



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE  
DEPARTMENT OF  
AGRICULTURAL, FOOD AND  
FORESTRY SYSTEMS

SAFE  
UNIVERSITÀ  
DEGLI  
STUDI  
DELLA  
BASILICATA



DISAFA  
Università degli studi di Torino

# Added value of wood in the future

*Workshop for PhD students and Early-stage researchers  
in Wood technology and Forest operations enrolled in Italian research bodies*

**Università degli Studi di Firenze**

**Sala Seminari SAGAS (Ex Aula 12), Via Gino Capponi, 9 - Firenze**

**27 February 2018**

## BOOK OF ABSTRACTS

**Editors:** Paola Cetera, Andrea Laschi, Francesco Negro

# TUWF



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE  
DEPARTMENT OF  
AGRICULTURAL, FOOD AND  
FORESTRY SYSTEMS

SAFE  
UNIVERSITÀ  
DEGLI  
STUDI  
DELLA  
BASILICATA



## **Added value of wood in the future**

*Workshop for PhD students and Early-stage researchers  
in Wood technology and Forest operations enrolled in Italian research bodies*

Università degli Studi di Firenze, February 27<sup>th</sup>, 2018

### ***Editors and Scientific Committee:***

Paola Cetera, Andrea Laschi, Francesco Negro

Printed by: GESAAF – University of Florence  
March 2018

## Preface

As coordinator of the Working Group in Wood Technology and Forest operations (GdL TLUF) of SISEF, I have gladly supported the organization of the workshop “Added value of wood in the future”. This event has surely represented a valuable opportunity for increasing the collaborations within the GdL. Further, young researchers particularly need to discuss their studies among themselves and with senior researchers in their field, in order to gain detailed suggestions. Overall, the workshop was very welcome and I hope that it will represent the starting point of a long series.

*Roberto Zanuttini*

## Introduction

The workshop «Added value of wood in the future» has been addressed at PhD students and Early stage researchers in Wood technology and Forest operations enrolled in Italian research bodies. A main aim of the event was to give them an opportunity to present their studies and to gain visibility, with particular regard to PhD students. Therefore, in order to focus the attention on young researchers and on their scientific interests, all contributions of the workshop have been single-authored.

The workshop also intended to create an occasion of reciprocal knowledge. We hope that this can trigger future collaborations among the young researches. Further, the event has been organized within the framework of the GdL TLUF of SISEF. The group has been constituted recently and over time has seen a constant increase in its activities: in this context, as young researchers we desired to give our contribution in animating the group and in strengthening its identity.

Overall, we appreciate the participation achieved by the workshop, also considering that the amount of researchers in Italy dealing with wood technology and forest operations is still limited, despite the strategic relevance of the forest-wood chain at national level. The oral presentations were held both by PhD students and by PhD, dealing both with wood technology and forest operations, and coming from many different areas of Italy. The attendance of senior researchers further enhanced the event, with particular regard to the discussion of the different presentations. These covered various topics that include, to mention some, sustainable forest operations, effects of forest logging on soil, impacts of wood bioenergy, uses of wood extractives.

Most of all, we thank the young researchers for their enthusiastic participation.

*Paola Cetera, Andrea Laschi, Francesco Negro*

## Participants

### Maria Roberta Bruno - PhD student



**Affiliation:** University of Basilicata - SAFE

**Tutor:** Dott. Luigi Todaro

**Profile/research interests**

The PhD program is focused on the secondary metabolites in the local wood species. Furthermore, it will be studied the application of this metabolites in the different sectors like industrial, pharmaceutical, agriculture et al.

**E-mail:** mariaroberta.bruno@unibas.it

### Paola Cetera - PhD student



**Affiliation:** University of Basilicata - SAFE

**Tutor:** Dott. Luigi Todaro

**Profile/research interests**

Paola Cetera is a PhD student in “Agriculture, Forest and Food Science”. Her research activity is mainly focused on the biological activity of extractives achieved thermo treated Mediterranean wood species. She works for increase use of the natural compounds according to Green Economy strategy.

**E-mail:** paola.cetera@unibas.it

### Alan Crivellaro - PhD



**Affiliations:** Dipartimento Territorio e Sistemi Agro Forestali, Università degli Studi di Padova, Legnaro, PD, Italy; CNR-IVALSA Istituto per la Valorizzazione del Legno e delle Specie Arboree, Sesto Fiorentino, FI, Italy

**Profile/research interests**

Alan Crivellaro's research is based on stem anatomical observations in herbs, shrubs, trees, and lianas to investigate the hydraulic, mechanical and/or other roles of different tissues. He loves to cross borders at the interface of wood science, ecology and archeology.

