European NWFPs network

Action FP1203

# A multi-methodological approach to assess the potential of NWFPs for small-scale forest owners

Short Term Scientific Mission (STSM)

Scientific Report


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| STSM dates | May 6-24, 2015 |
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# 1. Introduction

Non-wood forest products (NWFPs) cover a wide range of species (e.g. mushrooms, forest fruits, pine kernels, aromatic plants, medicinal herbs, chestnuts etc.) and are an integral element of sustainable forest management in Europe (MCPFE 1998). Up to now, forest management and planning methods have been traditionally tailored towards wood and wood-based products, inter alia due to their economic importance and competitive value chains (e.g. wood products, construction and furniture, pulp and paper, bioenergy). However, NWFPs are recently gaining momentum throughout Europe and the interest to engage in related businesses is growing (e.g. Rametsteiner et al. 2005, Weiss et al. 2011). NWFPs, i.e. products of biological origin other than wood derived from forests, other wooded land and trees outside forests (FAO 1999), are being considered as important means for business diversification and income generation, particularly in regions where wood is not the most profitable product (cf. FAO 2006, FAO 2010). For instance, Schvidenko et al (2005) report on more than 150 NWFPs that are of importance within international trade. In the most recent State of Europe´s forests report (Forest Europe, UNECE and FAO 2011), the total economic value of NWFPs in the Forest Europe region – while still considerably incompletely reported – is accounted for 2.7 billion €. Thus, there seems to be a high latent potential to strengthen the economic viability of rural economies via advancing the NWFP-focused forest management and related business. Nevertheless, data on the production and marketing of NWFPs as well as on their management and sustainable use is still scarce.

Taking into account that the share of private forest ownership in Europe is around 50 percent with great variations between countries (Schmithüsen and Hirsch 2010) and that some 15 million small-scale forest holdings exist (Wiersum et al 2005), the role of small private forest owners in the provision of different ecosystem services, wood and non-wood forest products in rural development is supposed to be significant (Pulla et al 2013). In this context the provision of expert knowledge and decision support for forest owners regarding the potential of NWFPs and their management is of high importance (Vacik and Lexer 2013). Given the frequent subordination of NWFPs to timber production, the changing societal and environmental conditions, and a loss of traditional knowledge, there is a need to design a decision support application to the demands of extension service providers (e.g. forest owners' associations, forestry consultants) in order to give advice to forest owners.

# 2. Purpose of the STSM

The STSM work targeted at the further development of an expert model approach that allows for an assessment of the potential of NWFPs for small-scale forest owners with regard to the regions operational environment and later on also with regard characteristics of their holdings. Thus it was one of the main objectives to synthesize the knowledge obtained during the first phase of the model development process and to elaborate on applied methods as well as related tasks (e.g. stakeholder interaction, data collection). Specifically, the STSM addressed the development of different parts of the expert model as follows:

- Analytic Hierarchy Process (hierarchy finalization, weighting scenarios) for defining how regional characteristics and operational environment support the production of selected NWFPs
- Bayesian Belief Network (structure & parameter description) for defining how the forest holding characteristics support the production of selected NWFPs groups
- Forest owner profiles (definition, weighting scenarios) to be able to give decision support for different forest owner types

Additionally, the STSM visit provided the opportunity to engage in relevant software applications in cooperation with the local host (i.e. Expert Choice, Hugin Researcher). Both will be applied for data processing in the future. In addition, the STSM visit was fruitful in searching for new regions within Europe where the expert model could be applied later.

# 3. Description of the work carried out during the STSM

The STSM was carried out from the 6th until the 24th of May 2015 in Finland, hosted by the Natural Resources Institute Finland (Luke). The main focus of the working visit was to advance the two major components that constitute the expert model, i.e. Analytic Hierarchy Process (AHP) and Bayesian Belief Network (BBN), as well as to define and outline related tasks (e.g. expert knowledge elicitation). The following subtasks were identified already prior to and further specified in the beginning of the STSM period:

- AHP criteria (discussion and finalization)
- Stakeholder interaction (to derive at regionally explicit weightings for the AHP)
- Forest owner profiles (description and development of distinct weighting scenarios)
- Expert consultation (as regards the AHP for N-Karelia)
- BBN (network refinement and description of states)
- Paper proposals (brief outline of possible publications)

Furthermore it was possible to give a presentation on the approach within a group of researchers who are actively involved in NWFP case study related issues across various European regions in the frame of a General Assembly Meeting of the StarTree project (funded by FP 7 KBBE).

