INCREDIBLE

Innovation Networks of Cork, Resins and Edibles in the Mediterranean basin

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Executive summary

INCREDIBLE aims at addressing existing research and innovation knowledge divides in Non-Wood Forest Products (NWFP) value chains across the Mediterranean basin. To achieve this, the project has stablished five *Innovation Networks* or "iNets", which will identify innovation needs and opportunities and share knowledge (both practical and science-based), best practices and business cases related to management, collection, transformation and place into market.

The iNet coordinators have organised a kick of *scoping seminar* for each iNet, gathering key stakeholders and researchers in order to better understand the functioning of the different value chains and their main knowledge needs, gaps and divides. These seminars were a great opportunity for stakeholders to propose new ideas, activities and opportunities which will contribute to the iNet development. Their outcomes are summaries in an *innovation roadmap*, that will help shape the future activities of INCREDIBLE.

This Deliverable D1.3, entitled "**A Road Map for innovating NWFPs value chains**" is, then, a synthesis report the outcomes of the five *scoping seminars.* IT will be available to all stakeholders and posted on web. This report is designed as basic guideline for further work and development of iNets.

Chapter 1 presents an overview of the project, as well as its driving ideas and tools, and the current state of the five NWPF (the narratives) in order to contextualise the outcomes of the scoping seminars and the *road map*. Chapter 2 contains short summaries on the outcomes of each scoping seminar. Chapter 3 analyses and discusses the main findings with a cross-NWFP analysis. Finally, Chapter 4 presents a synthetic roadmap for INCREDIBLE, with recommendations for action.

The Road Map contains references to and extracts from scoping seminars reports and supporting materials that can be found in the Annexes.

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1. Introduction to the innovation networks (iNets)

1.1. INCREDIBLE project overview

Mediterranean forests are facing significant challenges at many levels. In the northern Mediterranean, rural abandonment leads to a rapid expansion of unmanaged forests and increased risk of catastrophic forest fires. In the southern and eastern Mediterranean, rural and peri-urban populations are putting pressure on forest resources. The lack of well-developed forest products value chains that can generate jobs and income can be seen as a common underlying factor that jeopardises the capacity to sustainably manage forest resources already menaced by climate change. Non-Wood Forest Products (NWFP) can be part of the solution, if they can contribute to a smart and inclusive bio-based economy that can create value from and investment streams for sustainable forest management. Developing existing potentials requires the collaboration and knowledge exchange between NWFP practitioners and scientists, and among regions. The INCREDIBLE project is designed to speed up the flow of credible, salient and useful knowledge from science and experience, in order facilitate innovation to happen.

Interregional Innovation Networks (iNets) are the core tool of the INCREDIBLE project to promote knowledge exchange on NWFP across the Mediterranean basin. These networks will allow to seed, collect, co-create and disseminate relevant technological, economic, innovative and research knowledge linked to the main NWFP value chains. iNets are innovation networks where individuals meet to bring forward and co-create knowledge on selected topics. While being interregional in their structure, iNets will be actively working at the local, national and international scales in terms of dissemination outputs and activities.

INCREDIBLE has developed five iNets for the main Mediterranean NWFP: cork, resins, aromatic and medicinal plants, mushrooms and truffles, and wild nuts and berries, to better process the issues of NWFP across the Mediterranean basin. Each iNet will aim to gather the best practical and science knowledge related to NWFP production, transformation and trade channels. Special attention will be drawn to cross-cutting sectorial issues.

Within the iNets, the goal is to achieve and implement innovations through the project. The project concept is to identify challenges and needs in practice for each iNet and explore methods to address them by creating the competences and contributions of many various actors within the iNet ecosystem. The innovations in this context have to be interpreted like an innovation process in which actors from different organisations participate on its creation. Key to this is successful stakeholder engagement, allowing the various actors of the iNet ecosystem to be involved and to be a part of the innovation process.

The participation of stakeholders relevant to the iNet regional ecosystems in the discussions and decision-making process is the best way to ensure that their own perspective and knowledge contribute to the project's outcomes. Stakeholder participation not only results in a better narrative with a richer picture of the iNet challenges, but also allows to better expressing the innovation objectives and the options to reach these goals. Successful outcome also requires dealing with barriers to the implementation of the innovation. These barriers will be discussed and explored during the activities of the iNet.

1.2. Cork iNet narrative

In the cork production, the greatest peculiarity is that cork is harvested in periods of 9–14 years without cutting the tree (cork oak, *Quercus suber*) and therefore without the need to modify the

forest structure. In Portugal and southern Spain, cork is typically produced in open, multifunctional agroforestry systems stands (*montados* and *dehesas*), which also produce other products and ecosystem services with very high cultural heritage values. In other regions, Catalonia, Mediterranean France, the isles of Corsica and Sardinia and the Southern Mediterranean, cork is produced mainly in closed forest stands. In both systems, cork production is a main source of income. The manufacturing of stoppers is the most important use in economic terms, ensuring a vital role in maintaining the economic value of cork and the low intensity use of cork oak forests. However, there is an increasingly large portfolio of construction and other manufacturing materials produced with cork that are gaining relevance in the bottom line of cork processing companies. New markets related to sustainable construction and the transport and aerospace industries could uptake more cork products if those where available at competitive prices. However, these new applications cannot make today a profitable business model in the absence of quality stoppers that still represent some 70% of the total industrial turn-over.

As a typical Mediterranean forest ecosystem, cork oak forests are significantly affected by climate change. Many cork forests are scarcely managed but a significant area is now under less favourable conditions regarding its productive potential, reflecting overexploitation and inappropriate management practices due to lack of knowledge. Such factors in certain cases also contribute to put at risk the sustainability of the entire value chain. In addition, the long period for investment recovery, the relatively high cost of labour and low profitability for forest managers, the fragmentation of owners and the lack of innovation culture among forest owners and managers does not favour the desirable correction of these imbalances in the value chain.

1.3. Resins iNet narrative

Gum resin is a natural raw material that has multiple applications in the manufacturing of chemicals products. Historically, the production of gum resin has been a relevant economic resource in the coniferous forests from Mediterranean Europe, mainly in forests of maritime pine (*Pinus pinaster*) and in to a lesser extent, Aleppo pine (*Pinus halepensis*), Stone pine (*Pinus pinea*) and black pine (*Pinus nigra*). The European productive peak was reached in 1965, with 250,000 tons produced. Since then, the sector declined gradually in the continent due to lack of competitiveness against foreign gum resins and substitutive oil based products. In the decade of the 1990s, European production almost stopped. In the first decade of the 21th century, a change in the global market situation allowed a revival of the harvest activity in the most traditional areas of the Iberian Peninsula. This timid reactivation has been possible because of a marginal activity sustained by some first transformation local factories, the know-how hoarded by ancient workers, the interest of some institutional owners and the existence of forests ready for the exploitation thanks to their sustained management. Simultaneously, several institutions have launched their research programs in the gum resin area, regarding the improvement of the whole value chain from forest to market.

Nowadays, the industrial demand for resinous products in Europe is estimated at 300,000 tons per year. The reactivation of the Mediterranean forest production could supply part of this demand. Potentially, the revival of natural resin production in Spain could be replicated in other Mediterranean countries rich in suitable pine forests, contributing to a greener economy, improved rural livelihoods and creating industrial jobs. There are, however, significant hurdles related to profitability, uncertainty on the compatibility with other forest uses, the potential impacts of climate change and the lack or loss of traditional know-how. In this context, the focus of the iNet of resins will be to explore existing research and innovation knowledge and the best

practices across European gum resin value chain in order to deal with the main challenges that the sector is facing.

1.4. Aromatic and medicinal plants iNet narrative

Aromatic and medicinal plants (AMP) products are widely used in the perfume, cosmetics, food and pharmaceutical industries. These different market segments are very different in terms of value chain actors, volumes traded, relevance of national or international markets or quality requirements. While some plants or their extracts are cultivated, there is still a very significant portion of wild aromatic plants that are collected in forests and scrublands. Some of the wild plants more commonly traded for are lavender (*Lavandula* spp.), everlasting (*Helichrysum* spp.), sage (*Salvia* spp.), laurel (*Laurus nobilis*), myrtle (*Myrtus* spp.) and rosemary (*Rosmarinus officinalis*).

The AMP iNet the focus is on wild plants that make essential parts of Mediterranean forest/scrublands ecosystems. Often, they grow on the most degraded lands, and hostile conditions, unsuitable for classical forest or agricultural production. Despite their natural resilience to harsh environmental conditions, they are affected by climate change and can be affected by unsustainable harvesting levels and/or procedures.

There is an increasing interest worldwide in aromatic and medicinal plants as natural medicinal remedies, for their use in thermal treatments and as ingredients for natural cosmetics. This global trend is reflected in a growing demand for AMP products in the European markets that are becoming more sophisticated and demanding in terms of quality of products and reliability of supply. Other requested attributes are sustainability, social equity and wildness. They are becoming highly demanded in at least some high added-value market segment. All actors in the AMP value chains are increasingly required to address consumers' expectations (e.g. in relation to traceability, development of niche products) while also facing changes in consumer preferences, and increased global competition. Some high demanding sectors (e.g. perfume and cosmetic industries) are stretching to the limits the capacity of producers to supply essential oils based on wild-collected plants in quality, quantity and price. This rapidly evolving market situation and the menace of climate change pose significant challenges and opportunities for resources managers, collectors, processors and distributors.

1.5. Mushrooms and truffles iNet narrative

Mushroom picking is a growing activity in European forests, and a long lasting tradition for several Mediterranean countries such as Italy, Spain, France, Portugal and the Balkans area. They grow in almost all types of forest ecosystems across Europe and are mainly collected from the wild (with exception of cultivated truffles in Spain, France and Italy).

The benefits related to wild mushroom picking can be broad and when maximised can involve a variety of actors playing at the recreational level (e.g. occasional pickers), the commercial level (e.g. mushroom traders), as well as activities proper of the tertiary sector (e.g. mycotourism and leisure activities, education initiatives). However, often private or public landowners do not benefit from the revenues generated by these activities that can also cause friction between mushrooms harvesters and forest owners. In some cases, high harvesting pressures or conflicts between commercial and non-professional pickers can emerge. Most of the mushrooms species show a great ecological plasticity in regards to plant symbionts and environment, as long as there is enough humidity, and their production can greatly vary from year to year. This jeopardises stable value chains. Production levels can potentially be affected by harvesting intensities or

harvesting technics. Truffles are considered the most profitable Mediterranean NWFP with a high potential for development. Truffle species (*Tuber magnatum* and *T. melanosporum*) are highly demanding in respect to ecological conditions and have been domesticated only in some regions.

As all edible forest products, there are significant challenges in relation to traceability for safety regulations and market transparency. Innovative value chain integration models are often valuable tools to share benefit across all involved stakeholders. In addition, the development of diversified harvesting models aimed to co-production can improve resilience of the mushroom and truffles value chain.

1.6. Wild nuts and berries iNet narrative

Many species of Mediterranean woodlands offer edible seeds or fruits. Some of them have been traded since Antiquity, but others are only locally used due to limited supply or to perishability. The most emblematic and valuable gourmet nut gathered in Mediterranean forests is the seed kernel of stone pine (*Pinus pinea*), the Mediterranean pine nut. The second highly prized wild fruit are chestnuts, the fruits of the sweet chestnut (*Castanea sativa*), harvested from groves and orchards throughout Mediterranean countries and beyond. Among other wild fruits, blackberries (*Rubus* spp.), bilberries (*Vaccinium myrtillus*), and raspberries (*Rubus* spp.) already have an important development as new crops in Southern Europe, following the way of cultivated American blueberry (*Vaccinium* spp.). However, business opportunities for other berries, such as strawberry tree fruits (*Arbutus unedo*) are still not widespread.

In the last decades, mechanical harvesting of stone pines by specially adapted tree shakers has reduced costs as well as labour risks of manual harvesting by tree climbers. Recently, first elite clones have been legally registered and released as basic materials for scion production allowing for grafted orchards, with genetic gains estimated in 20-40%, but nurseries must still develop the plant supply chain for marketing high-quality grafted trees. The control of yield losses due to the exotic seed pest *Leptoglossus occidentalis* is a major challenge for the sector.

The European chestnut is facing new challenges that could be decisive for the future of the sector in Europe, namely diseases like ink (*Phytophthora cinnamomi*) and blight (*Cryphonectria parasitica*), the Asian chestnut gall wasp (*Dryocosmus kuriphilus*), fruit plagues and rot, as well as orchard management issues and the value chain development.

2. Scoping seminars

The scoping seminar was the first official meeting of each iNet. Its main goal was to create a specific road map for better targeting specific issues within its topic. Five seminars were organised by the iNet coordinators and they were held in Tunisia (Aromatic and Medicinal Plants), Spain (Resins, Mushrooms and Truffles), Portugal (Wild Nuts and Berries), and Italy (Cork). All iNet members were invited and a special attention was given to ensure the participation of key stakeholders. At the scoping seminar, stakeholders had an opportunity to validate previous work, to propose bottom-up, complementary activities and to contribute to the iNet future development.