**E-mail:** alan.crivellaro@unipd.it

### Andrea Crocetta – PhD student



**Affiliations:** DISAFA, Università di Torino; Energy Department, Politecnico di Torino

**Tutor:** Prof. Roberto Zanuttini

**Profile/research interests**

Andrea Crocetta deals with sustainability of wood bioenergy supply chain. He is referent for Legno Energia Nord Ovest project (Piedmont EAFRD-PSR 14-20 Op.16.2).

**E-mail:** andrea.crocetta@unito.it

## Participants

### Andrea Laschi - PhD



**Affiliation:** Department of Agricultural, Food and Forestry Systems, UNIFI

**Profile/research interests**

Andrea earned his PhD in 2016, developed in the field of forest operations, analyzing different aspects related with the sustainability of wood harvesting. He is mainly interested in the implications of forest operation on economy, environment and health and safety.

**E-mail:** andrea.laschi@unifi.it

### Elena Marra - PhD student



**Affiliation:** Department of Agricultural, Food and Forestry Systems, UNIFI

**Tutor:** Prof. Enrico Marchi

**Profile/research interests**

Her PhD project focuses on sustainable forest operations.

**E-mail:** elena.marra@unifi.it

### Omar Mologni – PhD student



**Affiliation:** TESAF Dept., University of Padova Forest Operation Management Unit

**Tutor:** Prof. Stefano Grigolato

**Profile/research interests**

The research topic is focused on the steep slope harvesting systems and, in particular, on the evaluation of the productivity and safety performances of the cable logging system in the Italian Alps, and on the potentiality analysis of the tethered logging system.

**E-mail:** omar.mologni@phd.unipd.it

### Francesco Negro – PhD



**Affiliation:** DISAFA, University of Torino

**Profile/research interests**

He earned his PhD in wood technology in 2011. His research activity is mainly focused on the development of innovative wood-based products, on the grading of structural timber and on Regulations in the wood sector.

**E-mail:** francesco.negro@unito.it



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE  
DEPARTMENT OF  
AGRICULTURAL, FOOD AND  
FORESTRY SYSTEMS

SAFE  
UNIVERSITÀ  
DEGLI  
STUDI  
DELLA  
BASILICATA



# Added value of wood in the future

*Workshop for PhD students and Early-stage researchers  
in Wood technology and Forest operations enrolled in Italian research bodies*

**Università degli Studi di Firenze**

**Sala Seminari SAGAS (Ex Aula 12), Via Gino Capponi, 9 - Firenze**

**27 February 2018, 9:00-13:00**

## Final program

9:00 – 9:15 Registration and get together

**INTRODUCTION** - *Chairman F. Negro*

9:15 – 9:45 Workshop overview

**ORAL PRESENTATIONS** - *Chairman P. Cetera*

9:45 – 10:00 **A. Laschi** - New challenges in wood harvesting: Sustainable Forest Operations

10:00 – 10:15 **E. Marra** - Photogrammetric estimation of wheel rut dimensions and soil compaction after increasing numbers of forwarder passes

10:15 – 10:30 **O. Mologni** - Skyline tension monitoring of cable yarding systems working in the Italian Alps

10:30 – 10:45 **A. Crivellaro** - Beyond wood science

10:45 – 11:15 *Coffee break*

11:15 – 11:30 **M.R. Bruno** - The perspectives of wood secondary metabolites: characterization and sustainable use

11:30 – 11:45 **P. Cetera** - Potential and alternative use of wood extractives

11:45 – 12:00 **A. Crocetta** - First data on environmental impact of wood bioenergy supply chain in Piedmont

12:00 – 12:15 **F. Negro** - Development of innovative wood-based composites with enhanced properties

**CONCLUSION** - *Chairman A. Laschi*

12:15 – 12:45 Final discussion

### Scientific committee and contacts:

Dr Paola Cetera, SAFE - [paola.cetera@unibas.it](mailto:paola.cetera@unibas.it)

PhD Andrea Laschi, GESAAF - [andrea.laschi@unifi.it](mailto:andrea.laschi@unifi.it)

PhD Francesco Negro, DISAFA - [francesco.negro@unito.it](mailto:francesco.negro@unito.it)

## Abstracts

Andrea Laschi

### **New challenges in wood harvesting: Sustainable Forest Operations**

Nowadays the concept of Sustainability has become fundamental according to the modern needs of Society. Despite the easy meaning of the general definition, a sustainable approach implies a multitude of complex interactions between economic, environmental and social interests. Research activities must take into account these different interests, and modern studies aim to give answers regarding the achievement of all the functions of forests. Wood production must be guaranteed together with ecosystems functionality and workers' health and safety. In this context, it is important to evaluate how the Italian forest management answers to these requirements. The aim of this contribution was to illustrate some results on different aspects of Sustainable Forest Operations (SFO), and to show possible interactions between factors. Different topics are described: i) analysis of the environmental impacts related with common forest operations through Life Cycle Assessment; ii) physical impacts on soil due to forest operations; iii) forest workers exposure to wood dust and exhaust fumes in forest operations; iv) cost optimization in infrastructure (forest roads) and forest operations planning.

