theory for carbon in the forest. The diagram explains it well. One, is sequestration in the forest, in the soil and the vegetation through photosynthesis. Two, storage in products (timber, paper, cardboard, logs, lumber). Three, the substitution of fossil fuels for more energy-intensive materials such as aluminium and oil: fossil carbon is substituted, and this helps limiting the greenhouse effect.

In conclusion, I would like to highlight three points. Firstly, it is essential for owners to have access to informed and specialized information, to help owners in their decision and to provide technical and administrative support. Secondly, the solutions available to owners have several levels of action. And thirdly, they are based on the multifunctionality of forests, both in terms of their ecological and economic value, as well as their carbon balance potential.

Thank you, I hope my presentation was clear, please do not hesitate to send me an e-mail if you have any questions.

## 3.6.10. MOOC 2 Webinar Reforestation – Questions and Answers

Good afternoon, ladies and gentlemen, I would like to welcome you to our webinar on reforestation in times of climate change. Many of you attended our on-site event on this topic on September 2nd (2021), and some of you have already taken a look at our MOOCs on the learning platform, and we asked you to send us questions, questions about your specific operational situation, your circumstances.

Thank you very much for the questions and in the next hour, the experts from the Center for Forests and Wood Management will be happy to answer them. I would like to introduce my colleagues to you, you already know them from the on-site event.

On the one side, there is Ms. Elke Hübner-Tennhoff from the Forestry Education Centre Team. Mr. Norbert Tennhoff from the Silviculture Team and Mr. Martin Nolte also from the Forestry Training Centre Team, forest education center, who are about to give answers. And we in the studio are of course vaccinated and tested negative. Perhaps a brief note on the use of our conference software, and some communication guidelines: Please keep your microphones muted during the transmission, and please unmute them for questions or your contributions to the discussion. If you are connected by phone, there is the zero button on the phone, which does the same, as the option to switch the microphone on and off. Further, if you have any contributions, via chat or by raising your hand, you can make yourself noticed, and will be switched on here in the studio. So much for an introduction, and now let's move on to the first question.

The first question here relates to a forest area very close by. It's about a higher ridge on the Sorpesee, and we got a question from a forest owner, and the area is located on a very heavily frequented path, with many mountain bikers and hikers. The area is made up of two adjoining triangles, a deforested former spruce area, the felling has been done in 2021. Ultimately, harvesting measures were caused by bark beetle calamity. We also received a corresponding image from the forest owner where you can see the area, also the condition on the surface. We will show it in a moment.

I would like to put the question to Norbert Tennhoff: so far there has been no natural regeneration in this area except for the blackberry, it just comes, and now the forest owner would like to know what to do. Should he wait for natural regeneration, or should he plant, and when he plants what should he plant and how do you protect these plants from game and humans?

A very complex question! Let's start first with the location. Ultimately, that is the most important requirement. The altitudes in the area of the Sorpe are more than 350 meters above sea level. As the forest owner already described in the question, it is a ridge location, which means that the water supply is usually



very marginal, we are talking about moderately fresh to moderately dry locations. As you can see in the picture, there is still old beech and oak growth on two or three sides, so our recommendation is to act in combination: Plant this area in groups with pedunculate oak and sessile oak - both native species are suitable. Or you can also combine the sweet chestnut very well with it. Otherwise, natural regeneration from birch, rowan, but also the neighbouring old wood, i.e., beech, will come into the area. This can then also be taken into the concept.

Due to the location, it is simply not possible to fence off the area to protect it from humans, dogs, and games. Two triangles are a very unfavourable area structure - if necessary, I would say with gates, which is actually the most common. It is built of wooden material, at some point, it can disintegrate and does not have to be dismantled and cleared away.

Thanks very much, are there any additional questions? This does not seem to be the case.

Then we come to the next question. This is again addressed to you, Mr. Tennhoff, and it is about the big relative of our hazel bush, it is about the tree hazel, so far, a rather unknown tree species in Germany, its original distribution area was the Balkans and Turkey, but it also grows here, certainly an alternative in times of climate change.

The forest owner had a question about it - she has planted tree hazel on 0.4 hectares, two by 1.5 meters, now 13 years old. She also sent a picture of what the stand looks like at the moment, it is growing impressively fast. The question now is, does anyone have experience with the tree hazel, what would one do in terms of care at this point? And there is now a small difficulty, namely, the trees have a black colouring, necrosis, we also have a picture of this, some trunks, did anyone have similar experiences in this respect? Those are basically the two questions the forest owner has.

Let's start with the front part. In the case of tree hazel, we have many test areas and observation areas in North Rhine-Westphalia. Almost all with positive results, because this tree species tolerates high temperatures and also moderately dry locations very well. It loves nutrient-rich locations, so you shouldn't expect everything from him, but it shows very good growth performance on these well nutrient-supplied and also fresh soils. It forms high-quality wood, which can also be used as furniture wood, and at the same time, it has very good litter decomposition, which also makes it a climate-stable tree species.

Otherwise, ultimately let it grow, and enjoy the fact that it's so vigorous! You can certainly take a closer look at one or the other F-tree in the near future, i.e., select it and clear its surroundings, also connected with a first pruning up to reaching height. This also makes such trees more conspicuous during the next maintenance operation. Otherwise, it also has very good knot cleaning. What certainly needs to be clarified is that it is not a second order tree, which many think we also have relatively old cultivations in the Cologne area that are over 100 years old and almost 30 meters high. It is very well suited as a mixed deciduous tree species in oak stands.

Otherwise, with regard to the second slide, we have not yet been able to detect these discolourations or bark necroses, but from the picture, I can only see a superficial black discolouration. Therefore, we should certainly observe the trees that have these black spots, if there is a loss of vitality, a yellowing of the leaves, an earlier discolouration of the leaves, perhaps a leaf drop, things like that. Then you would certainly have to call in the colleagues from the forest protection department and see what is there. Maybe it's just a superficial fungus that has settled there because of the rough bark. But that's all I can say at the moment.

I also pass the question on to the audience: do you have any experience with hazel trees in your forest?

Okay, that doesn't seem to be the case, so it's still a rare tree species, that may be increasingly cultivated in our area in the future. The next question from the forest owner is about cultivation and competing for vegetation. We have our maintenance expert, Mr. Nolte, to whom I would like to put the question. It is about an oak culture from spring 2020, it has been tended this year. One year later, in spring 2021, the oaks



under a layer of bush grass look far better than the specimens in the rest of the area, how can that be? Is grass a protection against evaporation for extremely dry years or is this accompanying vegetation rather be seen as a competitor for water?

Here are a few remarks: we know that the bush grass forms a strong grass root felt. On the one hand, this inhibits the penetration of rainwater, and on the other hand, this grass naturally forms extremely deep roots of up to two meters, which of course strongly influences the water balance for the entire area. Furthermore, we have a special feature with this grass: the death of the grass and the stems creates a biotope for mice in late autumn/winter. And here we have to mention the short-tailed mice, namely field mice, field voles and water voles. In the course of the feeding-poor period, all these cause damage to the trees planted in the area.

The third point is, that in spring, due to the grass straw layer and the lower warming of the soil, the late frost risk of the sensitive tree species is significantly higher on such sites than on other sites.

So, in short, we conclude that this bush grass has a negative influence on the water supply. Regarding the question, there must be another reason for the plants in this area to grow better in the bush grass than usual.

Again, my question to the audience: are there any comments or questions on the topic of accompanying vegetation or culture maintenance from your point of view? That does not seem to be the case. Then we come to our next scenario.

A forest owner has sent us a description of the area and it is about the choice of tree species for deforestation, and the question now goes to Mr. Tennhoff.

It is a 1-to-1.5-hectare spruce calamity area, located in a plain 52 meters above sea level, ground moist to humid, base poor, and there is natural regeneration of birch, partly spruce, and the tree species from the neighbouring stands are beech and sycamore maple. The forest owner sent us 2 pictures of the stand:

Here is the first picture, where you get an overview of the stand. This is about further treatment and reforestation, and also possibly - this is the goal or intention of the forest owner - inclusion of climate-stable tree species that we have not yet used in this way. In our NRW Forestry Guidelines, we have a corresponding recommendation, regarding new tree species - I would like to deliberately avoid the term "foreign" for the time being.

Mr. Tennhoff, what alternatives are there for the forest owner?

Looking at the pictures that have been sent, you can only give the recommendation: let the pioneer forest which has established itself grow tall in any case! This will reduce further weed growth, and then you can selectively foster the birch F-trees in the areas where the birch is established. This means selecting the best birch trees, pruning them, and maintaining them. To get there, however, there is I'll just hand it over to my colleague Martin Nolte, who can describe it very well.