The main objectives of each scoping seminar were:

a) to validate the narrative, and to establish a road map for the development of the iNet. The object was to focus on the themes that will be addressed throughout the project,

b) to manage expectations on what can be achieved,

c) to give participants opportunities for networking.

At the scoping seminar, stakeholders gathered from all links of the value chain had an opportunity to share their opinion and bring up problems and difficulties of their sector. This was a unique chance for everyone to learn about challenges and to get a wider picture of the condition in the sector. Most of the stakeholders were from the country where the scoping seminar was organised but international stakeholders were participating too. It was interesting to local stakeholders to learn and compare the difficulties, qualities and solutions in other countries.

The number of stakeholders attending scoping seminars (Table 1) was higher than expected (targeted number was 30) in three of the events, which tells us that the stakeholders were well informed and interested in collaboration. Despite the different concerns among participants from different countries, and even among regions in the same country, the participants agreed on the identification of challenges as well as the priority themes for reinforcing the NWFP sector.

	Cork iNet	Resins iNet	Aromatic and medicinal plants iNet	Mushroom and truffles iNet	Wild nuts and berries iNet
			Number of participants		
Spain	1	28	4	48	4
Portugal	4	7	1		15
France		3	2	2	1
Belgium	1	1	1		
Greece			1	2	
Italy	20			2	
Croatia				2	
Tunis	1	1	37		
Total	**27**	**39**	**46**	**56**	**20**

Table 1. Number of participants at each scoping seminar.

Per iNet, this chapter summarises:

- the main outputs from each Scoping seminar;
- the improvements that this event brought to the value chain map (improved description or addition of new stakeholders and fluxes), and

- the priority themes on which the INCREDIBLE project should focus, those that would have a bigger positive impact on the value chain.

2.1. Scoping seminar report of the Cork iNet

2.1.1. Summary output

The Cork iNet scoping seminar took place on 11 and 12 July in Sardinia, Italy. A significant number of participants attended the seminar and represented the most significant links of the cork value chain, namely forest owners, cork industry, research and development, wine industry, national and regional governments and chamber of commerce. Most of the participants were from Italy, with some participants from Portugal, one from Spain and one from Tunisia. Regarding the representativeness of the cork value chain, and thinking about future events, iNet should improve the engagement of more participants from Portugal, Spain, Tunisia and other cork producing countries like France and Morocco, and for a more balanced representation of the links in the cork value chain.

Although most of the participants were Italian, that was not an obstacle to obtain a very interesting and participated discussion sharing knowledge and doubts between the different players and the different countries represented. The interactive discussions, exercises, group works and session dynamics were essential for a well participated cork value chain reflection that allowed for the identification of priority themes to focus in INCREDIBLE actions (see section 2.1.3). They are key areas that require increased knowledge sharing, and better understanding of existing of regulations and policy innovation ideas in different countries, such as those aimed at:

- minimizing the grey economy,
- establishing of payment for ecosystem services (PES) models,
- maintaining/developing regulations to assure the sustainability of the cork oak ecosystem (including regulation of pastoral pressure and addressing oak decline,
- transparent assessment of cork quality before harvest,
- multifunctional ecosystem policies,
  recycling cork and advancing towards a circular economy.

2.1.2. Description of new/better characterised actors and fluxes in the value chain

Four working groups were established to discuss the cork value chain map (Figure 1) with representatives from the different stakeholders. The main issues that arose from the discussion to be included in the value chain map were:

- Existence of a sampling methodology applied by the forest owners associations in Portugal to evaluate cork quality and market price prior to the sale. This is seen as a tool to empower forest owners and improve their bargaining position with industry over price of cork;
- Different cork quality classes are used in different countries, which makes it difficult to share information on market and prices, but also on research results (e.g. seven quality classes are used in Portugal versus three in Sardinia or Catalonia);
- Relevance of the silvo-pastoral “actors” in Sardinia: establish connections between the farmers and the shepherds, and new relevant actors where identified and added to the cork ecosystem as is the case of tourism operators and small cork artisans;

- The existence of different forms of commercialization, for example the auctions in Tunisia and public forest in Sardinia, which are different from direct selling in private forests in Portugal and Catalonia.
- The presence of "grey trading" between farmers, intermediaries and industries was identified along with the need to better understand the connections between the "cork strippers contractors" and the cork intermediaries in different regions.

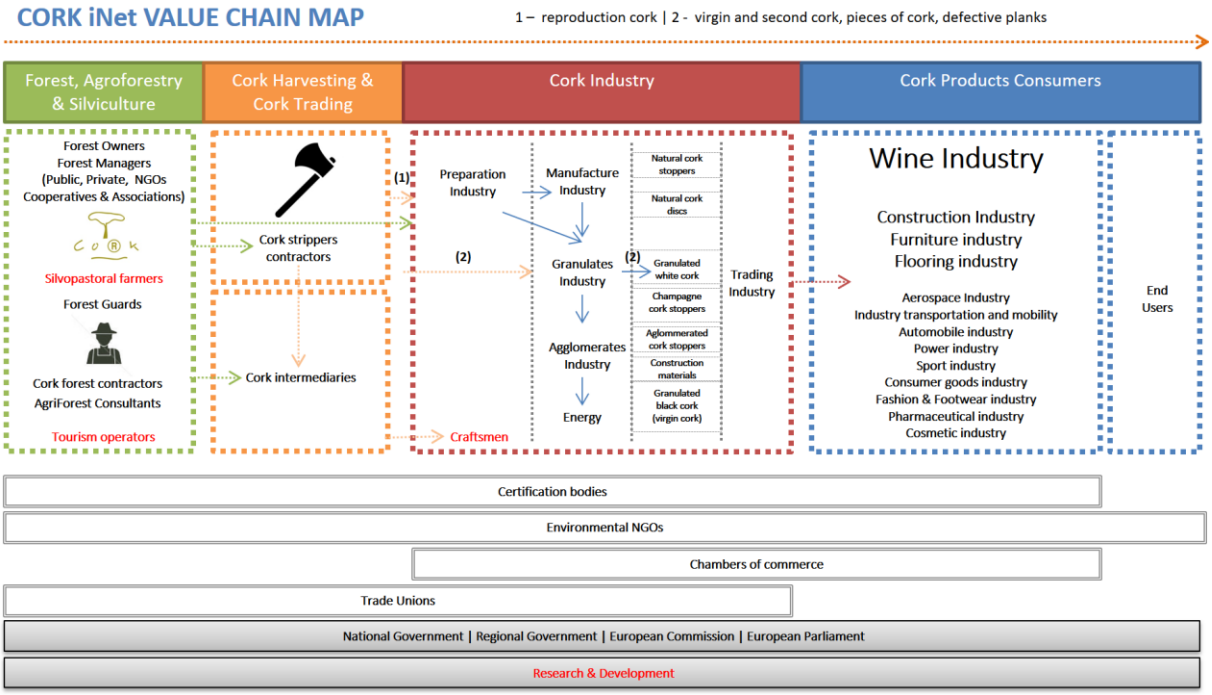

Figure 1. Reviewed cork value chain map. Note in red the contributions entered in the scoping seminar.

2.1.3. Priority themes to focus INCREDIBLE actions

During the iNet sessions, a list of future challenges emerged and priority themes to focus future iNet actions were established.

EVALUATION OF ECOSYSTEM SERVICES

This is seen as a technical and managerial innovation challenge.

Desired state: a set of management models suitable for different conditions available; balancing different ecosystem services (ES) and achieving synergies among them; delivery of ES is rewarded and profitable.

What needs to happen: research-based identification of management models; assessment of feasibility of proposed management models (stakeholder engagement); assessment of ES within each management model (quantifying synergies and trade-off).

Actions/role for INCREDIBLE:

- provide a rating system associated to different ES performances;
- documented and critical assessment of existing cork or related PES schemes.

PROFITABILITY OF CORK PRODUCTION

This is seen as a complex challenge with technological, managerial, social and policy components:

- technological challenge: mechanical cork harvesting, optimisation of cork extraction and transport logistics, reduction of time to first harvest and/or first revenue though silvicultural innovations (irrigation, mixed plantation…);
- organizational challenge: negotiation power increase for producers, new commercialisation approaches;
- policy challenge: related to ES payment regulation, including EAFRD;
- business model challenge: new contractual arrangements, new financial support to new plantations, operationalisation of ES and paying for ES schemes…

Desired state: stabilising new cork plantations is financially attractive, decreased costs of cork extraction by 30% maybe through mechanically debarking, new marketing strategies, increased profits for producers, payments for ES become a normal, dynamic and innovative sector, workers training, transparent market trading,

What needs to happen: improving funding to implement R&D agenda, sharing and expanding cork quality sampling and assessing methodologies, identifying solutions for humidity sampling methodology to better schedule cork harvesting, creating financial schemes to support plantation (attractive and adequate), expanding the cork market platform, performing operational research on cork extraction and logistics.

Actions/role for INCREDIBLE:

- attempt the adoption of a common standard for assessing cork quality across the Mediterranean;
- assessment documentation and share relevant cases and literature;
- workshop organization about the relevant cases;
- dissemination events (including field discussions);
- addressing rural development funding as a tool to support cork value chains in INCREDIBLE activities;
- a review NWFP training necessities and approaches;
- training school meetings;
- e-tools development: webinar and practical tutorials videos.

CLIMATE CHANGE

This is seen as a management and innovation challenge: facing the effects of climate change such as decrease in precipitation, increase in temperature and of extreme events, and with the fact that cork oak is a slow response system/species.

Desired state: resilient ecosystem services from cork oak systems.

What needs to happen: more adaptive management at a spatial and temporal scale (no unique management solution).

Actions/role for INCREDIBLE:

- awareness of public decision-makers for the need for long term research;
- analysis and integration of existing information and good practices for dissemination for forest owners;
- promote research and knowledge transfer cooperation among cork oak stakeholders;
- tools for better scheduled harvest operations in a context of increased drought.

2.2. Scoping seminar report of the Resins iNet

2.2.1. Summary output

The Resins iNet scoping seminar was held during the month of May in Valladolid, Spain, it was well attended by members of the value chain of the European resins sector. The participants came almost entirely from Spain, France and Portugal, the three countries that have historically led resin production in Europe.

From the point of view of sectorial representativeness, it can be said that there were participants from all the links in the natural resin value chain, with the exception of consumers. In future events, special efforts will have to be made to include representatives from this part of the value chain, as they are the real driving force behind resin production in the Mediterranean region.

The exercises of evaluation of expectations, review of the value chain map and generation of a SWOT analysis of the sector served to make the stakeholders recognise themselves, reflecting at the same time on the problems and deficiencies of the group, which can be covered by R&D initiatives. This is a first step, which in future INCREDIBLE events should be used to help improve sectorial cohesion as an essential objective to animate the innovation network.

In the work dynamics, the participants showed great interest in the joint resolution of the challenges facing the sector. A good proof of this is the volume and quality of the reflections made. It should be noted that in the working sessions in which representatives of the different links of the value chain interacted there was a desire for complementarity and the search for meeting and common points.

Many innovation priorities were put on the table, of which four were finally chosen as the most pressing:

- resource modelling in a context of climate change;
- progress in the compatibility of resin harvesting with other forest uses;
- improvement of the working conditions of the resin tappers;
- development of new natural resin derivative products.

2.2.2. Description of new/better characterised actors and fluxes in the value chain

The ecosystem of the natural resin value chain is characterized by a first distinctly forest segment, from pine crude oleoresin extraction from the pine tree in the forest to its fractionation by distillation into colophony, turpentine essence and water, which is then inserted into more

sophisticated chains through the chemical transformation of the essential resin components. Its technological versatility takes the compounds derived from natural resin to the final consumer as part of high value-added products such as cosmetics, adhesives, inks and coatings or pharmaceutical products among others.

The ecosystem is completed with administrative bodies, sub-sector organizations and academic and research institutions that intervene in each one of the value chain links (Figure 2).

