

# Detected research needs for non-wood forest products in the Mediterranean

From scoping seminars, science to practice events and interregional workshops



Coordinator



Partners



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## Contents

1.	Foreword .....	3
2.	Research needs.....	4
2.1.	Cork .....	4
2.2.	Resin .....	4
2.3.	Aromatic & medicinal plants.....	5
2.4.	Wild mushrooms & truffles .....	6
2.5.	Wild nuts & berries .....	6
3.	Annexe: list of events .....	8

## Tables

Table 1.	Interregional workshops between November 2018 and April 2021.....	8
Table 2.	Science to practice events between June 2018 and December 2020. ....	9

## List of abbreviations

The following acronyms have been used across this document:

- iNet: innovation network
- NWFP: non-wood forest products

## 1. Foreword

*Forest research in the Mediterranean region is handicapped by its fragmentation, its limited means, and occasional outdated and isolation. In addition, the low benefits that Mediterranean forests provide to forest-based industries - compared to other European forests - make it difficult to attract interest and funds from the private sector.*

EFIMED. 2009. [Mediterranean Forest Research Agenda 2010 – 2020](#)

This statement made more than ten years ago about the Mediterranean forest sector in general is still valid today for many of the NWFP of the region. Research, development and extension capacities are very different between Mediterranean countries and there is much to be learnt from cross-regional cooperation. Some countries had a long tradition of using NWFP. The lack of research is often related to insufficient number of specialised researchers for some NWFP, non-existent financial and/or development programs to implement specific projects and the lack of interest from political and governmental structures. Research capacities are fragmented across countries and among institutions within one country. In the case of cork and wild nuts, there are different field trials, not always connected to each other, despite being highly complementary. Sometimes, in-house research produced by companies (e.g. resin stimulants, new resin tapping technologies, etc.) is neither published nor disseminated. Usually, across the region, support for NWFP research and rural innovation is weak.

During the three years and a half of the thematic network INCREDIBLE (2017-2021), hundreds of stakeholders from Portugal, Spain, France, Italy, Croatia, Greece and Tunisia attended five scoping seminars (held between May and July 2018) about cork, resin, aromatic & medicinal plants, wild mushrooms & truffles and wild nuts & berries, 15 interregional workshops and 45 science to practice events (see Annexe) and expressed the research needs that are collected in this document.

The following are not comprehensive lists of research needs but may be considered as the most relevant ones. These needs, grouped by priority themes identified in the scoping seminars, should be validated in an open consultation with sectorial organisations, operational groups, research institutions and members of other research projects on NWFP. Besides gaps and challenges that could be solved through research, stakeholders also identified gaps and weaknesses which would need legal, social, communication and marketing actions, benefiting from the exchange of best practices and knowledge transfer. Moreover, seven panels of experts were consulted through a Delphi survey to rank the challenges and priority actions for cork, resin, aromatic & medicinal plants, wild mushrooms, truffles, wild nuts and wild berries. We invite you to explore them all in the [Deliverable 2.3 – iNet final report, knowledge gaps and innovation opportunities and barriers](#).

## 2. Research needs

### 2.1. Cork

#### Climate change adaptation and cork oak decline

Develop adaptive management schemes at spatial and temporal scales (no unique management solution) for cork oak forests to achieve a resilient provision of ecosystem services.

Assess cork oak genetic diversity to identify the provenances that are better adapted to climate change, with special emphasis to adaptation to drought conditions.

#### Evaluation of Ecosystem services (life cycle approach)

Develop and identify management models suitable for the different ecosystem conditions, balancing different ecosystem services and achieving synergies among these services. Assess the feasibility of the proposed models (stakeholder engagement). Assess the ecosystem services within each management model (quantifying synergies and trade-offs).

Develop management schemes where the provision of ecosystem services is rewarded and profitable for forest owners.

Assess how to finance and carry out scientific surveys on cork oak woodlands biodiversity by experts in the sector.

#### Profitability

Assess cork oak genetic diversity to identify the better provenances in terms of apical growth and dominance, plagiotropy, foliar area index and thickness, and resistance to fungi attacks, in order to increase cork productivity and quality for new plantations.

Assess the relationship between soil properties and cork growth and quality.

Promote technical developments to improve mechanical cork harvesting to decrease the mechanical harvesting costs and increase the share of the cork mechanically harvested.

Improve cork extraction and transport logistics, improve bark chipping operation.

Develop apps for smartphones that would help the stakeholders in identifying the cork quality.

Develop a humidity sampling methodology to expand cork quality sampling.

### 2.2. Resin

#### Long-term resource availability in a context of climate change

Study the causes and effects of resin tapping on *Pinus pinaster* decay.

Increase the knowledge on physiological mechanisms linked to oleoresin production, as well as the availability of long series of production, dendrometry and environmental data.