Such areas have a special feature, if they are already more advanced in their development, especially through pioneer tree species. In this case, it is important to inspect the area precisely and for this, so-called maintenance paths are helpful. They are only one meter wide and simply have the task of dividing up areas in order to provide an appropriate view of the plants and stages of development.

If you are creating these paths today, then please do it in such a way that you have the option to take turn them later into a corresponding skidding lane system, because it is a basic structure through all forest development types. Through these paths I get an overview of the area, I get to know the area better, I see what has already established itself and can then select and tend to the best birch or alder F-trees that will grow here on this relatively nutrient-poor, but very well water-supplied site.



Furthermore, I will determine whether naturally grown other tree species from the neighbouring forests are present, there are mostly oaks by jay seed, beech, or others that have flown in over the last few years. As soon as the birch trees are eight to ten meters high, maintenance can be provided in it in a targeted manner, and holes that are still present can then be planted.

Now I come to the tree species mentioned: on the one hand, the Red Cedar would be suitable as a trial, or also the Coast Redwood, which wants a good water supply, but can also cope with a nutrient deficiency or a relatively low nutrient supply.

Both are shade tree species, so they need the birch shade as a sunshade, also as frost protection. We must not forget that we also have a tree species that already exist in Germany, namely the silver fir, which copes very well in this environment and should certainly be used.

The forest owner is connected to us, as I can see - please take the opportunity to ask our experts questions further about this or your area. Or was that answered sufficiently from your point of view? That seems to be the case.

Let's move on to the next question: a colleague from the communal forest, who also attended our on-site event noticed that we were dealing with the topic of individual tree protection and especially the so-called spike tree. We have had many good experiences with this individual tree protection in this communal forestry operation, several thousand have already been installed and he now has a question on this topic, because he has heard from other operations that more and more blind or one-eyed deer are seen when hunting who had been injured in these spike trees. Is that true, or is it just a rumour?

The question goes to our expert for mechanical forest protection, Mrs. Hübner-Tennhoff.

I brought this one with me - what is the spike tree? We did not have it at the on-site event. It is made of wire, the horizontal ones always cross-opposed. The spike tree is placed right next to the plant. Experience says it is a very effective protection against fraying, you can say up to 95 percent. It has been often used in forestry but has gone a bit out of fashion. Why? We bring metal into the forest, and we have to dispose of it again, which means there are follow-up costs, you have to calculate about two euros per plant. But in itself, it is still an effective means, especially now that we have to reforest these calamity areas. There are reports of individual cases of injuries to humans and animals, that's true, and perhaps we need to take a closer look at how effective it is. Injuries to animals can occur, but only in isolated cases.

It's just that if it happens, of course, we have bad publicity, because we have endangered animals, and that's more of a communication problem, which you have to sort out. If you are perhaps a little cautious, especially in the communal forest, where many citizens go for a walk. There is also the possibility of using a spiked tree made of wood, perhaps as an alternative. We advise, even if the complaints are minimal, to simply accept and communicate them. General statement: we cannot actually confirm the frequent occurrence of blind deer.

Thank you very much for the answer, yes, any additions in this regard or further questions?

That does not seem to be the case. We just have another contribution - Mr. ..., can you perhaps hear us and ask your question by the microphone?

I have a question for the skid trail systems, Mr. Nolte, in an area in Brilon, we have created them seven or eight years after Kyrill, and you can still see these trail systems, but in the meantime, you have to look very closely. I would like to have some advice: Should I maintain these trails now ...they are twice as old, around 16 years, are disappearing and slowly growing over. Of course, we had worked before to integrate them later into the skid trail system. So, should they be opened now, to be able to find them later?

I would like to answer this question, Mr. ..., and you actually already got to the heart of how to proceed. In the beginning, we said about the maintenance paths: We are first creating the maintenance paths with a



width of only 1 meter in order to prevent them from growing back more quickly due to the greater influence of light. Logically, it grows over from the side, and we have to rework it. However, the time required is significantly less, and I would like to explain this: we have worked out planning figures with the University of Göttingen and assume that for one hectare with around 400 running meters of these maintenance paths, the time required is between 150 and 200 Euros, including the measuring.

Of course, that is not necessary for the second pass. It would be quite enough to cut them open a little further at the sides now, especially if they are conifer-dominated so that you can see them later - after this second intervention as you described - after 7-8 years so that you don't have to re-measure and re-plan as for the first thinning. Does this answer your question sufficiently?

Yes, thank you very much, and a follow-up question: I am concerned about these stocks because the top height has meanwhile been destroyed by the bark beetle and all neighbouring stands as well, if the bark beetle will now also enter the young growth and spread into the spruce, then of course [opening the maintenance paths now] would have been a waste of money.

So, I would now not do a stem number reduction, or as you did in your forestry operation, pruning single trees, that is what I would definitely not do now. But the cutting of the pathways refers only to side branches, which would definitely work. So, an intervention in the population now would also possibly endanger young stocks at the upper height of 6, 7 or 8 meters.

Thank you!

You're welcome.

Now we come to the next question from a forest district manager from the communal forest, is he connected? I think so! Then I can ask my colleague, Mr. ..., to ask his question.

Hello, I have a question for Mr. Nolte. I am thinking of his plant demonstration stand at the on-site event and I wanted to ask, if he could still give us a brief rundown: When the plant deliveries are due in autumn, what quality criteria one should look out for, or, under certain circumstances, what options one has to approach the nursery afterwards in the case of bad plants.

I am happy to do that, I have brought a specimen with me, and we have also prepared a slide accordingly by simply stating the criteria of the planting. We have described planting quality with regard to the depth of the planting and here you can simply see that the plant stands accordingly low as it stood before in the nursery. Here we have the term day-night zone, completely uncritical. The second point is the alignment of the plant, it stands reasonably straight. We accept a slight inclination, but if it becomes more, this is to be seen as a non-fulfilled quality criterion. Further, we have to check the firm stand by lightly pulling on the terminal shoot with the two-finger-probe, and notice resistance there.

What is much more important, and where you have to pay extreme attention to the quality control of the planting: what happened to our root. Here we see a normal root of an oak that is directed downwards, and we have also heard at the on-site event, that the root is decisive for growth and especially for opening up larger root spaces downwards in order to supply the plant with water and nutrients accordingly. Those were the rules.

We recommend that you inform your contractors about the quality of the planting, which you can also see here, and then you can carry out a quality control afterwards, which I would like to explain to you very briefly. For this I refer to the criterion of root alignment, as the first three criteria mentioned can be determined relatively quickly by eye or realized with the finger test.

What if we do not have the quality criteria we need to ensure that our goal – securing investment - is achieved? We see a specimen here that clearly has a deformation of the root and is clearly negative. How do we manage to keep the organizational effort of this quality control low for you like the forest manager?



We have another slide for you (please open below the video), where we record controls in an Excel-based calculation frame on a random basis via sample circles. And it is simple, you make a mark for this deformed root, and this shows in the evaluation how high the proportion of incorrect plants is in the area.

And then you can enter into negotiations again with your planting team, which has been active there, as a service provider or with the corresponding labour force. Please establish first what it should look like so that the planters know what you expect from them, and the target/actual status comparison can be carried out well later. Does that answer your question sufficiently, Mr. Kiefer?

Thank you very much, completely answered.

One more question for the participants, could you all see this takeover protocol, was that possible, or could it be shown again briefly? Good, we now come to the next question from a forest owner.

Again, it is about the concept of the reforestation of an area destroyed by bark beetle and the question goes to Mr. Tennhoff.

Perhaps I will describe it briefly. So, it is about reforesting 0.8 hectares of bark beetle area. It is a steep southern slope between 390 and 450 meters high, so it also has a corresponding changing water balance. Douglas firs have already been planted in the neighbouring areas, and otherwise, there is growing spruce and birch, as is already known from Kyrill.

The forest owner's goal, however, is a near-natural mixed deciduous forest and he is now asking how he can achieve this, when should he plant, now or later, should he work with natural regeneration, should he wait for it, if he has a pioneer forest, how old should it be, and what height should the pre-forest have? These are all things that interest him.

Thank you. The 0.8-hectare steep slope means that the water supply varies a lot within the slope from the upper slope down to the lower slope - possibly a watercourse runs at the bottom as well. Let's start at the bottom, the water collects at the bottom, which means that we usually have a water balance level of at least moderately fresh to fresh, so we have a lot of options. The desire, as already mentioned, for a near-natural mixed deciduous forest, where the pedunculate oak would be a good choice. The pedunculate oak can well be mixed with other tree species such as hornbeam and small-leaved lime. Due to the better water supply, these sites are also suitable for these three tree species in a mixture, whereby ten percent admixture of hornbeam and ten percent admixture of lime also secure the oak stand. Also possible, not on the open space - with a low nutrient supply - but this good water supply makes the site also suitable for silver fir and beech, both sensitive to late frost, both sensitive to the blazing sun. So, if you want to work with these two tree species, you will have to wait a while, but you can certainly take advantage of the developing birch or birch/wild berry pioneer forest.