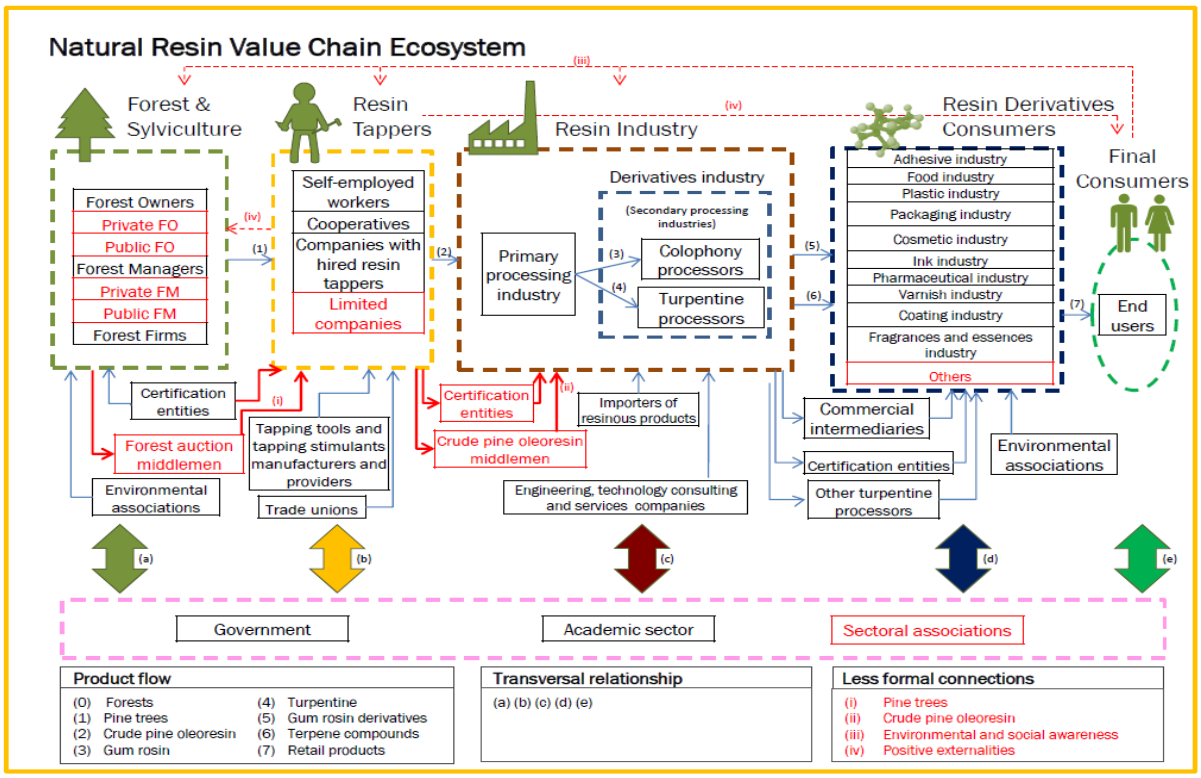

Figure 2. Reviewed natural resin value chain map. Note in red the contributions entered in the scoping seminar.

The forest owner receives income from the resinous use of his/her woodlands as a rental from the pine tree, usually to the resin tappers. The contracting unit is the tree, setting a fixed price per tree. Particularly important in the transaction are the ways in which the pines are allocated, giving preference to local workers or not, and the contract specifications, which emphasise use times, resin extraction methods and assembly and disassembly of the installation. Contracts are usually signed for one to five consecutive years, depending on the circumstances.

The forest owner is also aware of the indirect benefits and positive externalities that the resin tappers activity has for his/her property in the form of surveillance, cleaning and fire prevention. In the case of public landowners, resin extraction is often a political tool to fix population into the territory.

The resin tapper is the forest worker, usually self-employed or organised in worker cooperatives, who extracts the resin from pines. He usually rents the pine trees to the forest owner and sells the resin to the primary processing industry. The selling unit of crude pine oleoresin is the kilogram. Contracts between resin tappers and industry include not only price, but also aspects

related to payment methods throughout the campaign, transport costs or product quality, among others, which are key to closing operations.

The resin industry is classified in two sections: primary processing industry, which only performs the fractionation of the resin by distillation; and secondary processing industry, in which modification and fragmentation of colophony and turpentine are carried out.

The companies of the Mediterranean basin that perform the primary transformation of the crude pine oleoresin buy the raw material from the local resin makers, or import it from third countries, generally Asian and Central or South American Therefore, purchase prices are very conditioned by the international price of the product.

The secondary transformation takes place in much more sophisticated specialised facilities, either the modification of the colophony or the fragmentation of the turpentine essence. Some companies integrate the primary transformation with the subsequent transformation of the colophony and/or turpentine essence. This secondary transformation has an advanced technological component, which allows the elaboration of tailored derivative products.

The resin derivatives consumers are industries belonging to the sector of the industrial chemistry. They not always manufacture products aimed at the end consumer, but sometimes still make new transformations and intermediate products that will be used in the composition of products for the end user.

During the presentation of the narrative and value chain in the scoping seminar sessions, actors and fluxes of the initially proposed scheme were identified and accurately defined.

New actors identified:

- Forest auction middlemen: individuals who buy tapping rights and sell it to resin tappers. Their activity could affect resin tappers profitability. This actor should not be confused with some processing companies that buy resin extraction rights for transferring it to resin tappers and make it easier for them to access the activity.
- Crude pine oleoresin middlemen: individuals who trade with crude pine oleoresin between resin tappers and primary processing industry. It is an occasional figure that may rarely appear in some regions. Considering the current crude pine oleoresin prices, is not a very profitable nor sustainable activity, and can damage the resin tapper activity in areas where it is not well stabilised yet.
- Limited companies: in the resin tappers side, they represent some rare cases of companies devoted to crude pine oleoresin extraction.
- Others (resin derivatives consumers): that label represents the large amount of others applications of resin derivatives that characterize the versatility of this raw material.
- Sectorial associations: forest owners associations, resin tappers associations, and resin derivative associations. The resins industry has not well-developed associations.

Better characterised actors:

- Forest owners: it is essential to differentiate between public and private forest owners. It is also very different their role among the different regions.

  Public ownership:

Portugal: municipalities, *baldíos*, which are community areas, and the State.
Spain: municipalities, regional governments and the State.

Private ownership:
Portugal: enterprises, small owners and large owners, forest owners associations.
Spain: the same as in Portugal and, in addition, the "partner forests" which are *pro indiviso* forest properties owned by a group of natural and/or legal persons.

- Forest managers: it is essential to differentiate between public and private forest management. It is also very different their role among the different regions.

Public management:
Portugal: in both public and private forests, communication of intention to use, ensures compliance with specific legislation.
Control resin of transactions and agents of the sector through a website.
Spain: lack of homogeneity between Autonomous Communities. In general, in public forests: management of the forest, specifications for the use and control of the uses. In private forests: it processes the use authorizations and it ensures compliance with specific legislation.

New fluxes identified:

- Pine trees: regarding the new "Forest auction middlemen" actor identified.
- Crude pine oleoresin: regarding the new "Crude pine oleoresin middlemen" actor above mentioned.
- Environmental and social awareness: underlying the final consumer's attitude there is an interest in socially and environmentally sustainable products, which in the case of products derived from natural resin is not well perceived due to the remoteness within the value chain between these consumers and the activity of resins tappers.
- Positive externalities: they are generated by the resin tapper activity, in the direction of the forest, as forest keeper and forest maintainer, and in the direction of the final consumers, as sustainable chemical products and ecosystem services provider.

Better characterised fluxes:

- Certification entities: their activity has been extended in the scheme from forest to factories, passing through resins tappers, to represent the importance of crude pine oleoresin traceability. Many of the publicly owned resinous forests where the activity is currently carried out own sustainable forest management certification. However, few consumers of derivatives apply for forest certification of products, so product certification or chain of custody is hardly implemented in the sector.
- Academic sector: it works in the new forest model's definition, e.g. over stone pine (*Pinus pinea*) tapping, it provides training to technicians and forest managers and it undertakes research projects.

2.2.3. Priority themes to focus INCREDIBLE actions

A plenary session proposed a number of priority themes to focus innovation efforts on. The proposals were grouped by theme, establishing four themes covering all the proposals. The work of reflection concluded with a vote in which the topics were prioritised in the following order:

1. Long term resource availability in a context of climate change
2. Compatibility of resin harvesting with other forest uses and with forest health

3. Improvement profitability of tapping and working conditions for workers
4. Development of new derivative products.

LONG-TERM RESOURCE AVAILABILITY IN A CONTEXT OF CLIMATE CHANGE

Recent investments in new processing capacity in southern Europe underscores the existing uncertainty of the medium- and long-term supply capacity of the resin-producing forest stands as well as the need to better communicate improved available knowledge to potential investors, resource managers and other decision makers.

Long-term availability will be conditioned by ecological and forest management factors (e.g. productivity) socio-economic and labour market factors (e.g. economic viability) and technological factors (e.g. new technologies and products). Improved resource modelling can contribute to reduced uncertainty and better decision making.

The stability, continuity and persistence of resin-producing forest stands in the Mediterranean may be threatened by climatic changes, or by the effect of forest fires, specific pests and diseases and other anthropogenic and natural risks. Lowering water tables due to irrigation of neighbouring crops is thought to be a major threat in Central Spain. The demographic evolution of the resin-producing areas and the possibility of finding skilled labour is another factor that may jeopardise the productive capacity of the system. Finally, the appearance of technological developments that facilitate the exploitation of natural resin can contribute favourably to the stability of supply. There is a lack of large-scale predictive models, both on natural resin productive volume side and on the possible evolution of the state of the maritime pine stands under the impact of biological risks.

Ideal situation: a common monitoring protocol (indicators) for Mediterranean countries shall be stablished to regularly evaluate and communicate the state of current and potential production capacity of resin-producing forests. An optimal approach would be the integration of this protocol into national forest inventories and forest management plans. Based on these assessments, the effects of climate change would be modelled and the results shared as a tool to accompany regional forest management plans. Ideally, stakeholders should be informed and aware on current and future resource availability under plausible scenarios. There is the necessary understanding and support for the actions and investments required to carry out the planned monitoring as well as to define and implement control and corrective measures.

COMPATIBILITY OF RESIN HARVESTING WITH OTHER FOREST USES AND WITH FOREST HEALTH

This is considered a scientific/technological challenge. The owners and managers of pine forests lack factual knowledge on the interactions between production of timber products and natural resin extraction, through different tapping methods and periods. Existing knowledge in this area is dispersed and not available to directly advise stakeholders. Historically, both productions were carried out in a complementary way in many regions of the maritime pine distribution area. There are certain gaps in knowledge, from the technical point of view, about how resin tapping affects the structural or aesthetic characteristics of pine wood. The effect of resin tapping on other forest products, such as stone pine cones, is not well known. New resin extraction technologies might have better economic behaviour in wood producing areas (borehole technics). In addition, there are concerns on potential impacts of resin extraction on the spread of severe diseases, as is the case of the pine wood nematode (*Bursaphelenchus xylophilus*). There might be significant

knowledge in "grey literature" and coming from personal experience that could be identified, evaluated and shared,

Ideal situation: all stakeholders are well informed, share reliable information and know the benefits and disadvantages of making both productions (timber and resin) compatible to make appropriate technical decisions. This comprises current and improved methodologies and tapping intensities and approaches (e.g. tapping periods in relation to production of timber).

IMPROVEMENT PROFITABILITY OF TAPPING AND WORKING CONDITIONS FOR WORKERS

Cost of resin extraction is critical as natural resin derivatives compete with tar-oil and synthetic derivatives in globalised markets. Resin is a heavy product, produced in small *per tree* quantities and requiring large production areas. Efficient production poses significant logistic challenges. In fact, hard working conditions and limited profitability are the main obstacles for resin extraction in Europe. Improving profitability and working conditions is mainly considered a technological challenge, linked to the development of new resin stimulants, the mechanisation of tree and stand preparation, the bark chipping operation, improved resin tapping technologies and the optimisation of logistics. In addition, from a socioeconomic perspective, resin extraction could benefit from improved work continuity and income complementation. This could be achieved through the payment for ecosystem services (PES) schemes (e.g. linked to fire prevention) and/or through preferential access to work related to forest maintenance.

Ideal situation: develop more efficient tapping operations, better ergonomics, increased profitability with less effort and continuity of income. Generalise the recognition of positive externalities produced by tapping (by society, value chain actors and the public administrations) materialised in additional income for resin workers through, among other methods, PES schemes.

DEVELOPMENT OF NEW DERIVATIVE AND UNIQUE PRODUCTS

Innovation on resin derivatives could benefit from improved market knowledge in order to focus on the development of competitive products, especially against substitute products. Demand is complex and varied. It is necessary to identify and classify business opportunities to establish product development strategies based either on niche markets or on mass consumer products. The development of new natural resin derivative products has to be based on the eco-friendly and sustainable features of the raw material. On that note, some stakeholders considered advisable the creation of a designation of origin of the Mediterranean natural resin. The technological development of new logistic solutions would facilitate the traceability of the crude pine oleoresin. However, the potential real benefits and trade-offs of a designation of origin brand are not necessarily well understood.

Ideal situation: reach a good knowledge on the demand for high added-value products across the most relevant markets is a main objective to achieve. Achieve a good identification of products with compounds derived from natural resin as organic and eco-products, currently of high demand by the intermediate and end consumer. Consolidate a stable and equitable supply chain. Reach a good collaboration among actors of the resin ecosystem and a good traceability system that is easy to maintain and involves little administrative burden.