# 4. Description of the main results obtained

## 4.1 Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) is an indicator-based Multi-Criteria Decision Making method that supports collaborative decision making. Developed by Saaty (1990) it represents an approach that depends on the values and judgments of individuals and is widely used in decision making, planning and resource allocation as well as in conflict resolution (Saaty 2001). This approach allows for systematic evaluation of both qualitative and quantitative criteria or alternatives by means of pairwise comparisons and is particularly relevant to address complex decisions (Wolfslehner et al 2005). The final results provide a cardinal ranking of alternatives, including their relative priorities. In this study, the AHP is applied to generate a regionally explicit ranking of NWFPs that are available in the region (e.g. North Karelia, Finland) under consideration.

The criteria are arranged in a two level hierarchy with a set of NWFPs options to be evaluated under each criterion. The results of the AHP provide a reference for the assessment on the forest holding level, evaluated by means of a BBN. The AHP consists of the main goal "identify the most promising NWFP for a single forest management unit (FMU) in the region xxx" (xxx = e.g. North Karelia, Styria, Alentejo, Catalonia, etc. and expresses the spatial dimension of the analysis) and two levels of indicators (see Figure 1):

1. Criteria
2. Sub-Criteria

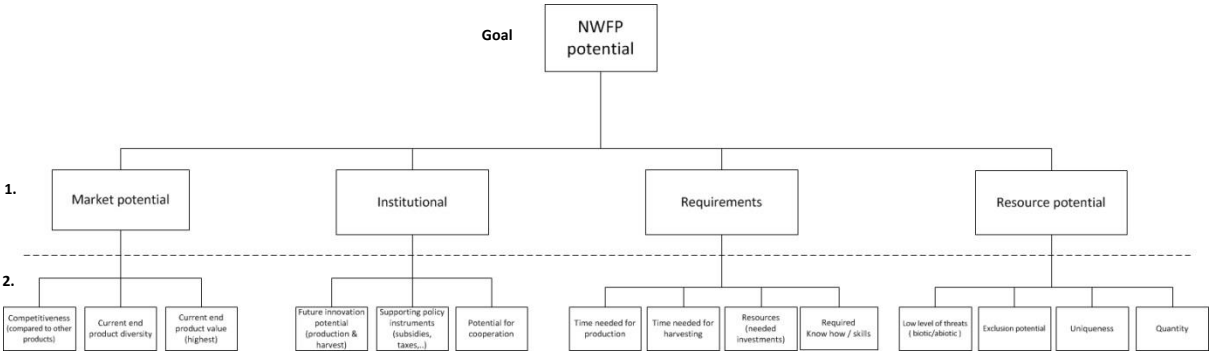


**Figure 1: Hierarchical structure of the AHP including "goal", "criteria" (1.) and "sub-criteria" (2.)**

The upper level of the hierarchy (i.e. 1. "criteria") is decomposed into four indicators: i) Market potential, ii) Institutional, iii) Requirements, and iv) Resource potential. All of them shall be specific to the region, i.e. the weight for each criterion is derived via an exercise with regional experts who identify preference values amongst those indicators to mirror regional circumstances as regards NWFPs. A guideline describing the interaction process was developed in order to harmonize stakeholder interaction processes across regions (see chapter 4.1.2).

The lower level of the hierarchy (i.e. 2. "sub-criteria") is used to further decompose the higher-level indicators and shall be specific to a forest owner/manager, i.e. according to several forest owner profiles that are applied to express different weights amongst sub-criteria (see chapter 4.1.3). The profiles are currently evaluated in order to derive at distinct weighting scenarios.

### 4.1.1 Expert knowledge elicitation

To derive at a cardinal ranking of alternatives (i.e. all regionally relevant NWFPs) it is necessary to get in touch with domain experts (e.g. NWFP researchers/practitioners in the region under consideration who have a broad knowledge in this field) in order to assess the relative preference of one NWFP over the other by means of pairwise comparisons (see Figure 2).