This forms sun and frost protection, and these two tree species feel very comfortable underneath. Further up into the mid-layer area, water supply at most still moderately fresh is becoming more and more critical. There, both the pedunculate oak and sessile oak in the aforementioned mixture, hornbeam and little-leaf lime are suitable. The latter is only meant to be serving trees, so they don't have to grow so well, which makes maintenance all the easier. Beech would also work and could be mixed in.

It's still feasible for the fir, but as I said, not on the open area. Yes, and when you get to the upper slope, we will probably only have a moderately dry water supply. For many tree species, it is very critical, the pedunculate oak would still be possible, and the sessile oak would also be possible, but for the cherry, for example, it is certainly too nutrient-poor with these Devonian clay slates and graywackes.

What would work in the middle layer is European larch, but not upwards, because it then also becomes sensitive. If I want to work with shady tree species, such as silver fir and beech, I first have to create a pioneer forest and wait and see. Otherwise, it depends first and foremost on what plants I can get at all in



the nursery, are they currently available in the corresponding assortments, and also in the respective origin that is relevant for my area?

It becomes critical - and this has already been mentioned – when certain competing vegetation starts covering the area. First and foremost, we should mention bracken. Before it spreads over a wide area, I would strongly recommend starting planting. Since it grows very quickly, you will not be able to avoid fighting bracken. You could use the modified bramble rake, which has certain advantages and is, in any case, easy to manage in terms of time and money. It also does not pose a great risk of accidents because it is not motor-driven.

How big would the financial outlay be for using the rake? Only for the eagle fern cover, but if you were to relate that to one hectare now, you need about 15 to 20 hours. I also need that for a brush cutter, but I have the advantage that I don't cut anything off with the rake and can therefore be relatively efficient.

Thank you very much, are there any questions about the situation now, is the forest owner connected? No sound, that means, the question is answered. Yes, ladies and gentlemen, we have many questions, and we also have questions about Waldinfo.NRW. Our expert whom you met, Mr. Wellers, was, unfortunately, unable to attend this appointment today, but the questions have been answered and will be put into the learning platform, for example concerning abbreviations in this system, how old are the aerial photos, what is it with certain symbols or colours, these questions have been answered by our expert and will be published on the learning platform.

You can read everything there accordingly. Are there any questions from your side that you would like to ask our experts who are present here on the subject of reforestation, we still have a little time now? How can our experts help you here? If you don't have a question for us, I still have a question for you. That was our first webinar as part of the integrated training format. We have already spoken at the on-site event about the concept. How did you find the Webinar, the preparations, how were your questions taken into account, and how have questions been answered, in combination with the on-site event...? It is important to finetune the knowledge that has been provided there according to your needs and your forestry operation. I would simply like to know your opinion, on whether we have succeeded and where we can perhaps still work on this form of the digital medium, which is also new for us. Did you get along with the videoconferencing software, or was it too complicated to operate, how was the accessibility or the transmission quality? Or is everything OK for you?

I think the problem is with me, I think I still have to learn a bit and work on it.

I can hear it from the voice, Mrs. ..., welcome!

I had my stumbling blocks and joined a bit later, although I had already started quite early before the webinar, but...

It's great that you're using this new digital tool.

You also had a question, Mrs.....

I'll see you, but I hear you on the phone, I've gone through the various computer options here. Until I had you at some point...

Then we will be happy to answer your question by phone, and our colleagues will get back to you.

This has less to do with you and your preparation and more to do with me doing this now.

Yes, Mrs. ..., but if you still have a question now, you are welcome to ask the question, you also had questions regarding your deforested areas and tree species, do you want to ask the question?



Gladly, I just came from the forest and today I noticed that in a Kyrill area. I have beautiful larches that are now turning brown. Well, they are very fast growing and also have enough air, the top is free, and they all turn brown. I don't know what it actually is. Unfortunately, I don't have the opportunity to show you directly. Do you have any experience?

Very briefly, for my information, to answer the question: is this larch culture from spring 21 or is it somewhat older?

Much older, it is an area from Kyrill (2007), where the larch and birch and all that goes with it has sown itself, a natural rejuvenation. And the larch is also beautifully growing and has, of course, always been treated accordingly, and it is now turning brown all at once. We still have on the top height some green needles, but the rest have suddenly turned brown. Are there any fungi because I don't see any beetles directly?

I suspect that due to some root development, the water supply is somewhat disturbed because the brown colouring starts from the bottom and the terminal shoot can still be seen at the top. You just have to watch it. I would not write this plant off and would continue to observe whether normal budding occurs again next year, that would be my suggestion.

I'm just getting a note in here, and there is still a question about tree species mixtures, there was probably a contribution where it was again about the tree species mix. Can the question be concretized? Mrs.... you asked after the mixture of four tree species?

Yes, exactly, I had that question. I would also be interested to know which mixture is suitable. If you go for a silver fir, of course, you do it later, so you don't bring in this mixture until 20 or 30 years from now, but in the past, you had Douglas fir and spruce planted together, or larch and beech and spruce, but that's all very expensive. Then you have to do intensive maintenance afterwards, and with the areas we have, it would be interesting to get mixes that aren't that expensive.

Well, Mrs.... generally, I have to disagree with you. Especially the mixture you mentioned, larch, in this case, European larch, with beech, here both tree species benefit. The European larch, as an extremely light tree species, grows very quickly and vigorously when young, and when it is brought into an area at the same time as the beech – I am now assuming a bare area - the beech benefits from the shade of the larch.

If the larch is pre-growing, 3-4 meters high, and the beech trees are maybe half a meter high, the beech benefits from this, the larch, on the other hand, is not influenced by the beech. It continues to grow and both profit from it. The only care that is required at some point is to select the best larches, to ensure high-quality wood through pruning, and, in case of doubt, from other larches - because this affects the same crown layer. And only in the middle age of fifty, sixty years the beech presses down from below.

Then the larch crown must be kept free in any case. Similarly - as I have said before – with the two oak species, pedunculate oak, and sessile oak, I always like to mix in a serving tree species, which usually remains smaller, but provides shade and maintenance of the stem, so it remains knot-free and produces higher quality wood. Furthermore, a mix of oak-chestnut: two light tree species that get along wonderfully with each other, where you simply consider the better one regardless of the species. Always keep in mind: that at least 10 percent of a species should be kept as an admixture in any case, so that one is not lost completely. In the case of deciduous wood, sycamore maple, Norway maple, cherry, and elm - if it is there - they also get along very well with each other, they all grow very vigorously and are usually mixed with hornbeam and little-leaf lime from the outset. Here, too, the serving tree species hornbeam and little-leaf linden only bring advantages to the other woody plants. It always depends: if I mix light tree species with shade tree species, this is usually carefree. I may have to separate light tree species from each other in terms of area or by creating groups or clusters. There I bring in the pedunculate oak against the sessile oak in groups and then bring another group or cluster of chestnuts into the mix. Then it is always ensured that I can find again these



separately mixed tree species, which only have a small share of the area, and thus keep them under observation.

And how big would you make such clusters?

This depends on the competitive strength of the respective tree species: The higher the strength is - Douglas fir, for example, has a relatively high competitive strength - the smaller I can make the groups, but they should have at least 1000 square meters, 1500 square meters. The upper limit, for sensitive tree species to keep an eye on, is certainly around 3000 square meters. If I have rare tree species, such as wild service trees, aspen trees, or bird cherries, I can also plant them along the edge of the forest, in the first or second row, so that I can also see them from the path: Is there a need for maintenance? A need for pruning or twig cutting or other things? I can always keep an eye on them from the path. I also found that with the Kyrill areas it is quite convenient if you can see it from the path.

We had small fences made, inserted somewhere in the middle and then it is not so quickly apparent after all. With the large deforested areas we have now, it is then probably no longer feasible.

Hence the question: How do you mix that if you want four tree species, not two, you will have to bring something else into it. But that's what you get easily because other tree species come naturally.

What is always important, as Mr. Nolte described: If the areas become confusing because they are five, six, or seven meters high, then it's all right to invest in maintenance paths so that the area is broken down into blocks of 22, 24, 25 meters and these can be walked along. Then you get a real insight into the area because depending on the small-scale site differences, the tree species planted will of course develop differently. This gives me an insight and enables me to make a more precise judgment as to which and whether care is needed, which tree species need care, and which can simply grow wonderfully.

I can only confirm that. After Kyrill, we practically did not create maintenance paths for the larger area but left the former skid trails in from the start and kept them clear from the beginning. Then you always have blocks A and B, and you can treat the blocks differently. You always have an overview, that's important. It also brings more motivation to the workforce.