2.2.4. How can INCREDIBLE better contribute

Preparing a systematic review of existing knowledge in relation to:

- resource assessment, modelling and monitoring;
- tapping and logistic solutions;
- compatibility of uses and externalities produced;
- existing business models and contractual arrangements.

Developing monitoring approaches for resin production capacity, maybe in cooperation with national forest inventories and existing certification schemes.

Compiling knowledge gaps, available research resources, and key infrastructures.

Adopting a transnational research agenda. The agenda should identify the most relevant knowledge gaps and contribute to increase investment in R&D on resource modelling, resin production, compatibility of uses, positive and negative externalities of tapping valuation and operationalisation of ecosystem services, and socio-economic arrangements and business models.

Supporting information and awareness rising efforts, providing unbiased and scientifically accurate facts and figures, aimed at public decision-makers and general public.

Better understanding of the potential role of current European, national and regional policies with the role of resins tappers in their materialisation, as could be the case of territorial contracts. This can be based on documenting relevant cases from other sectors.

Stimulating innovation and entrepreneurship in relation to technological or social challenges, thought, for example, open innovation initiatives.

Evaluating the feasibility of designation of origin or other labelling approaches, providing examples from other relevant sectors and collaborating in the establishment of common working rules for traceability, the definition of standards and the establishment of origin criteria.

2.3. Scoping seminar report of the Aromatic and medicinal plants iNet

2.3.1. Summary output

The Aromatic and medicinal plants (AMP) scooping seminar was held in Tunisia with the participation of various stakeholders coming mainly from Tunisia, Greece, Spain, Portugal and France. The results of the evaluation form confirmed the success of the seminar, with 38.1% of the answers rating the seminar as very good and 52.4% rating the seminar as good. All actors of the AMP value were represented in the seminar, for instance: producers, government agencies, researchers, NGO, exporters, etc.

The seminar was launched by three presentations to introduce the actual situation of AMP sector in Tunisia, Spain and Greece. These presentations were very inspiring to open the debate. Various exercises (SWOT analysis, value chain mapping, etc.) were employed to better characterise actors and fluxes in the value chain and to prioritize key themes to focus INCREDIBLE actions.

Participants were eager to join the AMP iNet and to present input for this scoping seminar. During the working sessions, each group of participants was heterogeneous to be representative of all key stakeholders.

Four key themes were identified by the end of the seminar:

- supporting production and marketing capacities;
- natural resource management and biodiversity conservation;
- legal framework adjustment;
- certification and traceability.

2.3.2. Description of new/better characterised actors and fluxes in the value chain

Aromatic and medicinal plants value chain consists of plant products used in the perfume, cosmetics, food and pharmaceutical industries. AMP in the Mediterranean region (Spain, France, Tunisia, Greece, Croatia, Portugal) can be based both on wild and on cultivated plants. This iNet focuses on wild plants which are still dominant in several market segments and that poses specific challenges in relation to supply arrangements and in relation to scale up beyond local and more or less informal markets.

INCREDIBLE project started understanding the functioning of the value chain and identifying the main actors involved in its large ecosystem (Figure 3). Relevant actions can rely upon individuals and institutions not directly involved in the material flow, transformation and placed into market. From there, main threats and opportunities for resource managers, collectors, intermediaries, first processors, industries and potential entrepreneurs are analysed.

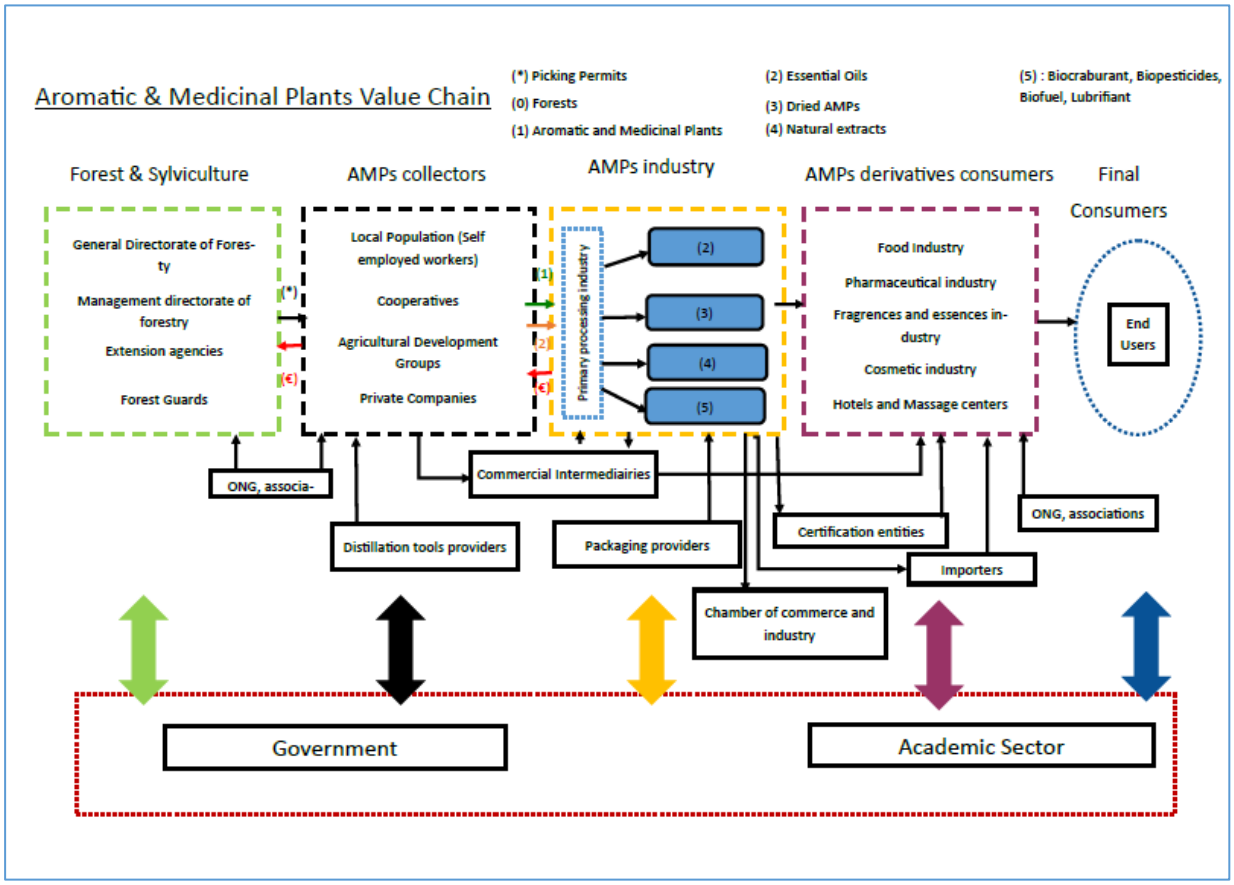

Figure 3. Reviewed aromatic and medicinal plants value chain map.

The AMP value chain involves three levels of actors:

AMP collectors: they harvest vegetal material from forest areas. This group includes local population (self-employed workers), cooperatives, agricultural development groups and private companies. This actor is considered as the main stakeholder in the value chain and should be sensitive to biodiversity conservation by applying conservation practices.

AMP industry: this category includes processors, firms and small distilleries that convert vegetal material into essential oils, dried aromatic and medicinal plants, natural extracts, etc. In addition to AMP harvesting, local population and development groups can also sell essential oils and dried plants to large firms.

Public authorities: in Tunisia, where forest are publicly owned, public authorities intervene in all the links of the value chain. AMPs are placed under the control of the Ministry of agriculture. Indeed, collecting AMPs fell under regulation of forestry, hunting permits and timber products. The first step to collect AMPs in forest areas is to obtain an "authorisation" or a permit from this ministry.

The AMP value chain is characterised by the informal nature of its upstream base (collectors without permits) and it is better organised and has more formally structured stakeholders downstream (processors, wholesalers and retailers). Summing up, the value chain operated with little vertical integration and almost few horizontal collaborations. Collectors have limited access to end-market information and obtain low benefits in comparison with other actors and are the least integrated in the value chain. Moreover, interaction between researchers (academic sector) and processors is almost absent to valorise research outputs.

2.3.3. Priority themes to focus INCREDIBLE actions

INCREDIBLE project actions should be oriented around four key priority themes:

NATURAL RESOURCE MANAGEMENT AND BIODIVERSITY CONSERVATION

The AMP sector's livelihood depends on sustainable management of vegetal material. Wild plants are susceptible to overharvesting and collectors seek to maximize quantity (and therefore income) in a short period. In many countries, there exists good practices manuals or recommendations for plant harvesting. However, there is a general lack of useful approaches to estimate, determine and monitor sustainable harvesting levels.

The important economic value of AMPs is not translated into incentives for sustainable management, much less biodiversity conservation. There is no incentive to improve harvesting behaviour. These initiatives should involve, be led by and be implemented by downstream value chain actors.

Biodiversity is an important resource in the search of new products. The Mediterranean region's rich biodiversity favours it as a source of innovation. Participants in the scoping seminar indicate that the greatest incentives for conservation of biodiversity can come from bio prospecting. Diverse plant species that present new opportunities for firms are still unexploited. Participants mention that botanical and agronomic research needs to focus on identifying and optimising AMP production and value-added opportunities.

ACCESS TO THE RESOURCE AND LEGISLATIVE FRAMEWORK

In the case of Tunisia, production is mostly coming from lands controlled by the State: resource use rights and harvesting of aromatic and medicinal plants are subject to a public tender (Article 18 of the Tunisian forestry code) organised each year by the Tunisian Forestry authority for the private firms to collect plants. A rigid legislative framework can be a handicap to access the natural resource (as product resource). In France, on private lands, collectors reach private one to one agreements with landowners for accessing the resource. In some cases, collection rights are auctioned, as is the case of regional parks in Andalusia (Spain). The existence of this large variety of models and their differential benefits/constrains for the actors involved in the supply chain are not well documented.

TRACEABILITY

Traceability was mentioned as one of the most priority themes in the AMP sector. The adoption of geographical indication or designation of origin is seen as indispensable for more consistent quality control and development of standards. Setting up geographical indications is considered a very useful method of indicating the origin of goods and services. Participants indicate that a geographical indication must be available for use by all producers of essential oils in that region, for instance small producers and local population. Indeed, using a certification mark is sometimes restricted to big producers and processors who comply with the established standards for its use. Participants mention the importance of a geographical indication for certain products and they explain that certain plants owe their special qualities to the place from which they come.

SUPPORTING PRODUCTION AND MARKETING CAPACITIES

Essential oils production is constrained by price variability on international market, continuity of internal supply and quality concerns. Export markets for essences and essential oils have very high requirements in terms of supply quantities and qualities and there is a reduced number of very well stablished operators. Outside mayor perfume and cosmetic houses there is myriad of opportunities not always well understood (e.g. natural cosmetics, thermal treatments, etc.).

Entrepreneurs lack of information and access to domestic and international markets. Is important for them to understand new trends in major consumer markets and the related quality and traceability requirements. In addition, in northern Africa, AMP could play a larger role in rural economies. However, the sector suffers from a lack of access to finance. Indeed, the sector is perceived as too unpredictable and highly risky by the formal banking system and the micro-credit sector. Local population and small processors are excluded of the banking system. Donor projects from NGO are the unique sources of external liquidity and funds for this category of producers (local population and agricultural development groups).

2.4. Scoping seminar report of the Mushrooms and truffles iNet

2.4.1. Summary output

The iNet of wild mushrooms and truffles is devoted to two non-wood forest products that share several similarities, but also have unique qualities and challenges. Therefore, the scoping seminar was organised in two different sessions, which took place in two locations. The first session (19th June) was devoted to wild mushrooms and was held in Soria (Castilla y León region, Spain), which is one of the leading world regions in the development of the wild mushroom value chain. The second session (20th June), was focused on the truffle sector, and the meeting was

held in Sarrión (Teruel province, Spain), which, with 1,100 inhabitants, is the world centre of black truffle cultivation.

The number of stakeholders who participated in both sessions was higher than expected, with wide representation of the first links of the value chain, while the consumers were underrepresented (if we do not count all the participants who are also individual consumers). Most of the stakeholders were from Spain, but we also enjoyed the high participation from international truffle sector, including the president of the European Tuber group.

The programs of both sessions were very much appreciated by the participants, generating active participation. The documents previously prepared by the INCREDIBLE partners, including value chain and SWOT analysis were discussed in depth and new insights were identified and added to the final documents.

Despite the different concerns among participants from different countries, and even within regions in the same country, the participants agreed on the identification of challenges as well as the priority themes for reinforcing the wild mushrooms and truffle sector. The main challenges, which will inspire the interregional workshops are:

- marketing;
- management of truffle plantations;
- development of myco-silviculture approaches;
- regulation of access to the resource, taxation, labelling systems;
- training to the truffle value chain actors, mainly black truffle producers.