E-mail: [andrea.laschi@unifi.it](mailto:andrea.laschi@unifi.it)

Elena Marra

### **Photogrammetric estimation of wheel rut dimensions and soil compaction after increasing numbers of forwarder passes**

Soil compaction and rutting are consequences of forest logging and is usually investigated by means of time-consuming methods, not able to represent the whole longitudinal profiles of forest trails. New methods based on photogrammetry have been developed. The overall objective of this study was to compare photogrammetry and traditional methods (cone penetrometer, manual rut depth measurements, soil bulk density and porosity) for evaluating rutting (depth and rut volume) and its relation with traditional measurements after repetitive passes of a loaded forwarder and two different levels of tire pressure. The comparison of photogrammetric vs manually-measured profiles resulted in  $R^2$  of 0.934. The results showed the effect of tire inflation pressure and number of passes on soil disturbance. The estimation of the rut volume caused by the forwarder on 100 m long trails after 60 passes were 8.48 and 5.74 m<sup>3</sup> for tire pressure of 300 and 150 kPa, respectively. The results showed a relation between soil compaction, rut volume and soil porosity. Increased rut volume correlated positively with increased soil compaction and decreased soil porosity. Structure For Motion photogrammetry can be an accurate instrument for high-resolution Digital Evolution Model creation and for morphology description of forest soil disturbance after forest logging.

E-mail: [elena.marra@unifi.it](mailto:elena.marra@unifi.it)

# Abstracts

Omar Mologni

## **Skyline tension monitoring of cable yarding systems working in the Italian Alps**

The cable yarders represent one of the most common systems for steep slope forest operations in the Alps. This system is based on the use of tensioned skylines, which should operate continuously under a specific Safe Working Load (SWL) in order to guarantee a proper safety level for the forest operators. The aim of this study is to analyze the operative skyline tensions in real harvesting sites, working with different cable yarders and rigging configurations, identifying the frequency of the overcoming of the SWL and the main factors influencing the peak tensions and the dynamic amplification. The analysis was conducted on 12 sites in the Italian Alps, monitoring 502 work cycles. The data collection was based on a high-frequency tensiometer for the skyline tension monitoring and on a machine-control-unit (based on a camera and an inertial measurement unit integrated with a GNSS sensor), installed on the carriages, for the time study and the special event detection. Each cycle load was measured at the landing. The line and corridor profiles were extracted from a digital elevation model derived from Lidar data and using the GPS position of the support elements. The results showed that more than 53% of the cycles observed exceed the SWL. The most critical conditions were recorded in the single-span configurations where more than 73% of the cycles exceeded the SWL and 3% of the cycles overcame the endurance limit of the skylines, generating a potential decrease in the lifespan of the ropes and potentially increasing the risk for the operators.

E-mail: [omar.mologni@phd.unipd.it](mailto:omar.mologni@phd.unipd.it)

Alan Crivellaro

## **Beyond wood science**

I strongly believe in the power of testing new ideas in a scientific context. Moreover, I am strongly motivated in spreading knowledge. Together with colleagues who inspire me, I love to provide conditions in which students can learn.

This talk is roughly structured in six, partly overlapping, subjects resulting from research activities and learning experiences I had with some of my students: 1) wood mechanical properties along stems, 2) a biogeographical perspective on wood ring-porosity, 3) starch location in twigs, 4) plant height reconstruction from archeological wood and charcoal remains, 5) wood species used in a water sawmill, and 6) the millennial age of *Salix herbacea*.

All examples herein provided are partly explorative. The examples will show how variations in anatomical features of plant stems represent a unique tool for conducting research at the cross-disciplinary interface of wood science, forestry, ecology and archeology, and more generally in numerous fields of environmental and life science.

E-mail: [alan.crivellaro@unipd.it](mailto:alan.crivellaro@unipd.it)



## Abstracts

Maria Roberta Bruno

### **The perspectives of wood secondary metabolites: characterization and sustainable use**

Many studies have been done about the secondary metabolites in different wood species. The secondary metabolites are non-structural wood constituents and is necessary to extract them for study their components.

Due to research is known that in this extracts there are aliphatic e alicyclic compounds, phenolic compounds and other compounds. Over this, we can extract the metabolites from wood thermo-treatment end no thermo-treatment.

There are different techniques and extractors for isolate and analyze the extractives from the wood. The analysis of the extractive can be made through several chromatographic techniques.

Beyond this knowledge, we should be improve the use of the extractives compound.