Mr. Nolte, do you have another tip for Ms....?

What she practices now would be my thought too. Facilitate walkability through the maintenance paths, and then make decisions on a case-by-case basis and not to work on the whole area in general, but to intervene where a certain tree species needs to be helped. This saves time and money and nerves and is, in our view, the most effective way of working.

Yes, Mrs..., are your questions answered so far? Yes, great, we just got another entry from Mr... You would like to ask another question about funding.

Exactly, not really a question but just a hint. I think that in terms of funding, you don't really have the option of just waiting. If you want to get funding, you have to do it relatively early, otherwise, the funding pot will be empty. But if you say you're going to wait and see what happens, something will turn up, or I would like to plant, but I first need a pioneer forest, Basically, it would be good if you could register a measure and it describes exactly what you want to do, but you first wait with the forest, so that perhaps appropriate funds could be parked. But if you wait to see how it develops, you have no possibility of receiving funding afterwards. I just wanted to say that I find it unfortunate, but of course, that is not your responsibility.

Thank you for your remark! I think it should definitely be considered whether funding periods can be extended. So that is a very important topic.

Do we have anything else in the chat? No more questions ...



OK, but that does not mean that we are no longer there for you; you still have the opportunity to ask us questions on our learning platform in the discussion forum. As participants in the course, you also can exchange information with each other, and of course, you always have the opportunity to take a look at what we have talked about here today in the webinar at any time on the learning platform.

The programme here is recorded and so you can watch it at any time. It is at your disposal in the MOOC, as well as our podcast and other contributions to reforestation. You keep your access to the learning platform, and we will post this webinar there in a timely manner.

Finally, I would like to thank you for your lively discussion and your questions. Thank you also to the experts here in the studio for being available and committing to answering the questions. We are at the end of our webinar today on the topic of reforestation, thank you very much for your attention, I wish you a good day and a nice week and good luck in managing your forests in these certainly difficult times of climate change. Thank you very much!



# **3.7** MOOC 3 – Spoken Text (video and webinar lectures)

Hardwood management - a perspective for female forest owners.

# 3.7.1.Planting Trees

I will explain the not so easy task of reforestation with broadleaved trees. I plant trees if natural regeneration is not possible or it's not suitable or I want to introduce other new tree species. Here where I stand, well, you can see a lot of grass. This was probably once a pasture area and not a forest, and therefore there grows a lot of grass. When like here grass grows very densely, then nothing else is able to grow. Here we can see a seed tree, in this case, it's a larch. Theoretically, the seed tree is considered a good practice as it propagates the natural regrowth of young larches. But certainly, no larch comes up here, the ground is too densely overgrown with grass. If I want to regenerate my forest, which will not work out naturally here, I have no choice but to plant new trees.

There are different planting methods. There are bare-root plants and there are container plants. Today, I will use container plants, which are grown in such containers. The specific feature is that this kind of plant can be planted throughout the year. The seedlings are grown with the soil in the container and can be planted as they are during almost any time. These are rowan or mountain ash trees, an ideal fit for my growing area.

Mountain ash is a servant tree species without great silvicultural importance. But for ecology it is quite important for tree species, for example, providing fruits for various birds. For container plants, you can use a special planting system with a planting tube, where the colour must match the container.

We don't have such a tool today. Today we use a cutter mattock. This is a traditional tree planting tool. Some people like it, others don't. You have to develop a little bit your own technique how to use it best. I like to work with it. We use it for hole planting, that is, I dig a hole for the young plant. By digging a hole, the soil in the ground is loosened, and then I can insert the container plant with the soil ball, fill the hole with soil, compact the loose soil, make a two-finger test, then mark the spot and plant the next tree.

Group planting was developed especially for deciduous trees and means grouping five seedlings at equal distance. One of the five trees I plant will become my future tree. The other four will eventually be eliminated, and finally, only one tree of these five will remain - the most beautiful. In group planting, I have a tree in the middle, another tree one meter away, the next one also one meter away, the next one again one meter away and the last one also one meter away. The group planting is very nicely visible here.

For the marker stakes, here I use branches, I stuck them in advance so I know where to dig. I will mark the stakes later to easily find the young plants in the next years for first and secondary pruning or weeding. What I recommend for planting: it is very advantageous to put the seedlings under the trunks, especially in steep terrain. So, the young tree is protected from snow, from branches, or the grass.

The trunk already protects the seedling from one side. That is why I decided to put two trees under these trunks. I first use the ax side of the cutter mattock. I cut once on the left and once on the right of the planting hole. Thus, I have a cut on the left and right, cutting through any existing roots. Then I turn the tool around and dig up the grass carpet with it from top to bottom. Once left, once right, and pull off the turf. Now that I've dug my hole, I get my young plant out of the container, put the plant up straight in the hole, and return the soil material that I have placed not too far away, and put it back.

Then I compact the soil with my fingers, check that the seedling is upright, tug lightly, and cover the hole. I use the two-finger test to check that the tree is firmly rooted, and cannot be pulled out. Finally, I am able to put the humus layer, or as in this case, the grass layer, around the hole. So, all set.

To help me find the young plant again, I put back the marker stakes. I can do this with purchased black locust stakes or I can just use appropriate branches lying around. I can leave it like it is, or I can take my marking



spray and colour mark the stakes to find the spot again more easily. It is important that you always plant the seedlings in the mineral substrate, i.e. you have to dig through the humus layer. That's all grass and humus. Below that, the mineral substrate begins, which contains all the nutrients that can be used by the plants. Now, within fifteen minutes alone as a woman, I have set these five broad-leaved trees without much effort.

As I said, that were now rowan trees. I can plant in the same way cherry, maple, or any other deciduous tree species suitable for my growing area. I now mark the stakes with colour, because I love marking and it makes it much easier to find the plants again. I look after the small trees for the next ten years. For the next ten years, during which they grow at a height of 1-2m, I make the first pruning, from 2.5m height, then I do a value pruning.

Value pruning I can do with hardwoods up to 6m of the knot-free stem, and then I'm done taking care of them. Then the so-called qualification phase is then finished, by that time I've decided on the one most beautiful tree that I will continue to cultivate in the future. This tree will be successively cleared from competitors later on to provide space for a nice big crown. Only with a large crown, it will produce a valuable large-diameter stem. So, then I move about 10m further or 13m, depending on the type of tree, and repeat the same thing again. As often as I want to.

With this method, I have a great opportunity to increase the value of my stock without much effort.

# 3.7.2. Tending and Caring.

I'm standing on a forest plot, where my father carried out a clear-cut in 2014. In 2017, we afforested for the first time with spruce and larch. Since then, we are successively reforesting every year, because reforestation does not work as easily as you think. If you look around, you can't really spot the seedlings that have already been planted, because all the other vegetation is growing much better. That is, I have to weed every year in spring and autumn, otherwise, the reforestation was a total waste of time and money.

The snow pressure and the grass weigh down the young trees, which are then no longer able to grow upright. If they survive at all, clearing weeds with a sickle is one of the most important measures in the care of seedlings. As I said, we are successively reforesting by mixing in birch and cherry trees.

The great benefit of clearcutting is that you have the opportunity to bring in new or light demanding tree species. This possibility is not so easily available with other forest regimes like natural regeneration. The larches are developing well. Birches, on the other hand, are difficult to raise, but a few have made it. The cherry trees, like this one, for example, I have planted this year in spring, grow amazingly well and look quite good.

Yes, and now I'll clear some young trees from weeds by sickling. Another tending measure that works very well is trampling down or bending over the weed vegetation. This is very effective, for example, with brambles. If you would simply cut off brambles, then they will shoot again very strongly. But if you kick the plants down, they are either damaged or will keep growing close to the ground under the seedling. They then don't show that shoot ability and you only have a growth spurt once in a vegetation period.

On the contrary, if you cut off the brambles, then the plant will sprout vigorously a second time. I also like stomping out weeds because it's a great thing to do with the kids. Just like with this clear-cut area, I tell the children that they have to seek out the seedlings. The children then run around the seedlings and trample down the grass, so that the young plants are no longer negatively affected.

What is also important is that I marked the planted trees because otherwise, I would not be able to find them in this high weed vegetation. Marking when planting is, therefore, in my opinion, absolutely necessary, otherwise, I will never be able to find my cherry trees again. If I have rediscovered the young trees, then it is important to carefully remove the weed vegetation. The seedling is still very fragile and can be damaged very easily, for example, with the sickle.



Here, for example, you can still see the sheep's wool that I put over the bud after planting. Sheep wool remains on the tree for an entire vegetation period. This cherry has already been browsed quite a bit. You could already do the first pruning here, or leave it like this so that the game can continue to nibble on it. You can prune the branches the same way the next year when they have become a bit larger in diameter. Oh, next to the cherry trees, we have discovered a neophyte. This is an invasive plant species that will propagate unhindered and that is why it is important to uproot it.