2.4.2. Description of new/better characterised actors and fluxes in the value chain

The value chain map was distributed during the scoping seminar stimulate the discussion. The wild mushrooms value chain was refined and the trading centres were included in the value chain. The direct selling to final consumer was added, connecting mushroom pickers with consumers, although this this relationship is only legally recognised in France. As a result of the discussion, the Wild Mushrooms value chain represented bellow was obtained (Figure 4).

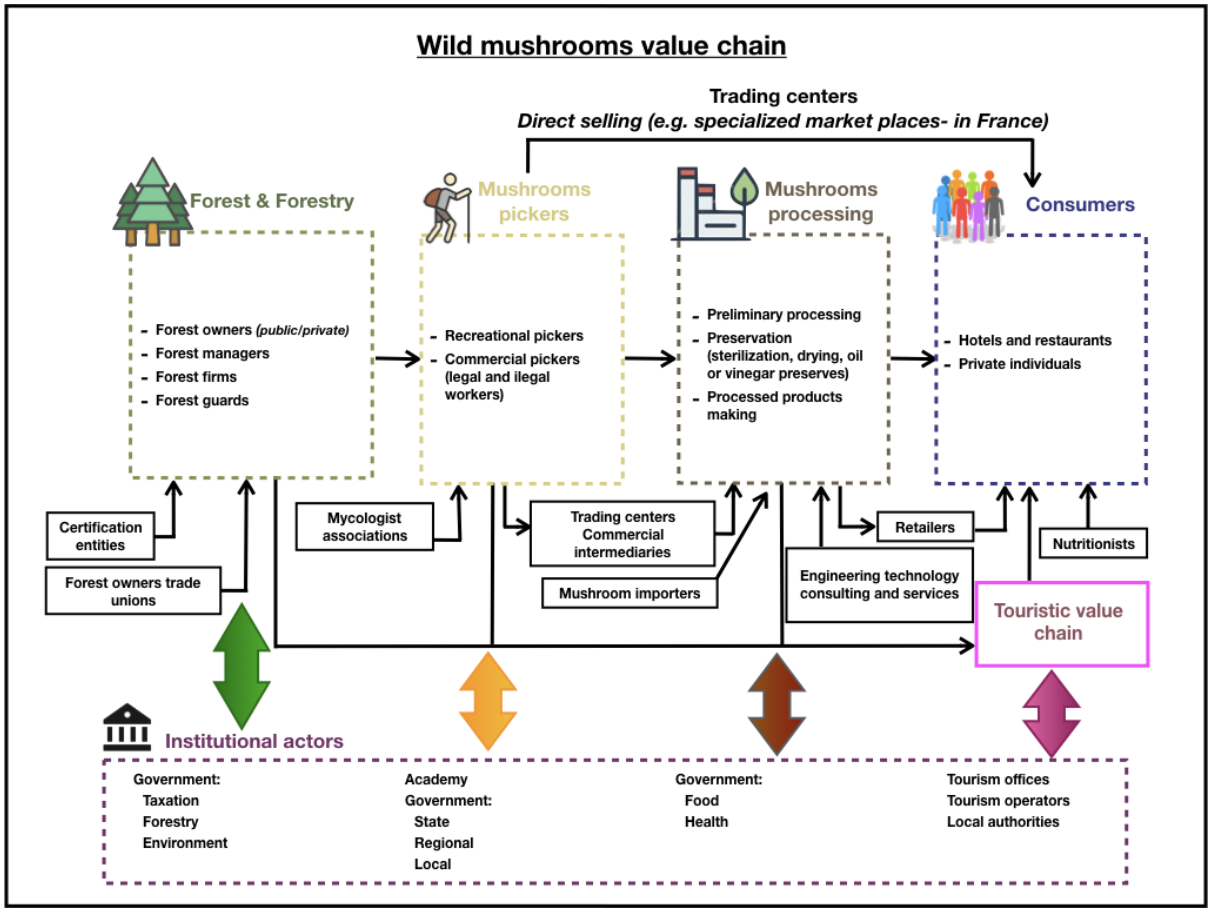

Figure 4. Wild mushrooms value chain map resulted from the scoping seminar.

The black truffle session was useful to review and complete the black truffle value chain map. Nurseries, engineering technology, consulting and services as well as truffle dog breeders and certification entities were included in the value chain. Water authorities were identified as part of the truffle ecosystem as there are issues related to water rights in irrigated truffle plantations in Spain. Also, the environmental departments were identified as part of the ecosystems as there are some administrative issues related to the conversion of pine plantations to truffle plantations in truffle-producing areas in Spain. Figure 5 illustrates the new completed and agreed truffle value chain map.

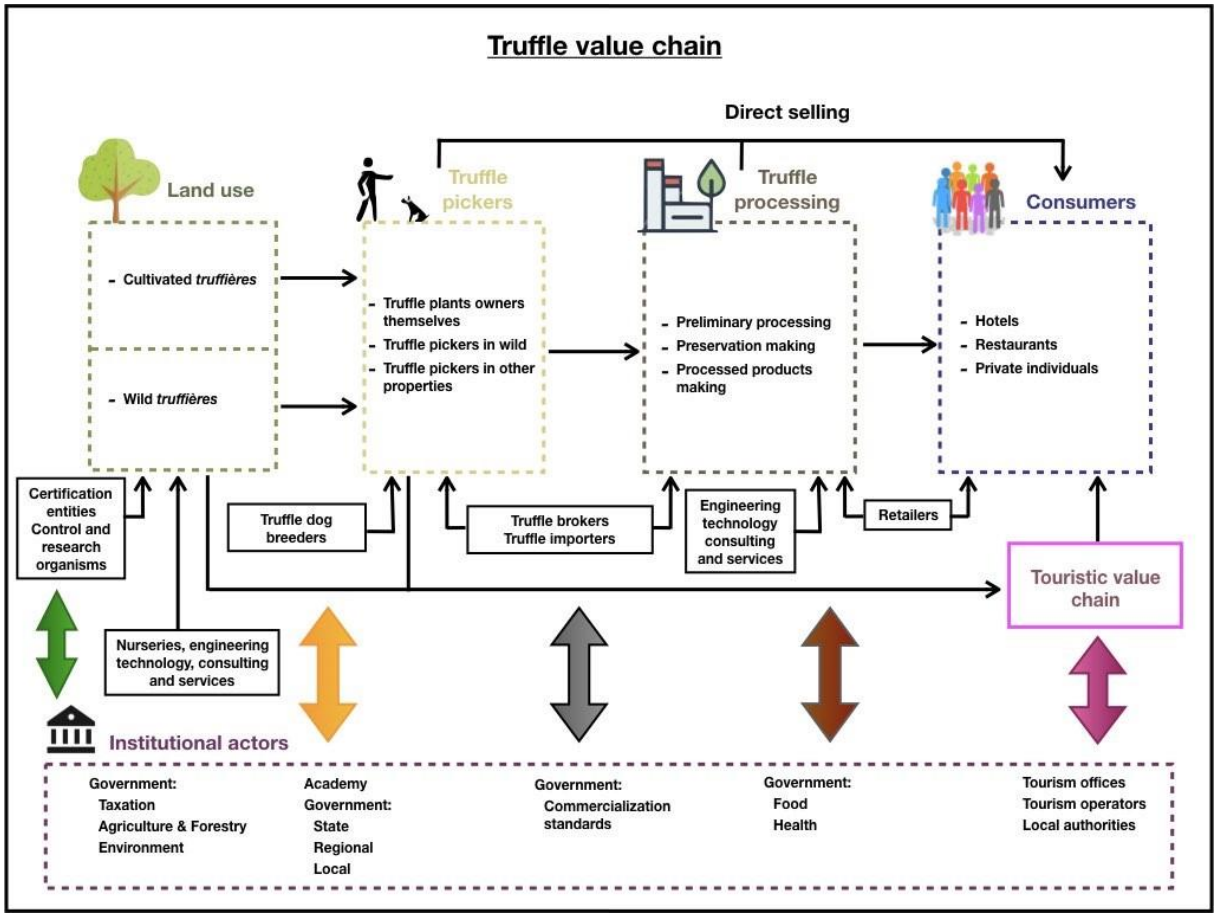

Figure 5. Black truffle value chain map resulted from the scoping seminar.

2.4.3. Priority themes to focus INCREDIBLE actions

The priority themes identified by the Wild Mushrooms and truffle iNet scoping seminar attendants are summarised by challenges based on the basic activities of the entire value chain:

SUSTAINABLE HARVESTING

1) Regulation of wild picking. This is considered a policy (legal) and social innovation challenge. Regulation includes aspects such as:
    a. Taxation for mushroom and truffle picking activity;
    b. Access to the resource, control of non-sustainable and/or illegal harvesting levels and management of potential conflicts;
    c. Market transparency and traceability.

Domestication and sustainable production. Yearly fluctuations, variable qualities, lack of critical mass are elements that interfere with the development of strong value chains on these products. Identified challenges are:

2) Domestication of wild mushroom species. This is considered a research and communication challenge. Domestication can be achieved at different levels:
    a. Improved yields through mycosilviculture;
    b. Intensive cultivation.

3) Improved cultivation of truffles. This is considered a complex challenges involving research, policy and managerial innovations. It includes aspects such as:
    a. Availability of certified high quality inoculated seedlings for truffle cultivation (policy and managerial challenge);
    b. Optimisation of plantations management. Including aspects such as: improved management of insect pests and efficiency of irrigation;
    c. Diversification cultivated truffle species (inoculation, management, irrigation, market development etc.);
    d. Improved dialogue across stakeholders (water authorities, forest department) to generate a better-shared understanding of truffle production).

SUPPLY CHAINS ARRANGEMENTS OF MUSHROOMS AND TRUFFLES

The development of wild mushroom and wild truffles sector faces difficulties are associated with the nature of the products that are fresh and short lived and the nature of picking and collection in the wild that implies high volume fluctuations, grey markets and lack of transparency. These are mainly Policy and managerial challenges that can be summarised as the need for:

- Improved supply security and continuity (volume, regularity, quality) through cooperatives, digitalised buying sites;
- Improved product traceability from the forest to the fork, and effective control of non-standard products that could create confusion in the markets;
- Broadly accepted quality standards, labels and certification including chain of custody.

COMMERCIALISATION AND MARKET DEVELOPMENT

Wild truffles and mushrooms are still niche markets with large growth potential. There is little or no gastronomic culture on the potential of these products, outside some specific countries or regions within countries. There are some challenges related to:

- Leveraging the intrinsic characteristics of wild mushrooms and truffles (organoleptic, wild nature, links to rural development etc.) This complex challenge related to traceability. Labelling and brand creation and certification;
- Broadening culinary offer and traditions to increasingly incorporate wild mushrooms and truffles and education of consumers;
- New transformed products, precooked dishes and new formats;
- Durability of truffles and mushrooms, preserves and packaging.

CREATION OF VALUE AND TERRITORIAL LINKAGES

Gastronomy has proven a very relevant leverage to develop urban and rural tourism strategies that multiply the economic and social impacts of agro-food value chains. Current mega-trends of experiential tourism, nature based tourism, wild foraging and green care offer attractive opportunities for Mediterranean territories. However, successful mycotourism requires the concerted action of multiple actors. Research, policy and social innovations are needed. An in depth review of some successful cases can facilitate successful replication across the Mediterranean.

2.4.4. How can INCREDIBLE better contribute

As in other iNets, INCREDIBLE aims at sharing scientific knowledge, practical experiences and societal awareness. In this case, the focus will be placed on the following elements:

SUSTAINABLE HARVESTING

- Knowledge and experiences on resource estimation and sustainable harvests levels and technics;
- Review of existing regulations and practices in relation to access to the resource, traceability and taxation, including the use of innovative ICT solutions;
- Documenting examples of practices addressing equity through the value chain and conflict resolution;
- Existing knowledge and knowledge gaps in relation to domestication and cultivation of mushrooms and truffles. Identification of critical aspects in relation to productivity and sustainability.

COMMERCIALISATION AND MARKET DEVELOPMENT

- Improve awareness and knowledge of the gastronomic value of mushrooms and truffles (gastronomic culture);
- Identify tools to address frauds;
- Include durability and preservation of fresh truffles and mushrooms in the research agenda to be developed.

CREATION OF VALUE AND TERRITORIAL LINKAGES

- Review of ICT tools and approaches for implementing territorial marketing strategies;
- Replicability of Territorial marketing strategies will identification of strategic drivers and barriers;
- Identify best cases in the application of EAFRD regulation to support territorial development Strategies based upon NWFPs in general, mushrooms and truffles in particular.

2.5. Scoping seminar report of the Wild nuts and berries iNet

2.5.1. Summary output

Participants of the scoping seminar were mostly local Portuguese stakeholders, as well as participants from Spanish and French public bodies. The failure to attract value chain actors from foreign enterprises was possibly due to opportunity costs of spending two working days abroad. Unfortunately, two relevant pinecone processors from Spain that were going to assist dismissed the meeting only short-term due to unforeseen issues at their enterprises.