Develop monitoring approaches for resin production capacity, maybe in cooperation with national forest inventories and existing certification schemes, and develop an oleoresin production model with Physiological Processes Predicting Growth (3PG) methodology.

Establish a network of test sites to obtain long series of production data and standardise the extraction methodology to obtain reliable production potential data comparable to each other.

Use of first-generation production models for the selection of areas of high production and productive classification of small-scale forest stands with application of the models through GIS.

Use of remote sensing systems and lidar technology to obtain stand scale variables and even individual trees for the application of evolved production models.

#### Progress in the compatibility of resin harvesting with other forest uses

Adapt or develop new forest management models and extraction techniques that are adapted and compatible with resin tapping, as well as forest management schemes that are complementary to agroforestry activities.

The socioeconomic implications of resin tapping should be analysed by means of a multicriteria evaluation that, in addition to productive factors, considers the positive externalities, the contribution to environmental and social sustainability, and the ecosystem services it provides.

#### Improvement of the working conditions of the resin tappers and pine oleoresin quality.

Develop more efficient tapping operations, with better ergonomics and methods that preserve the purity of pine oleoresin.

Study the possible impact of polluting elements and residues originated by the resin extraction activity, and reduction proposal.

Develop new resin tapping stimulants.

Develop new logistic solutions to facilitate the traceability of the crude pine oleoresin.

#### Development of new natural resin derivative products

Develop new competitive bio-based resin-based products, especially to replace the fossil-based substitutes. Some of the more promising products are: green fruit waxing, food and pharma products, polymers from gum rosin, rosin derivatives compatible with polyolefins and new esters for adhesives.

### **2.3. Aromatic & medicinal plants**

#### Natural Resource Management and biodiversity conservation

Develop research on the sustainable preservation of wild species population as well as on the agrotechnology for their cultivation.

Assess the maximum sustainable harvesting level per species and site.

Conduct bioprospecting studies to assess the plant species that are still unexploited and which present new opportunities for commercial exploitation.

#### Supporting production and marketing capacities

Develop silvicultural and forest management schemes to increase aromatic & medicinal plants yields in forested areas.

Botanical and agronomic research needed to focus on identifying and optimising aromatic & medicinal plants production and added-value commercial opportunities.

Develop the valorisation of the by-products produced in the distillation and drying processes.

Assess the economic viability of wild crops of aromatic & medicinal plants.

Assess how the quality of the raw material (wild or cultivated, organically or conventionally cultivated) influences the quality of the essential oils.

## **2.4. Wild mushrooms & truffles**

### Production

Develop mycosilviculture schemes to increase mushroom yields in forested areas.

Identify which parameters affect mushrooms and truffles interannual production.

Assess how continuous mushroom picking affects future yields.

Study the domestication of wild mushroom species.

Increase the research efforts in truffle plantations management: optimise truffle plantations management, including aspects such as improved management of insect pests and efficiency of irrigation.

Foster cultivation of truffle species, other than black truffle (*Tuber melanosporum*), by developing new domestication and cultivation strategies.

Assess how to restore black truffle production in forest areas and reduce its decline.

### Transformation

Research on innovative manufactured products from truffles and develop techniques to enhance the preservation of the fresh truffles once harvested.

### Commercialisation

Innovate in mushrooms and truffle tourism (mycotourism).

## **2.5. Wild nuts & berries**

### Production and harvesting

For pine nuts, research on optimised management and specific tending schemes that are still lacking: plantation density, tilling, pruning, fertilisation, irrigation and integrated pest & diseases management.

Forest the development of new crops in the Mediterranean area, such as blackberries, bilberries, raspberries and strawberry trees.

### Processing quality

For chestnut, develop operative protocols and foster their implementation by all industries through guidelines and examples of good practices.

Identify chestnut post-harvest processing that allows to avoid worm infestation and decay.

#### Pests & diseases

Develop monitoring and early warning tools for emerging pests & diseases, and develop new treatments (including integrated as well as biological pest & diseases control) for expanding pests & diseases, in order to prevent severe yield losses.

Find chestnut rootstocks resilient to ink disease and adapted to climate change.

### 3. Annexe: list of events

The previous research needs have been raised by the stakeholders of each innovation network in the 15 interregional workshops (Table 1) and the 45 science to practice events (Table 2) organised within the INCREDIBLE thematic network.