Basically, sickling is important so that the young plant can develop undisturbed. You should do this work in the spring and autumn. However, there is usually too little time for such work. You simply have to prioritize here, because you can't always do a 100% cleaning of every clear-cut area. For example, if you have a seedling that is already very high and sturdy, then it will survive the winter relatively well and I do not have to be so accurate.

I'll take a closer look at this particular tree. Well, this one is already a bit bigger than the others. You could, for example, remove the one branch down there, then the tree can keep growing upright. This terminal shoot is damaged, there is actually nothing that can be done about it now. This cherry is the most vigorous of the five. It is already somewhat taller and larger in diameter compared to the others.

There you can also see the sheep's wool that I put on the bud. The shoot has grown from down there up there from spring until now, so in one growing season. One, of course, may again put sheep wool on the coming terminal shoots, although here the young tree is already above the games' grazing height. Anyway, the sheep's wool helps that the young trees are no longer of interest to the game. The smell of sheep's wool discourages game from browsing. The sheep's wool is really awesome because this loose curly structure interlocks and does not fall off because of it.

Cherry trees are certainly not a high priority for producing valuable timber in my forest. The important thing for me is that they grow. Other than that, they serve as biodiversity trees. They bloom in the spring and have fruits in the fall. Thus, they are an incredibly valuable tree species for the forest ecosystem. They probably don't produce logs of commercial value, but the wildlife will have a treat with them. Yes, the game feeds on the leaves, but otherwise, the cherry trees have to see for themselves how to survive. But as you can see here, they have grown really well in this year's growing season.

I think they are doing quite well in my forest.

# 3.7.3. A Sunday walk in the forest

My Sunday walk in the forest: protecting, clearing and pruning. I love to walk through my forest. On my forest walk, I always carry my personal work utensils with me, so that I am able to take care of the trees at the same time. For this, I have gathered a few working utensils that fit my way of working. Of course, there is a much wider range of tools. For example, I always have with my sheep's wool, because the smell of sheep's wool chases away the game. Game and sheep do not go well together or I also have flax with me, which the game does not like either. Flax has somewhat the same effect on the game as a hair in the soup has on us.

If I put a small amount on the bud of this small tree, it is protected from the game for a while. Furthermore, I have in my "forest hand bag" a forest spray for marking, bypass pruners, where the upper blade passes the lower one to give a clean cut, gloves and signal tapes. A durable pink one made of plastic and a self-dissolving ribbon made of cellulose.

The buds of young trees are extremely often browsed by the game because of their high protein content. I take the sheep's wool, which I have in every jacket pocket and also in my forest handbag. I don't need much of it and just put it over the bud. Not too tight, so that the bud can continue to grow and not be strangulated, as would happen, for example, with wool strings. The small bud should now be protected from game browsing for about a season.


This fir is more wide than high, it has gone through a lot. It has been browsed several times. If I protect the bud, then it has a chance to make a new shoot and may grow in height next season. By making the effort to protect the bud, the tree gets a higher chance to grow further. Without protection, he will be browsed again just like every other young tree. The trees that I have protected, I also want to mark.

I usually take branches that I find in the forest and stick them to the ground. That way I know that I have taken care of the tree before. If I have my forestry spray with me, then I colour to mark the stake.

So, what else I can do is to cut this tree free. I do that either with pruning shears or, for larger trees, with a chainsaw. There's spruce growing up there. Anything that might compete with my protected fir is simply removed. Let's take a look at this terminal shot. It is completely browsed by game. You may want to apply pruning to this tree. I don't think it will grow into a particularly beautiful fir, but if you're in the mood, you can still invest time in cultivating measures.

When pruning, I aim to get a straight tree as much as possible. I have tried to prune this fir so that it continues to grow as straight as possible. You can count the age of the fir by looking at the branch bases.

I estimate this one at least 20 years. Firs have the ability to develop into relatively beautiful trees later, although they were often browsed when young. Whether this will be the case with this fir, I can not say now, of course. But even the smallest cultivation measure is better than none. For example, I apply some flax here, take a small amount, tie it loosely over the bud and with a high probability that the bud will no longer be browsed. And the next year the shoot is probably already so long that it is above the grazing height of the game and then the fir has a real chance.

Well, done within 2 minutes. In my forest, I have natural regeneration. Spruce trees that come up usually do not need any protection as they are rarely browsed. Firs are also regrowing naturally. We have just protected them, as otherwise the protein-rich buds will be chewed. And mountain ash trees are coming up. Lots of them!

Basically, they are simply removed as soon as they compete with my firs and spruces. If not, then I can also try to increase the commercial value of timber from mountain ash. Among all the young mountain ash trees, I choose one that shows fast growth, has a straight stem with thin, yet regular branches, and then I mark it and monitor how it develops.

Spruce is worth more than a mountain ash in money terms. But a mountain ash also has a value. It is not only the financial value but also the ecological value and there the mountain ash is of very high value. But at the end of the day, of course, you want to make the money by selling the timber. Here I have fast-growing mountain ash with a completely straight stem, which I will mark as my future tree.

Then I'll make sure that the competing trees are removed. So, we'll cut that one away, too. Here we have a cherry tree with a small steep branch, that we may have already removed. We cut the branch at an angle of about 45° so that we do not damage the branch collar. For cherry trees, this is best done now in late summer.

This branch can still be kept, it is important for the leaf surface area so that the tree can continue to grow well. Here again, you can tie sheep's wool around the terminal shoots. No budding is visible on this cherry tree now. The shoot is already above the grazing height and is therefore no longer in real danger.

There we have one of five newly planted young cherry trees that will most likely not produce a valuable log.

But as I said, you do not know how the tree will develop in the future. Maybe in the next period, it will do better than the others. Or who knows what will happen to my well-chosen, gorgeous future tree. Maybe a branch will break off or something else bad will happen to it. So you just don't know.



I'll just let it grow on and whatever happens, it will always be an important tree for the forest ecosystem. It is basically a healthy tree and it is impossible to tell now if this steep branch or that one will develop into a new terminal shoot.

I would like to thank you very much for taking the time to listen to me about my personal forest management. For more information, there is the forestry training center in Pichl, where I am a practical teacher and at the moment, I am completing my forestry master's training. My name is Kathrin van Zeist and it was really nice to have you with me.

## 3.7.4. Webinar Part 1 Timber Auction

What is a timber auction and when did we start it? 2001 was the first timber auction in Styria With great effort the event took place in Großwilfersdorf How are timber auctions set up? What are the key points? Dedicated logs are delivered to a central place. Lots are formed either from individual logs or from log bundles. Buyers can view and inspect the logs for a week and a half on-site and submit written bids for each lot. On the auction day, all offers are opened and made public. The highest bid per lot is the winning bid Any person is allowed (bidder and non-bidder) to be present at the auction What were our goals to start timber auctions in Austria? Why did we decide to organize auctions since 2001? In Germany, this form of marketing has existed for a long time and has a much longer tradition there. Basically, the forest owner was our primary focus.

There should be the possibility to offer good hardwood qualities to a wide range of buyers. We expected to generate additional revenue for the forest owners as a result. But wood buyers should also benefit from the auctions. Buyers have the opportunity to view large quantities of hardwood with very little effort due to this concentration of supply in one central storage location So it's a very big advantage for the buyer's procurement and logistics, which is also reflected in the continued buyer interest and prices achieved And last but not least, the general issue of hardwood marketing was a major factor in why we decided to start with hardwood/ valuable timber auctions.

Already in 2000/2001, the issue of increasing the hardwood share in the forests by promoting mixed forests was very strong. Likewise, our intention was to create a corresponding sales channel for broadleaf trees to achieve greater buyer interest for hardwoods as well.

With this picture, I would like to show you the result of our last timber auction. Only written bids were accepted and you can see that five bids were made on this walnut trunk. The lowest bid was 186 (EUR), and the highest was 2122 (EUR). You can see here very nicely the big jump from the second-to-last to the highest bid. The jump is almost double and the price would probably not be reached in a usual auction mode (with fixed bid increments).

However, with this auction mode, significant price jumps can occur due to the written bids. The example of this black walnut also shows this very well, too. It can be seen that many more buyers have bid on this log. Here, too, there was a significant price jump from the second-to-last to the highest bid.

For oak, which is very booming and in demand right now, we are not seeing as big of a jump in price from minimum bid to the highest bid. Of course, the offers are always dependent on the tree species and the current market situation. This year's timber auction 2021 in Heiligenkreuz looked like this in figures:

- There were 142 suppliers, which provided high-quality logs.
- 20 different tree species were supplied and
- 29 buyers mainly from Austria but also from neighboring countries submitted written bids.