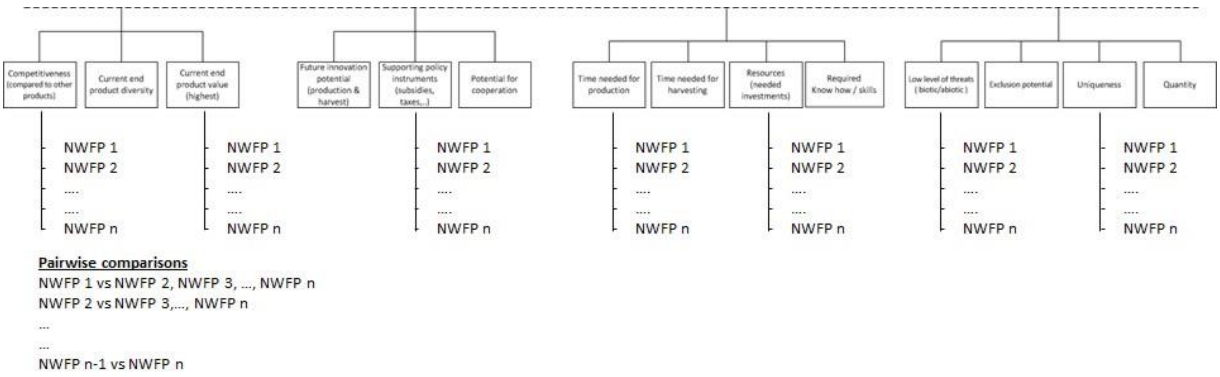


**Figure 2: Illustration of the pairwise comparisons for NWFP experts**

All selected NWFPs within the region have to be compared in a pairwise manner regarding their preferability/suitability against each sub-criterion. As a final result the overall performance per NWFP is calculated and depicts the preference ranking in relation to the weightings applied (i.e. region + FO-profile dependent). In Annex I both criteria and respective sub-criteria are explained in more detail.

### 4.1.2 Stakeholder interaction process for regional weightings

The ultimate goal of the stakeholder involvement is to achieve a consensual agreement on the relative importance of the AHP criteria (i.e. the upper level of the AHP hierarchy: Market potential, Institutional, Requirements, Resource potential). Thus it will be necessary to engage with regional stakeholders who are actively involved in NWFP management in the respective region. For the stakeholder interaction two different methods can be applied (but not mixed):

- Stakeholder workshop
- Delphi method

Details for both exercises are given below.

#### *4.1.2.1 Stakeholder workshop*

It is recommended to prepare a SMART (Simple Multi-Attribute Rating Technique) exercise in order to elicit preference ratings for the criteria as it is intended to generate at a common result for the region amongst all stakeholders within one stakeholder meeting, requiring:

- Material: Presentation, Handouts (e.g. criteria description), Flipchart, Stickers (5 different colours)
- Time needed: ~ 2.5 hrs

After an introduction to the general purpose of the AHP and an outline of the hierarchy stakeholders have to assign the relative importance of a criterion by pinning stickers to a flipchart (or similar). It is necessary to have all criteria and sub-criteria in a matrix that provides sufficient space to place stickers (the more stakeholders, the more potential stickers per criterion!). It is recommended to **start with the sub-criteria**, according to the following rules:

- One colour per criterion
  (e.g. Market potential related sub-criteria = blue, Institutional related sub-criteria = green, Requirements related sub-criteria = red, resource potential related sub-criteria = yellow)
- 10 stickers (i.e. points) per criterion to be distributed over all sub-criteria
  (10 points for one criterion is possible if perceived as utterly important by a stakeholder)
- All 10 stickers/points have to be assigned

Subsequently it needs to be continued with **the regional judgments (i.e. criteria)** by providing each stakeholder again with 10 stickers (in a different colour than all sub-criteria, e.g. black) who should then indicate the importance of a single criterion by distributing the stickers across all of them (max. 10 stickers/points for a single one).

As a final result it is expected to derive at a joint decision on the regional weightings for the AHP criteria, according to the sum of points (stickers) per criterion.

#### *4.1.2.2 Delphi method*

If it is not possible to meet the stakeholders jointly (in a physical meeting) an adopted Delphi approach can be applied to derive at regionally explicit weightings for the criteria. Therefore an MS Excel template was set up that needs to be filled by individual stakeholders (see Annex II). Single files have to be stored as follows (here an example for N-Karelia): "AHP_delphi_N-Karelia_SH1"

It is necessary to assign "SH1" (and subsequently SH2, SH3,...., SHn) to a single stakeholder within the selected panel of experts: i) for the second round of judgments, ii) in order to avoid mistakes (e.g. reduplication), and iii) to provide the opportunity to get in touch with an individual person in case of any questions. The following steps have to be accomplished iteratively:

1. Sending out the MS Excel file and asking the stakeholders for their judgments as outlined above (see 4.1.2.1 Stakeholder workshop), but this time asking them to enter values in the respective data cells.
2. After collecting the data from all stakeholders calculating the results and merging them in a single document (e.g. showing figures/graphs).
3. Circulating the results again within the stakeholder group (including their first judgements, i.e. "AHP_delphi_N-Karelia_SH1" for instance) and asking them for a revision of their data in order to provide the opportunity to adapt individual ratings according to the general perception (but: a stakeholder can stick to his/her judgements, so it´s optional to adapt!).
4. Finally, collecting the results again and calculating the final results (weights for the four criteria should sum up to 100 %).