There are several publications about the potential of the extractives, for ad example in the antibacterial treatment, bio refining, and how to preserve the surface of materials in wood, but there is still much to know and to study.

In the three years of my PhD, the extractive compounds of local wood species will be analyzed as also their possible use in different sector. The aim will be the sustainable utilization about this compounds for a practical use.

E-mail: [mariaroberta.bruno@unibas.it](mailto:mariaroberta.bruno@unibas.it)

Paola Cetera

### **Potential and alternative use of wood extractives**

Mediterranean area is often exposed to many factors of vulnerability, however is possible to valorize all wood species not only as energetic resources, but also considered them as sink of important molecules. According to European strategy in terms of green economy it is necessary to use our natural resources with the scope of reduce synthetic compounds. It represents the main reason to increase the knowledge on the Wood Technology, especially on the wood chain and try to find an alternative products to put on the market. This first workshop between PhD and young researchers is the opportunity for sharing knowledge and understand together which are the better solutions for our forests. The studies will show how the wood extractives open new perspectives in different fields, such as pharmaceutical or agro-forestry. Several species (*Quercus spp.*, *Populus spp.*, *Alder*, *Castanea sativa*, ...) showed an high antioxidant activity, especially when thermo treated wood was used. Additionally, some extractives coming from durable wood species, may improve the surface characteristics of non durable wood species and/or mitigate the processes of photodegradation.

E-mail: [paola.cetera@unibas.it](mailto:paola.cetera@unibas.it)

## Abstracts

Andrea Crocetta

### **First data on environmental impact of wood bioenergy supply chain in Piedmont**

Wood bioenergy has a key role in current EU 2020/2050 policy framework. It is identified as a carbon neutral and “green” source. However, its role in climate change mitigation is complex and requires correct analyses of full life cycle, from forest to combustion. Moreover, residential wood combustion is a major PM10 source, showing relevant effects on emissions of wood sizing/moisture, end-user behavior and heat generators efficiency. In this context Piedmont is an interesting field of work, due to poor air quality and widespread wood bioenergy utilization.

As a first step of a more accurate (actual and potential) impact assessment of regional wood energy supply chain, the current residential energy demand from wood biomass has been defined. This estimate was achieved by using, updating and extending a building-based model, developed in past years by Politecnico di Torino. Data reveal that in Piedmont wood biomass provides about 20% of residential thermal energy. Based on standard emission factors use, the potential reduction of PM10 emissions due to the replacement of heat generators is greater than 50%.

In next future, results will be used to assess grey energy and PM10 emissions of whole wood bioenergy supply chain, via an extended LCA approach.

E-mail: [andrea.crocetta@unito.it](mailto:andrea.crocetta@unito.it)

Francesco Negro

### **Development of innovative wood-based composites with enhanced properties**

Wood-based lightweight composites are widely used in building and transport sectors for their remarkable properties. In particular, their high strength to density ratio is well suited for meeting the requirements of several high-challenging applications.

The contribution aims to give an overview of the development of innovative wood-based composites that has been carried out by the author over the past years. One of them is a sandwich panel made of okoumé (*Aucoumea klaineana* Pierre) plywood skins bonded to a honeycomb core constituted by okoumé plywood cells. It was designed for use in boatbuilding and its suitability for marine applications was validated through a wide physical-mechanical characterization.

In addition, a variant intended for the acoustic improvement of closed spaces was realized by drilling its skins. The surface perforation enabled to confer sound absorption properties through the Helmholtz resonance effect. The drilled composite resulted able to absorb high fractions of sound energy within the low frequency range and therefore it is particularly suitable for applications in closed environments intended for speech.

E-mail: [francesco.negro@unito.it](mailto:francesco.negro@unito.it)

## Final remarks

Many important aspects about forest operations and wood technology emerged during the workshop. The new ideas, and the actual fields of study about the wood supply chain have been reported during the presentations, highlighting how there is a growing interest in wood properties and different potential uses. Wood is a versatile material, and new technologies and applications are growing, regarding in particular its use for structural, chemical and energy purposes. Further, it is important to underline that wood can be an environmentally friendly material, if the extraction from forests and the following transformation and use are made in a sustainable way. The consequences of the use of wood on environment and society are an actual and very important field of research. In conclusion, we are convinced that wood has been an unique material in the past and so it will be in the future.

Finally, we would like to thank all participants, including presenters and attendants, for contributing in this interesting event.

*Paola Cetera, Andrea Laschi, Francesco Negro*



### **Added value of wood in the future**

*Workshop for PhD students and Early-stage researchers  
in Wood technology and Forest operations enrolled in Italian research bodies*

Università degli Studi di Firenze, 27 February 2018

Printed by: GESAAF – University of Florence  
March 2018