*Table 1. Interregional workshops between November 2018 and April 2021.*

iNet	Interregional workshop title	Organiser	Place	Date	Attendees
Aromatic & medicinal plants	Natural resource management and biodiversity conservation	CTFC	Sevilla, ES	28-30 November 2018	22
Mushrooms & truffles	Taxation in mushrooms and truffles sector	ETIFOR	Padova, IT	5 & 6 December 2018	64
Resin	Resin resource monitoring & modelling in a context of climate change	INIA	Madrid, ES	21 & 22 January 2019	43
Cork	Cork oak provenance trials in the Mediterranean basin	ISA	Lisbon, PT	25 & 26 February 2018	30
Resin	Resin extraction as a building block of sustainable forest multifunctionality	CNPF	Bordeaux, FR	5 & 6 March 2019	31
Wild nuts & berries	Combining WN&B economic development and products quality	CNPF	Marseille, FR	7 & 8 March 2019	20
Cork	Cork market and cork quality assessment in the Mediterranean	UNAC	Coruche and Lisbon, PT	6 & 7 June 2019	45
Aromatic & medicinal plants	From networking challenge to market opportunities	UoI	Ionnanina, GR	6 & 7 June 2019	91
Mushrooms & truffles	Mushrooms and truffles: how to improve quality and market status	CESEFOR - UoI	Ionnanina, GR	7 & 8 June 2019	112
Wild Nuts & berries	Wild harvested nuts and berries in times of new pests, diseases and climate change	INIA	Palencia, SP	12 & 14 June 2019	43
Wild nuts & berries	Enhanced production of edibles from forests and orchards	INRGREF	Tunis, TN	13 & 14 November 2019	46



Cork	Cork oak forests and ecosystem services: market development tools	FoReSTAS	Nuoro, IT	21 & 22 November 2019	99
Mushrooms & truffles	Management of truffle plantations and development of mycosilviculture	CFRI	Varaždin, Croatia	10 & 11 December 2019	40
Aromatic & medicinal plants	Certification, Traceability and Legal Framework Adjustment	CFRI	Varaždin, Croatia	11 & 12 December 2019	33
Resin	Interregional workshop on innovative bio-based resin derivatives: current trends and promising research opportunities for bio-based colophony, turpentine, CTO and CST derivatives	EFI	online, Spain	13 & 14 April 2021	90, 76, 78, 74 (for 1 <sup>st</sup> to 4 <sup>th</sup> session, respectively)

*Table 2. Science to practice events between June 2018 and December 2020.*

iNet	Science to practice event title	Organiser	Place	Date	Attendees
Resin	Tournée forestière	CNPF	Biscarosse, France	15 June 2018	34
Resin	Réunion sur les nouveaux débouchés de la résine de pin maritime	CNPF	Pessac, France	27 June 2018	8
Resin	Réunion technique	CNPF	Bordeaux, France	6 September 2018	44
Cork	Roots to riches - Genetics & products of stone pine & Mediterranean oaks	FORESTAS	Alghero, Italy	26 September 2018	42
Cork	Valorisation of the cork value chain in rural development programmes (Azioni e programmi per la valorizzazione della sughericoltura)	FORESTAS	Roma, Italy	9 October 2018	39
Mushrooms & truffles	Advances in the management and valorisation of edible wild mushrooms in Europe and Canada	CTFC	Zaragoza, Spain	19 October 2018	52
Mushrooms & truffles	Truffles in Istrian region, Croatia - forest management, policy for truffle management and trade analysis	CFRI	Livade and Motovun, Croatia	20 October 2018	18

iNet	Science to practice event title	Organiser	Place	Date	Attendees
Resin	Future of mechanisation of forest resin extraction works to improve profitability, quality and compatibility of forest uses	CESEFOR	Tardelcuende, Spain	23 October 2018	63
Mushrooms & truffles	Mushroom regulation: An opportunity for adding value to our forests: Legal framework and examples	CTFC	Solsona, Spain	19 November 2018	28
Mushrooms & truffles	Truffle cultivation in Friuli's lowlands: status quo, techniques, perspectives and legislation	ETIFOR	Muzzana, Italy	24 November 2018	24
Aromatic & medicinal plants	Visit to the distillery Bordas-Chinchurreta: A growth model in the essential oils sector in Spain	CTFC	Seville, Spain	28 November 2018	19
Aromatic & medicinal plants	Gestion des ressources naturelles et conservation de la biodiversité: Opportunités et perspectives du secteur PAM	INRGREF	Tunis, Tunisia	16 January 2019	53
Mushrooms & truffles	Fiscal reform of the truffle sector in Italy	ETIFOR	Norcia, Italy	24 February 2019	16
Cork	La forêt de chêne liège en Tunisie face aux Changements Climatiques: Défis et perspectives	INRGREF	Tabarka, Tunisia	19 March 2019	27
Wild nuts & berries	Técnicas de injerto en pino piñonero para plantaciones clonales [Grafting techniques in stone pine for orchards]	INIA	Madrid, Spain	25 March 2019	21
Aromatic & medicinal plants	Renforcement des capacités de production, marketing et communication des PME et GDA	INRGREF	Hammamet, Tunisia	11 April 2019	37
Aromatic & medicinal plants	Medicinal plants and their uses in modern Medicine	UOI	Ioannina, Greece	8 May 2019	106
Mushrooms & truffles	Truffles: Revealing the treasures of the forest	UOI	Ioannina, Greece	15 May 2019	70
Wild nuts & berries	El castaño: una oportunidad para el desarrollo rural del Bierzo oeste.	CESEFOR	Balboa, Spain	22 May 2019	49
Resin	Réunion technique	CNPF	Bordeaux, France	9 June 2018	44