A brief introduction of the Delphi method that could be used for a general introduction to the stakeholders will be prepared in order to provide a harmonized approach across regions. This shall foster the involvement of COST countries and/or StarTree members where it might be relevant to translate the information to national languages.

### 4.1.3 Forest owner profiles

For the sake of diverging weighting scenarios as regards the lower level of the AHP hierarchy it was decided to define a set of forest owner profiles. On a rural-urban-continuum (cf. Hujala and Tikkanen, 2008; Hogl et al, 2005) four different profiles could be identified and will be used to define the weights for the sub-criteria of the AHP (see Table 1).

**Table 1: Definition of forest owner profiles and description of the rationale behind**

| Forest owner type | Description |
|---|---|
| Hands-on nurterer | Full-time (more) agricultural type of active NWFP producer who is capable and willing for self-active work, living close to the farm/forest |
| Part-time outsourcer | Part-time (less) agricultural type of active NWFP producer, who is capable and willing for self-active work but has to outsource various tasks due to a lack of time, living close to the farm/forest |
| Urban value extractor with rural background | NWFP harvester who is motivated to make active use of opportunities and has some connection to the forest (e.g. agricultural/forestry education, aims to increase the benefits of the family forest holding although living in a city), living in quite some distance to the farm/forest hence rarely able to actively work in/manage the forest but willing to do so, less capital available |
| Urban value extractor without connection to agriculture/forestry | NWFP harvester who is motivated to make active use of opportunities, without practical knowledge but high interest in economic benefits, outsourcing all tasks/ not willing to actively work in the forest, more financial power |

Building on the narrative behind each forest owner profile it is the overarching goal to define four plausible scenarios that will be derived in a Delphi-like approach within the core development team. The process includes a qualitative assessment for all profiles in a sequence of alternating judgments.

It is envisaged to apply these profiles (i.e. at least one out of four) within each case study willing to participate in (parts of) the expert model approach (e.g.COST country representative, StarTree project participant).

### 4.1.4 Regional results

As an initial step it was agreed to test the application in two case studies in order to gain insights to the feasibility and applicability of the criteria. For both case studies relevant NWFPs were selected in cooperation with domain experts who provided their expertise to conduct required pairwise comparisons. Styria was chosen to act as a role model. In order to come to grips with potential limitations of the approach (e.g. time, required knowledge, system boundaries) it was decided to test the AHP for two different sets of NWFPs in this region. Both tests could be completed successfully and provided plausible results from the perspective of involved experts. Similar promising results could be achieved for the N-Karelian case study. Figure 3 gives an overview of the first assessments for selected NWFPs in both case study regions.