This table gives an auction overview by tree species, quantity, average and maximum prices. A walnut log has achieved the highest price of 2878 EUR per solid cubic meter. By the way, this single log had 1.66 solid cubic meters and achieved a price of over 5000 EUR. With 2800 EUR also a very high bid was a black walnut. But



also the analysis of the quantities provides very interesting results There were 460 fm of oak offered and the highest price for an oak log was 1089 EUR.

It can also be seen that the sycamore maple is on the rise again with the highest bid of almost 1500 EUR/fm and also a comparably high quantity was supplied It is noticeable that not a single beech log was delivered It was different 20 years ago, there were only beech logs.

And also interesting is the ash. The ash was offered with almost 100 cbm volume and has come off quite well with an average price of 200 EUR. The highest price for ash was 339 EUR, which means that a real top price was not achieved for ash, however.

This slide shows the trend of volumes and prices for the last 10 or 11 years. It can be seen that the quantities offered varied greatly depending on the year This is primarily related to the weather at the time of felling, that is, the logging and forest road conditions during fall.

Average prices have ranged between 450 to 470 EUR/fm for the total volumes sold in recent years. The principles we can derive from this for the forest owners are as follows.

Large-diameter logs are not always high-grade logs, but high-grade wood is always large-diameter wood Please remember this saying and do not forget it. As a consequence of silvicultural measures, this means that the timber quality of broadleaf trees should be increased as a matter of priority, and here to pay attention to the lower quarter of the whole tree. This is where the added value of the log lies and the quality of this part of the log must be the primary silvicultural goal.

So much for this year's submission. I am at your disposal for further questions. As a moderator, I would be interested in the following: Andreas (Hofer) as a forest advisory you are with open eyes and ears in the forest all around the year. Are you also looking specifically for logs/trees that can be marketed at the timber auction? How does it work in practice when a forest owner thinks he has an interesting tree? What do you do when you receive a request?

Correct, most of my time I'm out in the forest with my eyes open and when I see a particularly interesting tree, I make a note of it and inform the forest owner about its location. If there's a logging operation coming up nearby in the winter, I'll contact him to see if he agrees to cut down the tree as well. Otherwise, the procedure is that the forest owners contact me and say, for example, "I have a beautiful walnut tree or a beautiful maple standing in my forest."

I then inspect the tree to see if it is a candidate for the timber auction. If I'm nearby, I give the forest owner a quick call and survey the tree. If the tree is located too far away, then I request a photo via WhatsApp, for example, so that I can see whether the tree basically fits for the timber auction.

Important features are a knot-free trunk and an appropriate large diameter. Much more cannot be said on the standing tree at this time. If the tree has been cut down, then you look at the log again more closely. As I said, either he sends a photo or I come by in person for further assessment. I assess the cross-section of the log, whether it has a discoloured core or perhaps there is rot and whether it has value-reducing defects or other detrimental features. If the log looks good, then I organize the timely delivery to the timber auction.

The tree logs are scheduled and collected for an optimized and efficient transport We also measure and classify the logs and then deliver them to Heiligenkreuz, which is the place of the timber auction

Thanks, Andreas, we still have one or two more questions. Josef, why is there no demand for black alder? And there is also a question regarding the apricot log sold at this year's auction, which was listed in the overview table of the 2021 auction result.

Referring to the apricot log: This was a curiosity from the province of Burgenland. It was not a particularly large log like is common for apricot trees The log had a diameter of about 25-26 cm. It was about 2.4 m long



with a pronounced spiral grain on the last 40 cm. These are simply curiosities that are of interest to a very specific buyer and for very specific use only. If a buyer is looking for wood with very special and distinct features for, say, inlay work for a table or the like, then he has the opportunity to find such wood at a timber auction. I remember a year ago, for example, plum trunks from an orchard were auctioned.

A private seller offered 15 small logs with 15-16cm diameter and between 1m and 1.5m long. The buyer was also a private person, who made boxes out of them for his collection of trophies. This possibility of finding trees with special features, you have on a timber auction.

However, it is very important to agree in advance with the organizers of the timber auction and inquire whether it makes sense to deliver such rarities. Apricot trees are offered very rarely, but as far as I remember correctly, I think that the apricot log has achieved a total price of almost 500 EUR or 500 EUR.

Yes, I would like to add that it is about individual wood species with very distinct features. Special logs, then have an individual value for special buyers like hobby carpenters, woodturners or carvers. It would be misleading, however, if one believes to deliver mainly rarities to the timber auction because then the achievable prices would probably be much lower. They are rarities and that is why these price outliers occur. But that is not the rule.

Black alder was not offered at this year's auction. This is simply due to the market situation. At the moment, there is hardly any demand for sawn wood from this wood species.

Ok, what happens to the logs that remain? I assume that not everything can be auctioned off?

This year there were 20 pieces without a bid (btw. the number of sold logs amounted to 1219). There are two possibilities why these logs could not be sold. The minimum price the seller wanted was too high. Then the seller retains the log. Or no offer was made for the log, in which case an attempt is made to market this wood in the post-auction stage. However, unsold wood remains for the seller to be taken back.

The average BHD (Breast Height Diameter) was also asked for. But I guess the BHD will be very different depending on the tree species, right?

Yes, this is quite different by tree species. Basically, the rule is: the larger the diameter the higher the price. Except for the rarities mentioned. There it is not about large diameters, it's about special features.

Question for Bernd. What are the costs for delivery to the timber auction in Heiligenkreuz located in the province of Burgenland? I think the logistic is very demanding when you have to collect individual logs for a full truck load? There must be incredible logistics behind it and an incredible amount of effort is certainly required before all logs are at the location of the timber auction!

With regard to our deliveries from Styria: We delivered just under 100 cbm this year to the timber auction in Heiligenkreuz. Of course, we try to keep the transport routes as short as possible. But I'll just take one case from this year: We had to deliver an oak from Voitsberg with 4.3 cbm. Anyone familiar with oak knows that a single loading crane cannot handle the weight of this particular log. Thus, two loading cranes were necessary. Nevertheless, we managed to minimize the transport costs by using two trucks, that were already working in the vicinity, and then we delivered the log directly to Heiligenkreuz. One principle is the longer the transport route, the better the timber quality must be.

I would like to add to Sepp Krogger on black alder: with black alder, the price difference between very good and mediocre qualities is extremely small. and thus the manipulation effort practically does not pay off.

Well, as I said, the logistics are challenging. If you take into account the costs for transport and the auction itself, then we are at a cost of about 50 EUR per cbm. It can also be 40 EUR, as the total cost of the auction is allocated to the delivered solid cubic meters.



We will answer one more question before the next presentation. Who dares to make a market forecast? Shall we sell the oak now or shall we wait?

In principle, oak has already passed the peak, but this does not mean that prices won't rise again. You have to think of market demand this way: normally, light tree species always alternate with dark wood species. The swing towards dark wood species is long overdue. Last year we had a slump of a few euros in the price of oak. In the meantime, the price has risen again. The demand for oak is still unrestrained and oak is at a very attractive price level. If someone has a beautiful oak with a BHD of over 50 cm, then I would definitely recommend that one of our forest advisors shall take a look at the tree.

Whether the oak is suitable for the submission or not depends on certain wood characteristics caused by buds, shoots or branch attachments. But an oak with 50 BHD can be harvested in any case. With 40cm BHD, even if the log is extremely beautiful, I would deliberately wait, because especially with oak the rule is, that a larger diameter makes the log more valuable. Of course, there are also oak rarities, such as oak with very distinct branches, if it has a 70-80 diameter, then it is in high demand for table tops.

Just do me a favour, don't just make firewood out of the trees. You can still make a nice buck if you get the right log to the right buyer.

## 3.7.5. Part 2 Value-adding timber characteristics

I would like to dispel the myth that hardwood is always valuable. The maximum prices achieved in the timber auctions are blinding. In fact, minimum prices are obtained much more often. We generally have a low proportion of stemwood in deciduous trees, which is often less than 50%. And most wood species have small, unstable markets and, as a result, low average revenues.

This means that in hardwood management we must try not to put in too much effort but to stay within the cost range of coniferous wood management. Correctly, we can say that hardwood is valuable "if you make sure you have it in time when you need it".

The top prices in those auctions should not blind us to the fact that in general, the hardwood market is a very troublesome market. On this slide, I would like to show how the diameter classes and the log qualities affect the hardwood price. Here, using black walnut as an example, we see the log price in relation to the pulpwood price. Here we are dealing only with relations - we are not dealing with absolute EURO amounts.

We see that the pulpwood price remains the same regardless of the diameter. Pulpwood is either chipped or processed into firewood. For hardwood grades, i.e. A to C qualities, semi veneer or veneer grades, we see log prices starting to increase from diameter class 4a/4b.