As the main outcomes of the meeting, participants marked issues such as the advantage of an international network that allows for knowing who-is-who in the sector, for an increased exchange of knowledge and ideas, including improved market information, or even for building commercial relationships. A fluid linkage between research results and the sector was considered essential for innovation. Optimistic views on advances along supply chains couldn't deviate the main attention from most serious problems that the sectors of chestnuts and Mediterranean pine nuts are currently facing: damages by severe exotic pests and diseases, yield losses due to increasing

droughts, persisting thefts and the persisting lack of certified, traced quality standards "from forest to fork" (traceability actually due for European food since Regulation (EC) 178/2002).

Key consequences for further action in the Wild nuts & berries iNet, namely inter-regional and cross-cutting seminars, open innovation challenges and other dissemination activities, are the marks put on the main challenges that are jeopardizing the sustainable and profitable production of forest-collected gourmet nuts (chestnuts and Mediterranean pine nuts). First, there is a need to recover a sustained and high production, by deployment of improved, adapted genetic materials, the spread of optimised management techniques, and the development of integrated pests management systems. Second, concerted actions are required against thefts and persisting black markets, that should be complemented with developing protocols, standards or even guarantee labels for traceability, processing standards and product quality. The work can start with a target as elemental as succeeding in arising consumers' (and public authorities') awareness about the differences between genuine Mediterranean pine nuts from Pinus pinea and pine seeds from different Asian pine species (*P. koraiensis*, *P. sibirica* etc.) labelled currently indistinctly in retail in spite of their huge differences. One action might be a "Check that it is Med" visual card (physical or digital for smartphones) that consumers could use at the supermarket for differing the botanical species by themselves, even coupled with a Citizens Science project that would allow feedback to verify how much pine nut is local.

2.5.2. Description of better characterised actors and fluxes in the value chain

The insights gained during the scoping seminar for chestnut and pine nut did underline that traditional forest owners or chestnut growers, often with seldom full-time dedication, should be clearly differed from a new type of farmers or landowners who do apply a more agronomic approach on new plantations, active management, and intensive treatment practices.

Some issues listed by participants to be reflected in the new value chain ecosystem were:

- Black market (a complete parallel, hidden supply chain, though often entangled with flows of the formal one) implying illegal harvesting or theft, as well as tax fraud;
- Lack of control/effective implementation of regulation and traceability along the supply chain;
- Different national regulation of standards, but a generalised trans-border trade;
- Market competition/confusion and lack of differentiation e.g. with Turkish products, and even with other, different species from China or Pakistan;
- Increasing relevance of new, more productive plantations;
- New/innovative equipment or mechanical harvesting and first transformation;
- Effects of climate change;
- Integration/interaction of agents in the value chain.

Some of these aspects claimed by participant are quantitative trends in time, or purely conceptual, and cannot be reflected properly in the value chain scheme, though the current persistence of informal actors along the supply chain, activities and flows outside the regulatory framework set up by public authorities has been added. As example, the updated value chain map for Mediterranean pine nuts below (Figure 6).

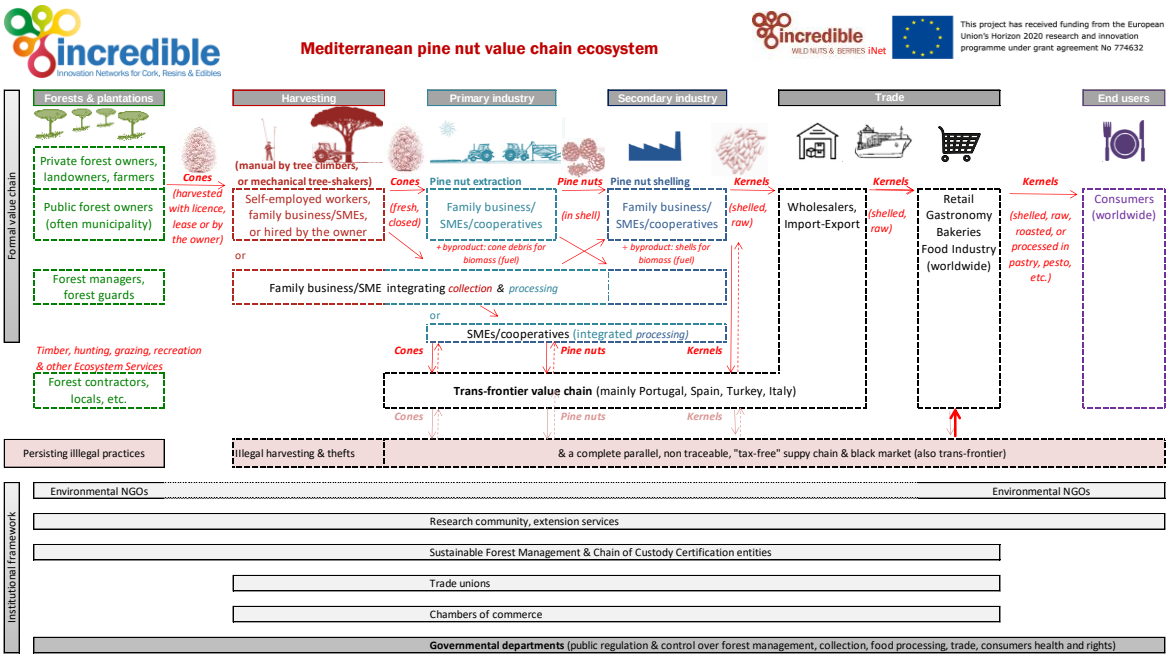

Figure 6. Mediterranean pine nut value chain map resulted from the scoping seminar.

2.5.3. Priority themes to focus INCREDIBLE actions

The following priority themes emerged from the session "Scoping the iNet". Each theme is listed here with title, its nature (technological, social, etc.) and a brief description. These themes will influence the design of interregional workshops and cross-cutting seminars within the next years of the INCREDIBLE project.

RESOURCE MANAGEMENT

Plantation management

In the case of pine nuts, domestication in quite recent phenomenon in pine nut production. As a consequence, a clear, although not precisely define, knowledge need of the sectorial agents is clearly related to the novelty of Mediterranean stone pine (*Pinus pinea*) as tree crop. Few decades ago, cones were only collected opportunistically from multifunctional pine forests, and research on this species has been focused on botany, ecology and silviculture. Only recently, the booming demand for pine kernel and the crisis of alternative tree species such as *Pinus pinaster* have reoriented landowners preference. While *Pinus pinea* plantations have rapidly expanded, optimised management and tending schemes are still lacking (including aspects such as: selection of genetic material, planting density, tilling, pruning, fertilization, irrigation, integrated pest management, mechanical harvest optimisation). Clone x site interactions need to be evaluated in new regions, since different clones might be the more productive in different agroclimate regions. Relevant knowledge can be gained by collecting the experience and outcomes of past plantations and notable by evaluating their performance. In the timeframe until 2020, existing knowledge should be collected, integrated and translated into management guidelines and good practices guidelines. Cooperating also with recently set up Operational Groups, INCREDIBLE can face this generic challenge making use of most of its tools. Domestication of chestnut production is well consolidated and resource management challenges are manly related to pests and diseases, addressed below.

Pest and diseases

The main nature of this challenge is the knowledge gap how to solve severe yield losses especially due to new exotic pests (chestnut gall wasp, conifer seed bug). However, there are also organizational gaps on how to apply at operational scale available solutions such as biological control by parasitoids, and in some regions a lack of politic support to these actions. Given that the threads are similar for both value chains, for 2020 a coordinated common approach/strategy should be looked for, not only for research, knowledge and innovation exchange within and among existing networks (European Inter-professional Chestnut Commission EUROCHESTNUT, FAO/CIHEAM Research Network on Nuts, etc.) and in cooperation with Operational Groups, but also for searching more efficient influence on and support from national, European and regional authorities. INCREDIBLE project is called to play a role as platform and meeting point to channel these initiatives by all tools the network does offer.

PROCESSING QUALITY

High quality standards are considered a challenge for the whole value chain, implying all actors. In 2020, there should be operative protocols developed and implemented by all industries. The steps to achieve this goal are the collection of knowledge from research and practice for the setup of good practices guidelines. Cooperation with related Operational Groups is one of the most obvious issues. INCREDIBLE project as network can contribute with science-to-practice activities and open innovation challenges.

MARKETING, PRODUCT INNOVATION AND CONSUMER AWARENESS

This is a market issue that aims at placing “chestnut as a common item in the consumers’ basket”. Currently, consumption of chestnuts is limited to a relatively narrow portfolio of products and could build upon existing trends favouring wild and natural foods. Some ideas for 2020 are product lines for chestnut beer or chestnut flour. Two main challenges have been identified in this respect. The first one has to do with standardised supply, with correct rating and labeling of product quality and sizing, geographic origins, varieties, etc. The second challenge is related to the need to improve marketing of forests nuts, and in particular, consumer awareness about health, environment and cultural benefits of chestnut consumption. Here we have a clear example how INCREDIBLE project might favour new market ideas as open innovation challenge.

Pine nuts also face critical challenge in relation to strengthening supply chains. This are related to persisting black markets, lack of quality standards, traceability procedures and guarantee labels, processing standards and product quality.

The situation in relation to market development is somehow different, as pine nuts already has a significant market in elaborated food products and traditional recipes (e.g. *pesto*). The challenges here are more related to substitution by other nuts facilitated by the lack of awareness of consumers (and public authorities) about the differences between genuine Mediterranean pine nuts from *Pinus pinea* and pine seeds from different Asian pine species (*P. koraiensis, P. sibirica*, etc.) labelled currently indistinctly in retail in spite of their huge differences in shape, nutritional properties and flavour. One action for rising consumers awareness about might be a “Check that it is Med” visual card (physical or digital for smartphones) that consumers could use at the supermarket for differing the botanical species by themselves, even coupled with a Citizens Science project that would allow feedback to verify how much pine nut is local.

ORGANIC FOOD LABELS

Being a market issue by nature, the labelling of certification schemes for organic food production, and/or, less prioritised, as sustainably managed forest product, such as FairWild standards, are seen as a chance for rising consumers' awareness about the superior quality of both European chestnuts and Mediterranean pine nut kernels. Discussion took into account that possible development of chemical control for extremely serious pests might enter in conflict with Organic Food Labelling. However, for 2020, the proposal oriented towards promotion campaigns in Europe for a better marketing of certification brands and labels. INCREDIBLE project might offer cross cutting seminars on this topic.

3. Discussion and findings

3.1. Overview

In the period from 8th of May 2018 to 12th of July 2018 five iNet scoping seminars were held in Spain (two), Portugal, Tunisia and Italy, with the total number of 184 attendees, coming from different backgrounds, positions in the value chain and also diverse interests and expertise. They included land owners and managers (both public and private), government officials, collectors, processing industries and retailers of different sizes, industry and retail associations, intermediaries and service companies (e.g. nurseries, consulting, etc.), researchers and technicians from various disciplines and, finally representatives of boundary sectors, as hotel and restaurants. In general terms, the biggest interest on the scoping seminars was found among the industry/trader representatives (29% of the attendees; Figure 7) and private and public forest owners and managers (20%) and the research community (12%).

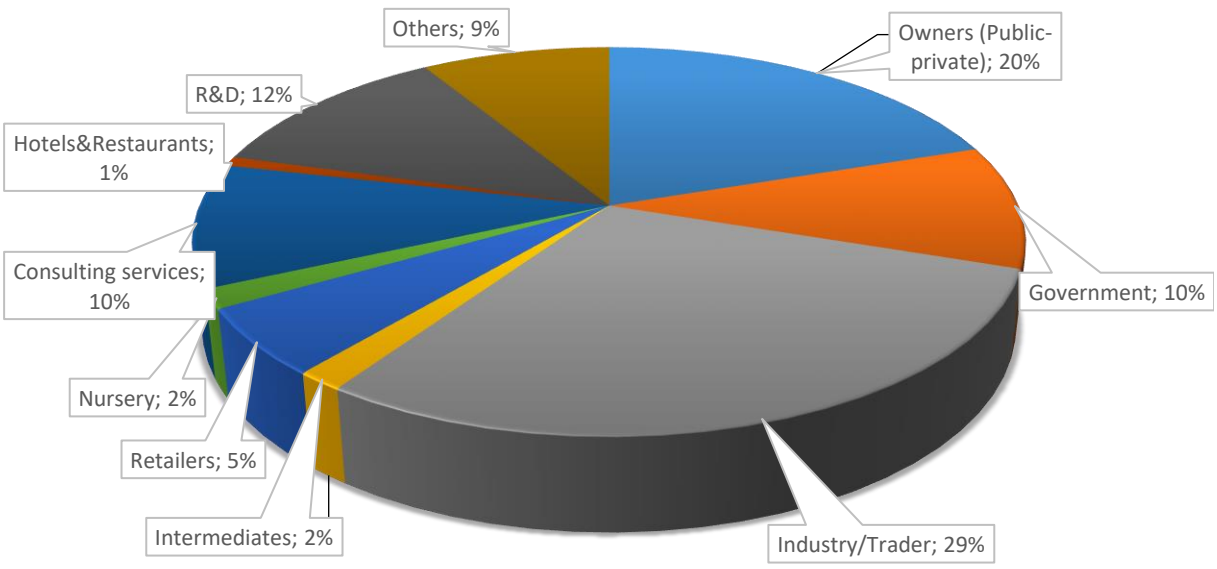

Figure 7. Percentage of attendees from all scoping seminars grouped by their value chain position.