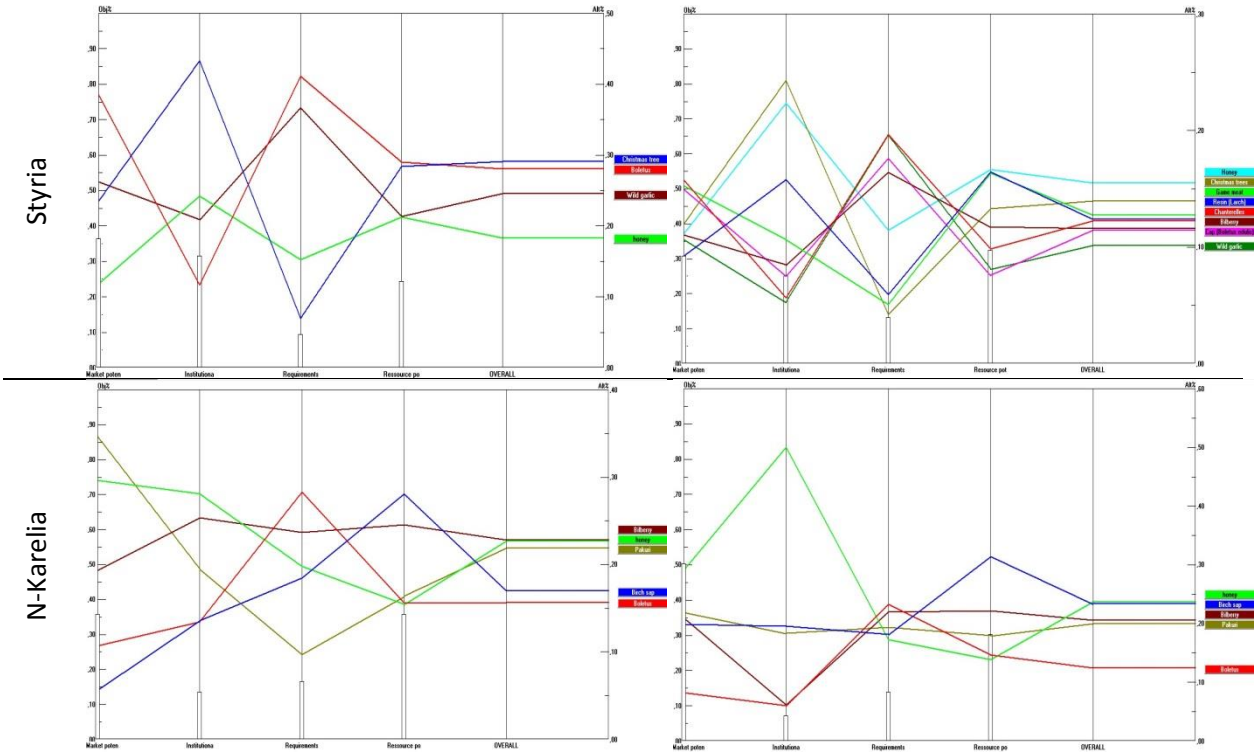


**Figure 3: Performance results of selected NWFP per case study region as regards the AHP**

In all cases NWFPs are ranked according to their performance with regard to four main criteria (i.e. summarized for criteria “market potential”, “Institutional”, “Requirements”, “Resource Potential”) and finally also for the overall goal. The results thus provide a reference for forest owners who are interested to manage (also) for NWFP or to engage in related businesses. Further data collection and related analysis will be conducted as soon as the work on weighting scenarios, both for the regional and the forest owner dependent ones has been accomplished.

## 4.2 Bayesian Belief Network

A Bayesian Belief Network (BBN) is a probabilistic graphical model that can be applied to a wide range of environmental problems (e.g. Landuyt et al, 2014; Catford et al, 2013; Howes et al, 2010). BBN has been used as a technique to model ecological predictions and to aid resource-management decision-making (Marcot et al, 2006). BBNs consist of two structural components: i) a causal network (often referred to as the directed acyclic graph), and ii) conditional probability tables that quantify the relations in the network (Jensen, 2001). In our application, the BBN is applied to unravel the potential in a FMU of integrating one or more of regionally available NWFPs (i.e. as assessed in the AHP) in its forest management concept.

Due to the overall complexity with respect to diverse environmental settings and management concepts the BBN is designed to be applied to clusters of NWFPs instead of individual NWFPs as follows: i) tree products (e.g. birch sap), ii) mushrooms and truffles (e.g. cep), iii) understorey products (e.g. berries), and iv) animals (e.g. game meat). Figure 4 highlights the causal network of the BBN.