iNet	Science to practice event title	Organiser	Place	Date	Attendees
Aromatic & medicinal plants	RemeiART	CTFC	Sta. Margarida i els Monjos, Spain	14 June 2019	55
Aromatic & medicinal plants	Aromatic and medicinal plants in Croatia – State of the art	CFRI	Jastrebarsko , Croatia	26 June 2019	11
Mushrooms & truffles	How to enhance mushroom and truffle sector in Croatia?	CFRI	Jastrebarsko , Croatia	27 June 2019	10
Aromatic & medicinal plants	Experiences of aromatic & medicinal plants production: technical field trip	CTFC	Spain (several locations)	16-18 July 2019	31 to 43, depending on the day and location
Cork	From research to practice seminar: Agroforestry systems - cork oak and much more!	ISA	Lisbon, Portugal	13 September 2019	48
Wild nuts & berries	Escenarios de Cambio climático y Producciones Forestales - ¿cómo se pueden adaptar las masas forestales? Claves para propietarios y gestores en la cuenca central del Duero.	INIA	Valladolid, Spain	9 October 2019	40
Mushrooms & truffles	Mycological restricted areas: learned lessons	CTFC	Solsona, Spain	18 October 2019	not provided
Resin	Mejora de la producción resinera mediante mejora genética: familias grandes productores	INIA	Coca, Spain	24 October 2019	41
Wild nuts & berries	From Research to Practice: Stone pine and pine nuts - more knowledge for a better management	ISA	Lisbon, Portugal	30 October 2019	92
Resin	Resin Use, Territorial Development and Demographic Challenge.	CESEFOR	Soria, Spain	5 November 2019	51
Aromatic & medical plants	Enhanced production of edibles from forests and orchard: field trip	INRGREF	Tabarka, Tunisia	12 November 2019	35
Mushrooms & truffles	Seminar on the identification of edible mushrooms	UOI	Ioannina, Greece	14 November 2019	23

iNet	Science to practice event title	Organiser	Place	Date	Attendees
Aromatic & medicinal plants	Using DNA metabarcoding to monitor the illegal trade in medicinal plants and protected orchids, and to detect adulterations in food	UOI	online, Greece	31 January 2020	41
Mushrooms & truffles	Mushrooms and truffles: from forest to table	UOI	Ioannina, Greece	15 February 2020	56
Cork	Prevenzione e gestione della Phytophthora spp. nei querceti Mediterranei	FoReSTAS	Oristano, Italy	19 February 2020	47
Mushrooms & truffles	Drafting the Strategy of sustainable truffle management of Varaždin region, Croatia: online consultation	CFRI	online, Croatia	1 May 2020	19
Resin	Le gemmage de Pin en Tunisie : Nouvelle opportunité socio-économique ?	INRGREF	Tabarka, Tunisia	8 September 2020	24
Wild nuts & berries	Impact du Phytophthora dans les châtaigneraies: du diagnostic à l'adaptation	CNPF	Vals-les-Bains, France	16-17 September 2020	12 & 10
Mushrooms & truffles	Sylviculture, production, tourism, consumption	CNPF	St-Bonnet-le-Froid, France	6-7 October 2020	45 & 44
Cork	Cork quality assessment: training session <sup>a</sup>	INRGREF, INIA and UNAC	online, TN/ES/PT	7 & 9 October 2020	34
Cork	Transfer cork assessment methodology to Sardinia: training session <sup>a</sup>	FoReSTAS, ISA and UNAC	online, IT/PT	18 & 19 November 2020	21
Wild nuts	Pinha e Pinhão: desafio e oportunidades	ISA	online, Portugal	14 December 2020	75
Resin	Redes colaborativas sobre la resina como materia prima para la bioeconomía	CESEFOR	online, Spain	16 December 2020	34
Aromatic & medicinal plants	Aromatic and Medicinal Plants (MAPs) after COVID: what should we expect?	UOI	online, Greece	21 December 2020	131

iNet	Science to practice event title	Organiser	Place	Date	Attendees
Mushrooms & truffles	Dal vivaio alla produzione di tartufi	ETIFOR	online, Italy	22 December 2020	39