This scoping seminars where aimed at better understanding the most relevant needs and opportunities for innovation and strengthening the respective value chains. The methodology was based on a combination of plenary, break-up groups and informal discussions during coffee breaks, lunch and fieldtrips. Starting point of all discussions was an understanding of all the actors and fluxes involved in the different value chains and their extended ecosystem. There was no attempt to generate consensus on a desired scenario for every non-wood forest product sector, as this could lead to roadblocks due to diverging interests among different actors of the value chains. The objective was rather to develop a collective assessment of the functioning of the value chains and the identification of challenges of opportunities, as perceived by the different actors. As expected, this approach facilitated an extensive discovery of themes and topics, the identification of new or better characterised actors and fluxes in the value chain. Similarly, no hard prioritising was seek although, in some cases, participants were asked to vote

priorities as a tool to stimulate discussions. The methodology was designed to rather capture all issues and priorities, and to further process and distil them in an iterative approach, to better understand them and to allow common priorities to emerge naturally.

Successful completion of the scoping seminars proved that the chosen methodology fully meets the expectations of project outputs. High rates of stakeholders and individual responses to join the scoping seminars is just one of the indicators. More important, the results of scoping seminars revealed precise problems, needs, expectations and possible solutions for problems in each of the five iNets. That clearly indicates that the project topic is highly relevant for the European NWFP sector as it is for the overall development of rural communities across Europe.

3.2. Innovation challenges in non-wood forest products in the Mediterranean region: common themes across iNets

Since the different NWFP are collected, produced, processed and marketed in different social-ecological systems (as a consequence of divers biophysical, socio-economic, technological and cultural aspects), different priority themes arose at each iNet scoping seminar. The analysis of the outcomes, however, shows common knowledge gaps and challanges for innovation. The identified cross-cutting themes are described below.

LONG-TERM AVAILABILITY AND SUPPLY OF NWFP IN A CONTEXT OF GLOBAL CHANGE

Understanding and mitigating the impacts of climate change

Climate change is recognised as a major threat to all forest ecosystems and is predicted to have especially intense impacts in the Mediterranean region. Higher temperatures and reduced precipitation will directly affect the composition, structure and productivity of forest ecosystems and thus, of non-wood forest products. How this will affect the production of NWFP and what are the options to mitigate this impacts is an area that needs research and knowledge transfer. While agronomic practices can be adapted for domesticated products (e.g. irrigation in truffle or chestnut), mitigation options for wild NWFP are less evident. The same can be said for emergent pests and diseases. Climate change can also affect the length of the production/collection period and increase the inter-annual variability in production, hampering the development of the value chains. In some cases, the impacts of climate change can be exacerbated by human activities. For example, irrigation of agricultural crops can reduce underground water availability for nearby forests, thus jeopardizing also the production of NWFP.

Sustainable production and harvesting

In the case of many wild NWFP, sustainable harvesting levels are not well understood. The condition and availability of the resource is not regularly monitored nor evidence-based harvesting levels are estimated or enforced. This situation can become critical as market develops and demands increases. Also because intense harvesting can concentrate in the most accessible areas. What would be the impact of increasing mushroom picking in long-term production? What is the impact of using rakes to increase harvesting by professional pickers instead of the traditional picker knife? What will be the long-term availability of rosemary for wild collection in a context of high picking pressures and climate change? How much resin can be produced in southern Europe under plausible climatic and social scenarios? How can NWPF primary processing industries can forecast their investments with such uncertainties? In some

cases, the lack of knowledge on future resource availability difficult rational business and policy decisions.

In the case of more domesticated products, there are still significant knowledge gaps in relation to, for example, genotype x site interaction for relevant characteristics as it can be cork quality in cork oaks stands or kernel productivity by stone pine groves. Management of pests and diseases are also a critical issue that requires increased knowledge generation and transfer. In all domesticated crops, optimization of irrigation to improve yields, quality and economic return with maximum efficiency is also a very relevant area (e.g. truffle, cork and stone pine).

UNSECURED AND IRREGULAR SUPPLY

There are also critical socio-economic challenges related a stable and secure supply of NWFP. Supply of forest products depend on individual non-professional collectors (mushrooms, wild truffles, some aromatic plants) and sometimes on professional crews working for periods, with inadequate labour conditions and limited knowledge on the sustainable collecting practices (mushrooms and AMP mainly). In some cases, there is lack of workers due to hard working conditions and relatively low income as it can be the case for resin and cork in high-income regions. This situation makes difficult the creation of stable value chains and in some cases limits the market expansion in well stablished industrial activities (cork, resin, some essential oils).

For all widely collected products, there is inadequate knowledge on the size of the market and its economic relevance. Black and grey markets are very important and there is a generalised lack of traceability. This, consequently, favours black and grey markets and also robbery, as in pine nuts, and the concurrence with uncontrolled substituting products from other regions (e.g. pine nuts from east Asia, mushrooms from Russia, etc.). The lack of traceability can have especially negative effects for those products used as food, in cosmetics and related to human health. New business organisations, improved or adapted regulation and registration of collectors, or mobile ITC are some of the promising innovations, either social or technological, that can help tackling some of these issues and that could be adapted and adopted more widely. However, firstly, challenges should be better understood.

REDUCED PROFITABILITY

The situation described above is partially related to the tight profitability of NWFP production and collection. Most of the wildly collected or only partially domesticated NWFP analysed in the different scoping seminars have limited capacity to generate sufficient income for producers (private forest owners, forest municipalities, etc.) or for collectors (resin tappers, AMP collectors, etc.). This is a structural weakness that in some cases almost totally prevents the development of NWFP business activities or that jeopardises its future. This is especially true in countries or regions with a high average income and explains the almost inexistent resin or cork production in France, or the incapacity to mobilise cork from the forest to meet the existing demands as it happens in Catalonia (Spain). Some social, managerial and technological innovations can help in improving NWFP production and harvesting profitability. These are related to mechanisation (e.g. pine nuts or chestnut collection, cork debarking, resin tapping), to harvesting methodologies more adapted to the socio-economic context (e.g. borehole resin tapping in timber-oriented stands), to silvicultural or agronomic practices that increase productivity (e.g. improved genetics, forest management practices that improve mushrooms yield, truffle plantations irrigation), to logistics, etc. Evidently, the development of high added-value products based in NWFP is a necessary

condition to maintain and improve the profitability for producers and collectors, although it does not guaranties equity and fairness within the value chain. At the same time, the recognition of the positive externalities produced by the NWFP production, as through PES schemes, is seen as a strategic component on the economic viability of, at least, cork and resin value chains.

In some cases, producers or collectors have weak bargaining power in relation to the primary processing industries and they are not able to get a fair compensation, or they feel so. In other cases, processor cannot mobilise the resource because they cannot meet the expectations of producers that may have unrealistic views on the market value of their products, as it can happen in cork. Improved awareness on market functioning, transparent and widely recognised procedures to measure quality or public price observatories can reduced tension within the value chain, along with contractual arrangements and new forms of collaboration among producers/collectors.

ACCESS TO THE RESOURCE

Across the Mediterranean region there is a large diversity of forest tenure regimes and different regulations on who and how can access wild resources. Free access to forest and the right to collect NWFP for all citizens irrespective of tenure is rooted in many countries. However, the risk of overexploitation or the need to manage conflicts between recreational collectors and professional collectors are fuelling the adoption of new regulations.

LACK OF AWARENESS OF CONSUMERS, POLICY MAKERS AND SOCIETY AT LARGE

The lack of awareness of the economic, social and environmental benefits that NWFP production provide is common among all five NWPF; for those that reach the consumer highly transformed (resins and AMP) as well as for those that are easily recognisable by end-users when eaten (mushrooms and truffles, nuts and berries) or used (cork). The lack of awareness is of different nature depending on the NWFP: knowing the origin of the product or the ecosystem services its production provides, being able to distinguish between a given product and its substitute, or simply identifying that a NWPF (or its derivatives) enter in the composition of a manufactured good.

In this case, the challenge is related to marketing. Already existing tools to tackle this challenge are marketing campaigns, product traceability labels and regulated geographical indications or designations of origin.

3.3. Cross-cutting areas for action

On the one hand, climate change, globalisation, urbanisation, tertiarisation are megatrends affecting the development and sustainability of non-wood forest products and explain to a large extent the challenges identified. Competition in the global markets with other producing countries and with alternative products put high pressures on profitability of raw materials (e.g. pine nuts, cork, resin, essential oils). Rural abandonment makes difficult to find labour. All this favours black and grey markets for products and labour to reduce costs. On the other hand, the emerging trends represent new, even immense, opportunities. Nature-based and experiential tourism, green care, societal preference for natural cosmetics and natural food are experiencing and increasing demand. The need to replace oil-based or non-renewable products with bio-based solutions in creating a new market pull for manufacturing and construction (cork or resin and other plant-based chemicals). Facing challenges and making the best of emerging opportunities

requires concerted action of diverse actors in multiple directions. The outcomes of the Scoping seminars allow us to highlight three domains that require specific attention as they can provide the necessary conditions for sustainability and innovation to happen.

BETTER FOCUSED RESEARCH AND IMPROVED KNOWLEDGE FLOWS

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.

IMPROVED GOVERNANCE

Having better, stronger, more comprehensive governance frameworks for NWFP should allow for better decision-making by all actors, should facilitate stronger and more equitable value chain arrangements and contribute long-term social and environmental sustainability. Institutional arrangements and public regulation varies from country to country and between NWFP, becoming much weaker or inexistent as we move form fully domesticated products to completely wild products. In general, governance is considered fragmented, confusing, inadequate, limited or totally inexistent by INCREDIBLE project stakeholders.

In the case of wild NWFP, some Mediterranean countries or regions do have a regulation that covers aspects related to collecting rights, access to the resource or permits and taxes. However, this is totally absent in other. In some cases, existing regulation is not helping to facilitate cooperation and transparency inside the value chains or can even represents an obstacle for collection, production and trade. As an example, forest or environmental regulation, or the way is interpreted by the competent authorities, can limit the establishment of new truffle plantations in forestlands in central Spain. Across the iNets, the need to overcome this problem is recognised as one of the most important. In the case of edibles, regulating quality, forest to fork traceability and allowing for effective protection of origin is a specific challenge.

Governance approaches, arrangements and procedures by private (e.g. companies) and other non-governmental actors (e.g. forest certification entities) are much less known. Formally adopted good practices codes or due diligence systems among collectors and processors are generally missing or have not been yet identified and properly described. Some NWFP are covered by sustainable forest management certification schemes (e.g. cork in PEFC and FSC), although they might not be generating the added value that could be expected or desired.

Addressing these and other related issues (market and environment, plant health regulation, incentives and PES schemes, irrigation rights, etc.) will greatly benefit from more structured public-private cooperation.

MORE EFFECTIVE COMMUNICATION FOR GREATER SOCIAL AWARENESS

When sustainably managed, the production, collection, and transformation of NWFP can generate multiple positive externalities: rural development, forest fire prevention, climate change adaptation and mitigation, etc. However this benefits are rarely recognised in the markets, where Mediterranean NWFP compete with petroleum-based counterparts (e.g. petroleum derivatives, plastic stoppers, etc.) and with imported products that can differ in quality and environmental performance (Asian pine nuts, Russian mushrooms, etc.). Stakeholders across the iNets are convinced that it is extremely important to increase the awareness about the current situation and existing potential for NWFP and the environmental, social and economic benefits that they can provide. Product, environmental and geographical certification schemes are seen as promising tools.

On the one hand, the actors in the value chain could better communicate outside their sector. On the other hand, the need for better communication along the value chains (between producers, processors, market and government) is clearly identified by the stakeholders. Between different stakeholders, there are different communication problems. Depending on the region or the country, the problems are identified as:

- reduced information flows between producers/collectors, traders and transformers;
- lack or not existent knowledge and technology transfer between actors of the value chain;
- lack of cooperation towards potential common goals such traceability schemes, quality assurance, joint marketing and certification;
- lack of awareness by policy makers on the barriers and opportunities for NWFP that translate into fragmented, inadequate or non-existing regulation.