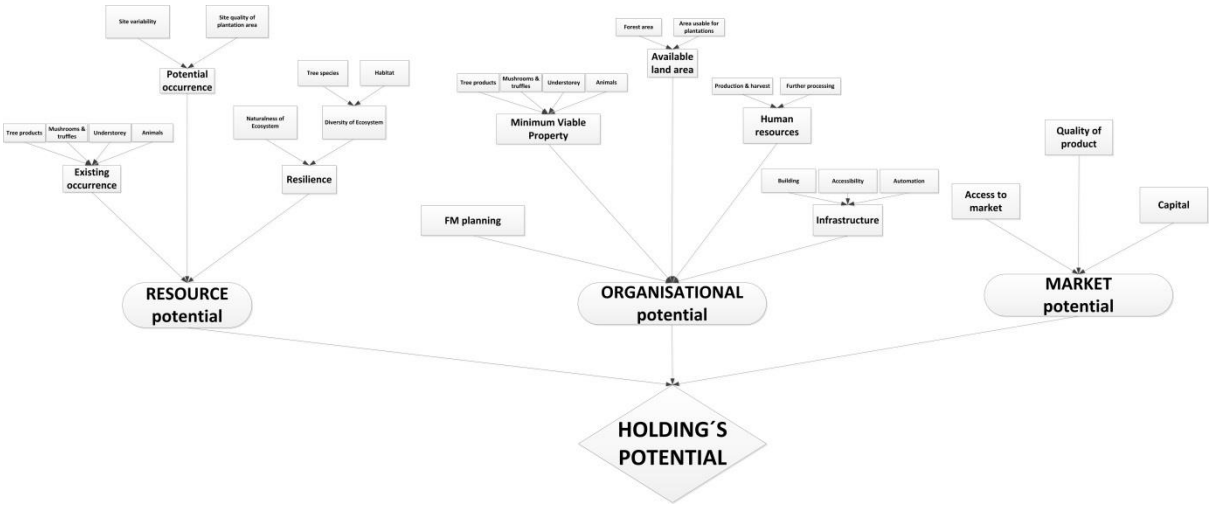


**Figure 4: Causal network of the BBN indicating parameters and their relations (i.e. arrows)**

Consisting of different nodes that are described by certain states, the causal network covers the final child node “Holding´s potential”, which is influenced by three so-called parent nodes. “Resource potential” gives indication on the potential to produce certain (group of) NWFPs within a holding and aims to mirror a variety of ecological aspects. It is assessed via three indicators: a) Existing occurrence, b) Potential occurrence, and c) Resilience. “Organizational potential” is split into a) FM planning, b) Minimum Viable Property, c) Available land area, d) Human resources, and e) Infrastructure, and estimates the capacity of a holding to produce a certain (group of) NWFPs within its property.

Finally, the “Market potential” targets at an assessment of a holding´s potential to market a certain (group of) NWFPs and is influenced by a) Access to market, b) Quality of product, and c) Capital. Wherever relevant these indicators are further refined by additional parameters (as outlined in Fig. 3).

The results of the BBN provide a probability estimation for a selected set of NWFPs (respectively a cluster) with respect to a single FMU. Annex III highlights the content of the BBN diagram and briefly explains the rationale behind.

## 5. Future collaboration with host institution

During the STSM visit Dr. Mikko Kurttila, my local host, provided me with the opportunity to work both at the Vantaa Unit and at the Joensuu Unit of Luke and thus to meet an array of researchers at both locations. As several researchers are active in R&D projects related to a wide variety of different forest products and services, this opportunity served as a great platform to exchange both ideas and data in order to facilitate knowledge transfer and future cooperation. While I was supervised by Dr. Teppo Hujala in Vantaa, an active member of the core development group, Dr. Kurttila was my supervisor in Joensuu.

A number of tasks arose out of the STSM that need to be accomplished in the coming months to continue our joint work and elaborate on our vision of an expert model that can be applied across Europe within diverging environmental and socio-economic contexts (e.g. stakeholder interaction processes for regional weights to be finalized until June, forest owner profiles weighting scenario development, BBN states definition, system boundaries to be finalized in order to allow for a harmonized application across regions, planning of collaborations with other partners of COST + StarTree). Apart from further development of the expert model it is expected to collaborate in several joint publications (see chapter 6). It is also expected that the STSM will lead in future collaboration in different international research and development projects.

## 6. Foreseeen publications/articles resulting

From a current perspective it seems to be very likely that various publications arise out of the expert model approach and related STSM work. First ideas on joint publications have been discussed, briefly outlined and circulated amongst the core development group. These drafts include:

a) Application of the Analytic Hierarchy Process for a participatory assessment of different non-wood forest products in two European regions
b) A Bayesian Belief Network approach to assess the potential of non-wood forest products for small-scale forest owners
c) A holistic expert model approach to analyze non-wood forest products´ potential for two European case studies

As the presentation during the StarTree General Assembly meeting triggered huge interest across case study responsible persons it is expected to work on additional joint publications in the long run in direct exchange with our partners (e.g. Case study comparisons, European perspective, Regional findings). In addition, it is possible that the above outlined publications will include more than two case study regions.

## 7. Confirmation

The STSM visit and its results have been confirmed in a separate letter by Mikko Kurttila (see “Confirmation_STSM_Kurttila”).

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# Annex I

In the following both criteria and respective sub-criteria of the AHP are explained in more detail.