The larger, the higher the price can rise here. With coniferous wood in general, or with alder for example, we do not have these jumps in prices. Here, regardless of the diameter and quality, the prices are very close to each other and we don't see this effect of the diameter class on the prices.

This is a very significant difference between hardwoods and softwoods, The cut-to-length aspect - I will present this aspect in more detail in the third part of my presentation. Generally, in the Austrian timber trade rules for hardwoods, a minimum length of 2 m - 2.2 m is specified, the length increment being 10 cm and we see that there are no classic standard lengths for hardwoods as is the case for coniferous wood.

The cut-to-length quality is a very decisive factor in determining whether the added value is created or not. That is, quality is far more important and profitable than quantity optimization. This means that the EUR/ha is important and not how many solid cubic meters are on the hectare.

Again, as mentioned, silviculture measures shall concentrate on the single trunk and for this single trunk on the lower quarter of the tree. This is where we need to focus our silvicultural attention. The "good" wood quality is also more important than the "right" wood species. Market demand for a wood species is fashion-



dependent, as we have already heard. Log quality, on the other hand, especially in terms of yield is independent of any particular fashion. Therefore, the right silvicultural treatment of the butt log is of greatest importance.

Discoloured wood is generally more susceptible to economic cycles, as its technical applicability is limited. Now some will argue that there was once such a fashion trend with heartwood beech. Yes, that's right, the fashion trend was there, and beech heartwood has been processed too, but at the price of discoloured beech logs. So not at a higher beech log price, but the lower one. And we have to try to avoid any kind of discolourations through appropriate silvicultural practices.

This means that we need short rotation periods adapted to the optimal locations of the respective tree species and we have to make sure that rotten-knot induced discolouration will not spread to the stem. Knottiness is a very significant factor in hardwoods and can cause up to an 80% decrease in value. This means that we must start formative pruning very early to avoid such pictures. Early means that when the breast height diameter is less than 15 cm, the pruning process must be completed and only branches with a maximum diameter of 3 cm may be pruned. Larger branches do not meet the requirements of a value-added pruning process.

Large diameters are also more important than long lengths. We know that furniture is rarely over 4 m long We have diameter class prices and not length class prices in the case of hardwoods. In the case of softwood, we have a higher price for long logs, while for hardwood it is a matter of diameter, so from 50 or 60 cm upwards you can get higher prices.

Therefore, again, early and heavy thinning, so that the butt log can quickly reach a large diameter. Diameter is also more important than the structure of the annual rings. It has always been believed that narrow annual rings are very important. We know from the results of Austrian timber auctions - and there are a number of diploma theses on this subject – that the annual ring structure can have large, wide annual rings if this structure is regular. It is still possible to get a good price because when we see this log, the yield is tremendous.

And that brings more than, for example, an annual ring width of 2 mm. So, don't try to slow down the growth of annual rings crown spacing and size are the key silvicultural measure. And the diameter is also more important than the wood species because as I said, the demand for a specific wood species depends on the current fashion.

And of course, there is - as we have already mentioned - the value factor abnormality, i.e. extraordinary logs with distinctive characteristics. For example, a log - you can see the comparison here to a passenger car which has a diameter that is rare, exceptional and has a particular end-use market and can command an appropriate premium price.

This can also be a silver willow. Such a rare log with this diameter and quality can certainly fetch a good price. Or even poplars with burls, or, as here, with overgrowths. Then this again attracts special buyers who already see furniture or specific use for it and are willing to bid a corresponding price.

So much for value-adding wood characteristics and a silvicultural excursion on how to raise value-added wood. Thank you.

Thank you, Josef. Right away, a question that I think keeps many busy. Many have heard of curly or fiddleback maple, which fetches particularly high prices, and the question is how do you recognize curly maples? Or Andreas, how do you recognize this distinct grain pattern in standing maples?

In the woods, it is very difficult to identify a fiddleback maple. It is easy, when the tree is cut down you remove the bark and then you look around the debarked log, You can then recognize this particular grain pattern by such circular marks.



Looks like an old-fashioned washboard, doesn't it?

Yes, like a washboard, and it's important that this pattern is uniform throughout the whole log. Often only the base of the stem is rippled, but this does not necessarily mean that it is a fiddleback maple. By the growth ring pattern, I think some experts are able to recognize a fiddleback maple as well.

Another question, there is this wonderful trunk to be seen, which has a crack in the middle. The question is whether valuable wood should be cut free of defects.

That always depends on the type of defect. For example, when seeing this crack, then you must always keep in mind that such large-diameter logs are always cut through. And if the log is cut along from the crack, then the crack automatically falls away. So also in the case of cross-cracks, which we often can see in veneer logs, looks horrible, but in reality is de facto no loss of value, because the veneer log is quartered before slicing anyway. And what is very fashionable today are these massive, large table tops, where cracks or other defects are filled with non-wood material, like epoxy, aluminum or whatever is used to pour into the crack. These are given a unique appearance, and such tabletops then cost much more than the whole log.

We already talked about the immense effort in the selection of the value logs and the whole process of logistics until you get the logs to the auction site so that they can finally be auctioned off. What are the overall transaction costs for the forest farmer or the person who wants to sell the log?

As I said previously, it varies from year to year. I have already answered this question in the first part. In Styria, of course, we make sure that we deliver very good log qualities to Heiligenkreuz, where the mark-up price is usually well above the average price that can be achieved. The auction overhead is something in the range of 40 - 50 EUR or 35 to 50 EUR (per solid cubic meter).

Andreas, once again please some words about the schedule. Until when do I have to decide at the latest in autumn if I think that I would like to bring this particular tree to the submission in January?

Yes, as I said, the timber auction always takes place in the middle/end of January. Basically, we usually suggest to report in September/October to the forest officer or the district forest chamber so that you have a suitable log. Then we assess the tree and I would say felling at best in November/December.

Felling too early doesn't help either, but at the end of December/beginning of January we start to deliver the logs to the location of the auction, and by then the log should be ready at the latest.

Sepp, could you answer one more question, because it's been asked a few times. When is the ideal time to perform the tree pruning?

The ideal time is basically when you have time. So it's more important that you do it than that you wait for the right moon phase or the right time. In general, we recommend the outgoing winter, i.e. February to March, for the timing of the pruning, where the timespan from cutting down the branch to the beginning of the growth period in the spring is as short as possible. As short a time as possible means that this open wound is not exposed to fungal infection or whatever for a long time. That is, the tree begins to form callus relatively quickly in the spring, even if the cut surfaces begin to ooze, these are not tears, but cleaning fluid. So no problem, no tree dies from it. So generally around the time of the end of winter after the big frosts.

For walnut and cherry trees, there is a recommendation to do the pruning rather in summer, in August, that is, after the cherry harvest. And if you want to put it that way, perhaps the least favorable time would be somewhere in October, when you create a wound in the fall and then throughout the winter that wound is left open to fungal infections. At what branch diameter should you refrain from pruning?

Well, I had it on in the slide, above 3 cm we do not refer to it as value-adding pruning anymore. It has to be done earlier. We will answer one more question before we continue with the third part Bernd and Andreas, you are also forest owners.



Do you perform pruning on coniferous trees? Does that make sense?

Pruning of coniferous trees is basically problematic because you do not get the added value. However, the issue is extremely important in the case of foreign tree species, i.e. Douglas fir. In the case of Norway spruce, considering that there is a conventional A-C marketing in Austria, that is, A, B, and C logs have about the same price, you will not be able to recover the additional effort from today's point of view.

Once upon a time, 20 years ago, there were even pruning machines where trees were delimbed almost automatically. The problem there is the tree injuries. It may well make sense for extremely fast-growing, broad-interspaced reforestation areas.

However, one invariably comes to the conclusion that these injuries are potential entry points for fungi. Maybe if someone has such forest stands in such a way, it may happen that the first/second log may look perfect and then suddenly, if you cut up the log near a knot or branch base, you notice there a brown discolouration. And this is not by chance, although in former days it was done with an axe or something similar, and sometimes also with a fine saw. So it is still an injury and, as I said, it is more important than thinning operations are carried out at the right time to improve stand stability, etc. so that no loose knots are produced, and a well-developed crown is obtained.

I think I mentioned it before: For hardwoods, the price jump from a regular log to a value-added log is due to the knots, which can cause up to 80% of the loss in value. That is, if I cut down a branch on an oak tree at the right time, then the log can become significantly more valuable. And we cannot achieve this price jump with our prevailing coniferous species spruce or pine, which otherwise justifies the costs for pruning.

Thank you, Josef. Andreas, how many conifers have you already pruned?

No conifers yet, but several deciduous trees. So I can see it at our place - I am from the Frohnleiten area in Styria, maple trees clean themselves and develop really great knot-free stems. With walnut trees, and especially with cherry trees, you have to prune. I see that in our place, where I have pruned several cherry trees this summer. But as I said with the coniferous tree I have never thought of pruning. For conifers, I think thinning is of higher importance, as Bernd [Poinsitt] has said.