Consequently, better dissemination of information between procedures for quality control and certification methods from certification entities, both for harvesting and processing is needed. For those sectors where we have good practices, dissemination between actors in the value chain should be increased. For the sectors where quality control and certification methods are not established, it is necessary to make a complete analysis and to set up good foundations so certification entities can produce a uniformed method for quality control and certification of every product in each iNet.

4. Roadmap for INCREDIBLE and beyond

The reports from each Scoping seminar are very concise; they perfectly represent the situation on the field and are a good starting point for each future regional or international events organised by the INCREDIBLE project. Adopting new knowledge and ideas to existing ones, spreading the existing discussions and trying to solve the small problems through networking guarantees successful future work of each iNet. The following discussion will try to gather the conclusions and propose next steps for each iNet based on the Scoping seminar reports.

4.1. Cork iNet roadmap

The Cork iNet Scoping seminar highlighted several main issues that will need more attention in the future:

- Improved profitability of cork production:
  - possibility of mechanic debarking introduction;
  - production increase by irrigation and pest management;
  - improved genetics;
  - recognition of the generated externalities.
- Optimise supply arrangements:
  - overcome difficulty of finding skilful workers;
  - increase transparency in the market.
- Development of new products in order to achieve new markets.

IMPROVED PROFITABILITY OF CORK PRODUCTION

While discussing the mechanisation of cork debarking in order to solve the problem in lack of experienced workers, we should consider the examples of mechanic debarking that exist in Portugal and Spain. As a potential innovation output, this network should include the potential for promotion of innovations by mechanics, ergonomics and similar engineers working on this issue. Since the tests for new methods of debarking last for more than 10 years, Cork iNet should address in its next steps the problems of implementing the mechanical cork harvesting into action and through discussion with relevant stakeholders to find the way to overcome those barriers. For sure, the goal of these efforts will not be the decrease of cultural and natural heritage emerged from cork stand management, but to support the growing demands of this economic sector. Mechanisation of this sector probably will not be eligible without solving the other two challenges mentioned during the Scoping seminar.

Regarding the second point, a case study was mentioned: irrigation started in Spain four years ago and they still lack of published results. Pest management is a part of climate change effects, which can also cause extreme draughts and fires. More effort should be involved into gathering knowledge on irrigation and on pest control. If this knowledge is not available on published works, it could be obtained, maybe, from the experience of stakeholders.

Similarly, the provenance trials that where set up in different countries are entering now the age of first debarking and this should allow to have first data about the influence of genetics on production by different site qualities. INCREDIBLE project should document this knowledge. Finally, the maintenance of non-intensive, cork production ecosystems (*montados* and *dehesas*) will be facilitated by the economic retribution of their positive externalities through, for example,

PES schemes. INCREDIBLE project can document existing drivers and barriers and can help bridge the offer and demand sides, through a market place.

OPTIMISE SUPPLY ARRANGEMENTS

Concerning this second issue, the difficulty to find skilful workers is linked to reduce profitably, on the one hand, and insufficient training in vocational schools, on the other. INCREDIBLE project can work with existing institutions and the European Network of forest vocational training to help overcome this issue. In relation to supply chain transparency, producers can benefit from common procedures to estimate cork quality pre-harvest and through a Mediterranean price observatory. INCREDIBLE project can provide a neutral place for evaluating the feasibility of both approaches.

DEVELOPMENT OF NEW PRODUCTS IN ORDER TO ACHIEVE NEW MARKETS

For the third issue, it will be very hard to find and promote new products or new methods of cork usage, since the value chain identified 13 industry branches that use the cork products on regular basis, from wine industry all the way to aerospace industry. Even if new usage possibility exists, a question of "How will this product satisfy the needs of this new industry that any other products until now do not do?" will remain. A possible answer to this issue lays in finding new business models, standardisation of cork harvesting (stand years and debarking height) or in developing new policies on multifunctionality. This being said, research and development, promotion (through marketing, communication and dissemination) and economics should have higher and more important position in the future value chain.

4.2. Resins iNet roadmap

It is estimated that today needs for resin derivatives exceed 300,000 tonnes on European market and that production of natural resin in Spain, Portugal and France barely reaches 23,000 tonnes, although the pic of natural European resin production was 250,000 tonnes in the year 1965.

The Mediterranean potential remains high: in southern Europe, pine stands with potential to produce resin exceed 3 million hectares. This resource is jeopardised by natural and anthropic risks and uncertainties, and consequently a large extent of this area is not mobilised in terms of natural resin production because of lack of efforts in counting resin extraction and other forest uses. A large barrier for natural resin mobilisation in the Mediterranean basin is the low profitability of the extraction activity for the resin tappers. The engine of the whole value chain is the Mediterranean chemical industry demand. Natural resin must compete against substitute products via derivatives diversification and specialisation for reaching market niches only available for natural products.

Proposals for solving the before mentioned bolded issues are:

RESOURCE MODELLING IN A CONTEXT OF CLIMATE CHANGE

Make available an updated and comprehensive image of the state and potentiality of the resource at a Mediterranean scale. This proposal involves:

- collection of technical and scientific knowledge;

- divulgation among policymakers and population at large to make them aware of the importance of the issues that the resinous forest faces;
- assessment of knowledge gaps and identifying new monitoring tools, and
- establishment of a structure for sharing, disseminating and improving the updated information for technical and management uses.

PROGRESS IN THE COMPATIBILITY OF RESIN HARVESTING WITH OTHER FOREST USES

The compatibility and integration of forest products value chains are key for reaching the best profitability in the forest activity. However, there is no adequate knowledge about the compatibility of resin tapping activity with other forest productions such as wood, biomass, pine cones, etc., and with the forest ecosystem services provided. The progress in compatibility involves:

- gathering existing information about natural resin production compatibility;
- establishing a research agenda to advance in the study of resin, wood and other NWFP compatibility;
- developing new forestry models and extraction techniques adapted to compatibility;
- identifying research resources;
- developing R&D projects to fill the gaps of knowledge identified, and
- disseminating the necessary knowledge to technicians and owners for their implementation.

IMPROVEMENT OF THE WORKING CONDITIONS OF THE RESIN TAPPERS

There is a common agreement among stakeholders considering that resin tappers workers are both a bottleneck in the natural resin production and the weakest link of the resin value chain. This is a major concern that needs to be addressed from both a technical and a socio-political perspective, in four main axes:

- document and disseminate the role of the resin tappers in the rural and green economies, as a way to increase social awareness;
- document and disseminate the environmental externalities of resin tapping;
- scan for new technologies and logistic solutions to reduced workloads and improve efficiency;
- identify opportunities to support the activity in rural development policies and examine the viability of payment for ecosystem services or related schemes, and
- advance in professional training regulation and recognition, mapping existing approaches at the global level.

MARKET DEVELOPMENT THROUGH IMPROVED COMPETITIVENESS WITH OIL-BASED ANALOGUES AND THROUGH THE DEVELOPMENT OF NEW PRODUCTS

The resin derivatives market is more and more complex due to the vast range of products and the strong competition against substitute products. INCREDIBLE project should focus efforts on:

- improving knowledge on the global demand and market fluxes;
- generating a common understanding on the potential benefits of environmental and/or product origin certification, and

- advancing in traceability, bringing together value chain actors and stimulating the establishment of common working rules for traceability.

4.3. Aromatic and medicinal plants iNet roadmap

Long-term sustainability, access to the resource, sustainable collecting practices and developing new market opportunities are the key themes so far identified in the iNet discussions.

In Tunisia, the discussion was primarily focused on incentives, quality control, product distribution, and not on the origin of plants. The sustainable management of aromatics and medicinal plants need to be better assessed and discussed. In addition, there is a need to map examples of regulation, access to resource and monitoring from other countries that could offer, in conjunction with local case studies, a starting point for policy changes and their adaptation. Finally, as the AMP iNet focuses on wild plants and it will be important to have good representation of public, communal or private forest owners in the iNet discussions.

Next steps should focus on:

- proposing approaches to define measure and monitor sustainability of wild AMP harvesting and their contribution to multifunctionality of the ecosystems;
- mapping regulation of access to the resource in the Mediterranean, understanding potential policy failures and replicable cases. This should take into account not only the interest of collectors and processors but also hat of land owners and managers;
- identifying and documenting relevant cases for traceability and policy and economic schemes to support sustainable collection;
- understanding the opportunities and barriers to AMP domestication for the most relevant markets in different countries, and
- better understanding emerging market trends and market niches outside the global commodity markets, and support entrepreneurship.

4.4. Mushrooms and truffles iNet roadmap

Wild mushrooms are a food product which is picked pursuing an economic and/or recreation purpose. Mushroom pickers are not usually the forest owners and the legislation on property varies among countries. Activities derived from the mushroom value chain are dependent of different governmental legislation including forestry, environment, taxation, food and health. This presents a complex scenario in which different administrations have legislative competences on the wild mushrooms value chain. Mycotourism (including mushrooms and truffles) is well developed in certain areas, while is very recent or absent in other productive areas. The wild mushrooms and truffles sectors also coincide in the complexity of the legislation affecting the entire value chain. Truffles are also a food product, with different legislation affecting the value chain (sometimes considered as a forest product, sometimes as an agricultural product). Therefore, the different governmental legislations include agriculture, forestry, environment, taxation, food and health, and this adds complexity to the truffle sector.

Updated narrative for both wild mushrooms and truffles section encompasses all the partner countries, for which we can say that the discussion during the Scoping seminar well identified the current situation and differences between regional cases.

The mission defined during the Scoping seminar can be used as a motivation for future steps of this iNet: “The Wild Mushrooms and truffles actors are organised aiming to reinforce their value chains at different territorial levels (local, regional, state and international). They develop collaborative innovative projects, establishing procedures and transactions guaranteeing product traceability, recognised by the competent administrations. The normative is well adjusted to the mycological and truffle sector realities, driving the sector's growth and generating value for the rural areas”.

This iNet recognised good practices from other iNets that could improve the mushrooms and truffles sector, an effort that could be used in all other iNets.

Correspondingly, the iNet will focus on:

- compiling and sharing relevant knowledge on sustainable management of wild and domesticated truffles and mushrooms (e.g. mycosilviculture, enrichment, irrigation, etc.) and the potential impacts of climate change;
- documenting, analysing and evaluating in participatory set-ups existing or proposed cases of regulation, including aspects such as access rights, taxation, ITC tools, traceability, etc.;
- documenting and analysing replicability of mycotourism and other territorial marketing strategies, and
- facilitating the inclusion of mushrooms and truffles in the scope of vocational training and forest extension services.

4.5. Wild nuts and berries iNet roadmap

Key consequences for further action in the wild nuts & berries iNet events are the marks put on the main challenges that are jeopardising the sustainable and profitable production of forest-collected gourmet nuts, namely chestnuts and Mediterranean pine nuts. There is a need to recover a sustained and higher production by the deployment of improved and adapted genetic material, the spread of optimised management techniques, and the development of integrated pests’ management systems.

This iNet defined a very interesting topic: “Traditional forest owners or chestnut growers, often with seldom full-time dedication, should be clearly differed from a new type of farmers or landowners who do apply a more agronomic approach on new plantations, active management, and intensive treatment practices”. This issue will involve a hard effort to identify chestnut growers as such, especially incorporating this into national policies that will offer different kind of support and incentives.

Although the Scoping seminar on wild nuts and berries successfully identified the possibilities and challenges of the pine nut and chestnut sectors, other nuts and berries that have or could have an important role in the rural economy of other countries and that are not of much interest in Portugal and Spain were poorly discussed. The conclusions of the Scoping seminar should be reviewed and see how much do they differentiate from other wild nuts and berries (blackberries, bilberries, raspberries and strawberry trees), especially because they are identified as new crops in development, which could be very interesting as an innovation in rural economies in most of the partner countries.

Accordingly, the iNet will place additional efforts on:

- documenting and sharing existing knowledge on plantation management (pine nuts, chestnuts) including the potential impacts of climate change and the management of emerging pests and diseases;
- identifying (in multi-stakeholder set-ups) domestication opportunities for other nuts and berries (e.g. blackberries, bilberries, raspberries and strawberry trees);
- compiling existing research infrastructure (e.g. clonal and provenance trials) in other to foster research cooperation and identify future collaborative projects;
- promoting intra-sectoral dialogue and multi-actor governance, in relation to traceability, identification of origin and product labelling, and
- contributing to a new culture of innovation and entrepreneurships in the transformation and marketing of wild nuts and berries.

5. Annexes

5.1. Access to scoping seminar reports and other materials

- Cork iNet: https://incredibleforest.net/inet/cork
- Resins iNet: https://incredibleforest.net/inet/resins
- Aromatic and medicinal plants iNet: https://incredibleforest.net/inet/aromatic-medicinal-plants
- Mushrooms and truffles iNet: https://incredibleforest.net/inet/mushrooms-and-truffles
- Wild nuts and berries iNet: https://incredibleforest.net/inet/wild-nuts-and-berries