- Market potential

  indicates the **current** market potential of a distinct NWFP and synthesizes existing opportunities to market them (i.e. on local, regional, national, international markets). It consists of

  - *Competitiveness [the higher the better]*
    expresses how competitive a single NWFP (i.e. the raw material, not the potential end products) is compared to other products, i.e. substitutes (e.g. organic tannins vs fossil fuel based ones), derivates (e.g. wild berries vs cultivated berries) , other products in the same category (e.g. wild fruits vs fruits in general)
  - *Current end product diversity [the higher the better]*
    reflects the portfolio of final products that can be derived out of a single NWFP (e.g. berries can be marketed raw or processed [e.g. dried, powder, jam, mash, liquor,…])
  - *Current end product value [the higher the better]*
    assesses the range of value added for a single NWFP (e.g. berries sold raw on local markets á € 10/kg and berries sold as distilled liquid for € 70/litre ), i.e. the highest price that can be achieved for a distinct end product derived out of a NWFP taking into account the proportional value of the raw material (e.g. berry powder ~ 100%, personal care product derived out of berries ~ 70%)

- Institutional

  depicts the institutional potential with regard to a single NWFP and mirrors supportive institutional structures by

  - *Future innovation potential [the higher the better]*
    focuses on the future innovation potential (i.e. within the next 10 years) for production and/or harvesting processes taking into account the current state of knowledge (e.g. new machinery to harvest mushrooms – is it realistic to be implemented within the next 10 years?; cultivation of wild mushrooms – is it realistic to produce Chanterelles on straw within the next 10 years?)
  - *Supporting policy instruments [the more available the better]*
    pinpoints existing economic policy instruments that support the production/harvesting of NWFP, like subsidies, taxes, incentives,.. (e.g. LEADER supports projects that foster regional development and was used to create NWFP businesses; tax exemption for NWFP pickers)
  - *Potential for cooperation [the higher the better]*
    estimates the current potential to cooperate with other actors in the same field (e.g. association of Christmas tree producers provides support for its members; marketing cooperative for certain NWFPs)

- Requirements

  highlights necessities for NWFP production and harvesting and is split into

  - *Time needed for production [the less the better]*
    indicates how time consuming the production of a single NWFP may be (e.g. artificial introduction and thus planting, tending,…) – also taking into account the rotation period (i.e. how long it takes to harvest the NWFP for the first time) initiating the production from bare land
  - *Time needed for harvesting [the less the better]*
    mirrors the time needed to harvest a single NWFP in relation to the yield/working hrs and only considers the harvesting process (e.g. manually harvest mushrooms/berries, harvest machinery for wild fruits, shoot game)
  - *Resources (needed investments) [the less the better]*
    depicts how much resources would be needed for the management (i.e. production and

harvesting as outlined above) of a single NWFP (e.g. mushrooms = knife, basket; game = hunting license, weapon, munition, night vision device/binicoluar, car,…;honey= beehive, beekeeper´s equipment, honey separator)

- *Required skills/know-how [the less the better]* estimates the level of knowledge necessary to successfully produce/harvest a single NWFP (e.g. mushrooms = how to sustainably harvest them; game = legal framework, hunting exam, species dependent know-how,…)

- Resource potential

  gives an estimate on the potential to successfully produce and/or harvest a single NWFP and comprises of

  - *Low level of threats (biotic/abiotic) [the "higher" the low-level the better]* relates to biotic and/or abiotic risks with regard to a single NWFP (e.g. chestnut = chestnut blight, gall wesp, ?; honey = varroa mite, pesticides/insecticides, ?)
  - *Exclusion potential [the higher the better]* indicates the potential to exclude others (i.e. the general public) from production/harvesting of a single NWFP and thus relates to access , harvest and property rights (e.g. berries are a common good in FI and can be harvested by everybody -> everyman´s right; berries in AT may be picked for personal use but the owner has the right to exclude the general public from picking)
  - *Uniqueness [the higher the better]* refers to the uniqueness of a single NWFP on a national level (e.g. endemic species)
  - *Quantity [the higher the better]* reflects how much of a single NWFP can be produced within one production cycle on a defined spatial scale (i.e. within the region under consideration) and relates to the regional potential of a single NWFP (e.g. the potential to produce bilberry in N-Karelia is high – the potential for birch sap even higher)

# Annex II

The following two figures highlight the content of the template for the Delphi approach to elicit stakeholder judgments for the weightings of AHP criteria.

| Corresponding criteria | Name | Rating |
|---|---|---|
| Market potential | Competitiveness | |
| | Current end product diversity | |
| | Current end product value | |
| | | Sum needs to be 10 current 0 |
| Institutional | Future innovation potential | |
| | Supporting policy instruments | |
| | Potential for cooperation | |
| | | Sum needs to be 10 current 0 |
| Requirements | Time needed for production | |
| | Time needed for harvesting | |
| | Resources (needed investments) | |
| | | Sum needs to be 10 current 0 |
| Resource potential | Low level of threats (biotic/abiotic) | |
| | Exclusion potential | |
| | Uniqueness | |
| | Quantitiy | |
| | | Sum needs to be 10 current 0 |

| Name | Rating |
|---|---|
| Market potential | |
| Institutional | |
| Requirements | |
| Resource potential | |
| | Sum needs to be 10 current 0 |

# Annex III

The final *child node* „Holding´s Potential" is positively influenced by 3 *parent nodes* (i.e. RESOURCE potential, ORGANISTIONAL potential and MARKET potential – see tree structure below, format underlined) and not listed seperately. Influence (written as $S^+$ if positive or $S^-$ if negative) describes the type of influence of the parent node to a child node in the BBN.