## 3.7.6. Part 3 Production of high quality hardwood

Today we are talking about hardwood quality assortments according to the 2006 Austrian Practices of Timber Trade (ÖHU). The Austrian Practices of Timber Trade regulate the sale of wood in general, including coniferous wood and there are also precise provisions for the sale of most common hardwood species. In general, all hardwoods should be harvested outside the sap season. In Austria, this period is defined until March 31, in exceptional cases until April 15.

The length oversize for hardwoods is 1.5% of the nominal length. This percentage is more than for softwood, but again, a minimum of 6 cm applies. Beech and poplar are always measured in 50 cm length increments. Generally, hardwood can also be billed in 10 cm increments. If you use steel staples over the end grain to prevent cracking, you must add an additional 10 cm of oversize.

Basically, it must also be stated that the concepts of grading by end-use and bucking by end-use are crucial points because it really depends on how the respective buyer utilizes the wood. So it is quite important to know before the bucking who will process the timber and what the requirements of the final customer are.

And basically, in the ÖHU the following listed wood species are defined quite precisely according to the quality grades A, B and C. Of course, it would be too much to deal with every wood species here. The regulations for the European beech, yes, in 2006, were substantially changed and revised.

And I want to focus essentially on the beech grading right now because many of these provisions are applicable to the other hardwood species. Basically, the minimum length for the best grade A is 3 meters.



For grade B, the percentage of shorter logs is slightly higher, but B-grade also means a minimum of 3 meters. C and Cx have a 2 m minimum length. For A, generally, middle diameters from 30 upwards are required. For B it is 25 and for C and Cx the minimum diameter must be agreed upon with the respective buyer.

The general condition for the A grade must be healthy and free of bumps and also the spiral grain can not be too large, so up to 1 cm per linear meter is allowed. For grade B, the spiral growth of up to 3 cm per meter is allowed. C is basically healthy, but the spiral grain is not a reason for exclusion here. Knottiness is, as mentioned, the key feature in grading. For grade A, the trunk must be absolutely knot-free up to 3 m. For longer pieces, sound knots with 4 x 6 cm knot diameter are allowed, namely 1 piece per meter from the 3rd meter. A 4 m piece with one knot like that would still qualify as grade A. For grade B, the number of sound knots per meter increases. So a 4 m piece may have 4 branches up to 8 cm in diameter. For C quality, the number of knots doubles, meaning 2 healthy knots per meter. And if there are even more knots, then it is Cx. What does decayed knot actually mean? It is a knot, that is not solid across its face.

An important term that frequently occurs is the so-called Chinese beard, a scar below the base of a branch. This bulge, seen here, shows exactly how steeply the branch grows out from the center of the trunk. The flatter this bulge is, the more horizontally this branch protrudes. And when this Chinese beard runs down very steeply, we know that the branch also grows out very steeply from the inside upwards and devalues a large piece of wood.

Very often you can see such bumps, whereas to the layman it may look like there is no branch. But a bump is nothing more than an overgrown branch and then you make a cut here and the knot appears. Here you can see a forked or a strong branch, which is cut on the band saw and how it looks inside and you can imagine that this log cannot be utilized. Here, too, you can see a branch that has been cut down and overgrown. It is very likely that rot will occur with such large branch diameters. I have already mentioned the issue of cracks as well.

Generally, such star-shaped cracks, if they happen as here at almost right angles, do pose not too much of a problem, because the band saw can cut alongside these cracks. The discolouration is a big issue, especially with beech. Splash or cloud cores are not permissible for grade A. This discolouration maybe 25% for upper log diameters of 30 cm and above. For Grade B as well, splash or cloud cores are not permissible but discolouration maybe 35% for upper log diameters of 30 cm and more. This percentage increases accordingly with the grade C.

Here are a few example images. Splash cores are not allowed, because based on the visible surface on the front side, it cannot be predicted exactly how this discolouration behaves along the stem axis. And, therefore, you buy a cat in a bag.

The same applies to cloud cores, which are not allowed, too. Or when storage causes discolouration to occur. Crook is a big issue, especially with large-diameter hardwoods, because of the immediate lack of yield. For grade A up to 3 m, the logs must be practically straight. And for length above 3 m, the crook maybe 2 cm/ meter of the greatest distance from the straight line, max. 10 cm. And of course, these values increase for the lower grades B and C, where we may then already have 8 cm/meter of crook.

Fungal and insect infestation is, of course, unacceptable for A, B and C. Logs with fungal or insect infestation are useless.

And finally, there are often these T-stains to see over the end grain wood They are also not allowed for A, B, or C quality. These are elongated scars that occur on the standing tree and show such typical T's on the cross-section, and these defects naturally devalue any board.

And the last important assortment, especially for beech but also for oak, are the sleepers. We are talking about rail sleepers and sleepers for switch points. The sleepers have a fixed length of 2.60 m and must therefore be formed with 2.60 or double length 5.20 m, whereby it must be said that many sleeper



manufacturers want more overlength here, as sleepers must be delivered without cracks on the crosssection. If cut-to-length is too tight here and the cracks go in too far, then the yield is again very low.

Here, more overlength is often demanded from buyers. The diameter of the upper log must be over 31 cm. For the sleepers for switch points, there are lengths to order and here the upper log diameter is a minimum of 33 cm. And also the sleeper roundwood must be provided by March 31. This is a general issue with hardwoods to provide it as early as possible in the fall rather than in the spring. So much for the Austrian Practices of Timber Trade (ÖHU).

Thank you Josef for your interesting presentation and the stimulating information. We already have one question: are there any digital or laser scanning solutions to be able to recognize wood characteristics or wood qualities better? Are there any developments, or can anything be expected to happen there?

Yes, of course, it is being researched and developed and I think the prototypes can already see a lot inside the log. The speed is still a bit of a problem, although this would not be a big issue with hardwoods. For softwood, the main issue is the speed of detection of features. Of course, in the future, there will certainly be methods to detect the defects or features in the log. and of course, this will have a corresponding impact on the log price. For the good quality, where a higher yield is given, one will be able to achieve higher prices and where this is not the case, you will certainly have lower prices.

This is a major issue, on the other hand, experienced hardwood buyers, of course, are well aware of these small features and know the impact of these characteristics and, of course, already take this into account in the purchase.

Andreas, finally from your point of view. What would you like to get from forest owners who want to market high-value timber? so that you have less stress, and that everyone can be satisfied?

In principle, the earlier you harvest hardwood, i.e. right in the fall from October onwards, the smoother everything goes. At this time, the lumber yards are still empty, the hardwood sawmills all need lumber, the haulers have time, and the transport is usually done relatively quickly.

In February/March, however, when many log piles are placed along the forest roads, everyone is stressed, the hauliers are busy, and then maybe the roadblocks (snow) occur on top of that, everything takes longer and you get further out into the spring. And then maybe the sawmills are full and can't take these quantities.

But what I would like to add to the presentation of Krogger Sepp: For the bucking, it is important that you know beforehand to which sawmill you sell the timber, because every hardwood sawmill uses different lengths. One would rather have 3 m or 2.5 m long logs, and another one would rather need the sleeper lengths. That is, never cut down a hardwood tree until you know where you're going to sell it, that's the most important thing.

Because then in the worst case you have a 4 m beech log but the buyer requires a sleeper length of 2.8 m and needs to cut away 1.5 m. So as I said, always ask first what is needed and check whether your timber fits the sawmill.

And yes, as I said first contact the forest advisor and only then cut the tree - that's what I would wish for.

Andreas please, answer one more question How is the brown core evaluated in ash trees?

At the moment, the brown core is not really a problem with ash, as I know from the buyers where we deliver. So that's not really an issue, and it's not a problem in terms of price. A few years ago, sawmills didn't take the brown core, but right now it's not an issue with ash. I would generally add that the more beautiful the log surface, the more pronounced the brown core can be, so if you're talking about an A, A/B log, then the brown core can be quite distinct. The important thing is that it really has a uniform colour.

Josef, another brief statement from you, please.



What else can be passed on to forest owners to help them achieve maximum prices in the timber auction, in a nutshell.

Yes, everyone knows the saying that you check in time to make sure you have it when you need it. I can only repeat: with hardwoods, it is crucial that you prune very early, and that is where we fail in advisory services and execution because the hardwood grows too fast in dimensions where it is too late for pruning measures. The deciduous tree that is 10-15 cm in diameter and maybe 12-13 m high must be more or less fully pruned to the first 8 m height. And we very often let this time pass in the forest and then complain about poor quality or too much firewood. So, here's where I would want to rigorously invest early in hardwood tending.