## RESOURCE potential ($S^+$)

Gives indication of the potential to produce a certain (group of) NWFP within a holding´s property and aims to mirror a variety of ecological aspects. It is assessed by the following parent nodes:

- Existing occurrence ($S^+$)
  measures the current occurrence of the NWFP (group) of interest in the holding
  (more areas currently used for NWFPs production are favourable)
- Potential occurrence ($S^+$)
  assesses the potential of a (group of) NWFP to occur within the holding´s property and is influenced by
  - Site variability ($S^+$)
    holistically describes the heterogeneity of a holding in terms of the available site conditions (e.g. different soil conditions, different altitudinal zones, nutrient rich/poor, water availability,…)
    (different site conditions are favourable)
  - Site quality of plantation areas ($S^+$)
    indicates the potential of areas general suitable for the (artificial) introduction of certain NWFPs
    (site quality of the area is assessed - the better the quality, the better the index)
- Resilience ($S^+$)
  assesses the ecosystem´s ability to mitigate risks and threats and is influenced by
  - Naturalness of Ecosystem ($S^+$)
    expresses how close the ecosystem is to its natural state (e.g. potential natural vegetation)
    (artificial or moderately disturbed forests are bad)
  - Diversity of Ecosystem ($S^+$)
    highlights the species richness within the holding and is influenced by
    - Tree species (amount and variability of tree species)
      (more tree species are favourable)
    - Habitat (availability of different habitats/biotops - e.g. riparian forest, grassland, peatland,…)
      (more habitats are favourable)

## ORGANISATIONAL potential ($S^+$)

Assesses the holding´s ability to produce a certain (group of) NWFP within its property and it is influenced by the following parent nodes:

- FM planning
  mirrors the existence of FM planning intruments (i.e. inventories, maps, plans)
  (the more advanced the better it is)
- Minimum Viable Property ($S^+$)
  describes the yields (e.g. t/ha) and the size required to produce a certain (group of) NWFP in order to achieve a sustainable production for the property (the larger the required area is, the worse)

- Available land area ($S^+$)
  depicts the land area (in ha) available for NWFP production (more areas available for NWFPs production are favourable) and is influenced by
    - Forest area ($S^+$)
      indicates the area covered with forests
      (more forest area available for NWFPs production is favourable)
    - Area usable for plantations ($S^+$)
      illustrates the land area suitable for NWFP introduction
      (more area available for NWFPs production is favourable)
- Human resources ($S^+$)
  displays how many employees the holding has available for
    - Production & harvest ($S^+$)
      number of employees (including third party contractor, to be hired) potentially available for the production and harvesting of a (group of) NWFP
      (the more / the easier, the better it is)
    - Further processing ($S^+$)
      number of employees available for further processing of a (group of) NWFP inside the holding
      (the more employees available the better it is)
- Infrastructure ($S^+$)
  represents the infrastructure available within the holding and is influenced by
    - Building ($S^+$)
      indicates the availability of storage capacities inside the holding
      (the larger the storage capacity is, the better)
    - Accessibility ($S^+$)
      displays the area (in %) reachable via roads, paths and hiking trails (the larger the reachable area is, the better)
    - Automation ($S^+$)
      highlights the level of current use of ICT and monitoring systems as well as supporting IT infrastructure (e.g. web, WLAN, computer equipment, website, printer)
      (the more advanced the better it is)

<u>MARKET potential</u> ($S^+$)

Addresses the holding´s potential to market a certain (group of) NWFP and is influenced by

- Access to market ($S^+$)
  displays the holding´s potential to access markets (local, regional, national, international)
  (the larger the markets are, the better it is)
- Quality of product ($S^+$)
  estimates the holding´s ability to achieve a distinct product quality out of a (group of) NWFP (e.g. availability of certification systems, monitoring systems, …)
  (the more advanced the better it is)
- Capital ($S^+$)
  expresses the capital of the holding in terms of cultural, historical and/or narrative aspects (e.g. being part of a historical area)
  (the more capital features are existent the better it is)