

## PRIORITIZING THE POTENTIAL OF NON-WOOD FOREST PRODUCTS FROM ARAD COUNTY BY USING THE ANALYTICAL HIERARCHY PROCESS

Ioana Maria Pleșca<sup>1\*</sup>, Tatiana Blaga<sup>1</sup>, Lucian Dincă<sup>2</sup>, Iuliana Gabriela Breabăn<sup>3</sup>

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**Abstract.** Romanian forest management plans and policies, traditionally focused on timber production, need to reconsider the NWFPs (non-wood forest products) importance in the development of the socio-economic sector. Within the country's forestry economy, the nature, quantity and weight of NWFPs are variable factors from one county to another, influenced to a large extent by the area covered by forests. The aim of this study is to unravel the most important NWFPs available in Arad County. In order to analyze the potential of NWFPs, data from the forest management plans of the ten subunits within the structure of the Arad Forest Directorate and statistical data from various institutions were used. In accordance with the purpose of the study, NWFPs were clustered into four categories as designed in the European project COST FP1203 *European Non-Wood Forest Products (NWFPs) Network*: mushrooms, tree products, understory plants and animal origin products. Eight different types of NWFPs were identified and analyzed using the analytic hierarchy process. Potential NWFPs were prioritized in accordance with the 19 criteria selected, and thus the most promising NWFPs were determined. Subsequently, AHP results were implemented in the Choice Expert Desktop software package. The results of the study indicate that *Coturnix coturnix* and *Vulpes vulpes* are in the top of the most promising NWFPs. More importantly, the obtained results can help to better address the management of NWFPs from Arad County.

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<sup>1</sup> National Institute for Research and Development in Forestry "Marin Drăcea", Bacău, Romania, e-mails: ioana0407@yahoo.com, tatiana.blaga@yahoo.com

<sup>2</sup> National Institute for Research and Development in Forestry "Marin Drăcea", Brașov, Romania, e-mail: dinka.lucian@gmail.com

<sup>3</sup> "Alexandru Ioan Cuza" University, Faculty of Geography, Iași, Romania, e-mail: iulianab2001@yahoo.com

## 1. Introduction

During the last three decades, the role of non-wood forest products (NWFPs) was reconsidered at a global level, with the intention of acknowledging their importance in the development of the socio-economic sector (Marshall and Cherukat, 2009). As a consequence, a series of programs were initiated dedicated especially to recognizing, organizing and capitalizing NWFPs (Vacik et al., 2014; Wolfslehner et al., 2014). They focused on improving and diversifying rational alimentation, conserving biologic diversity as well as ensuring multifunctional and sustainable forest management (FAO, 2010; Ros-Tonen, 2012).

Contrary to the fact that the importance of NWFPs is unanimously recognized at a European level, forest management plans and policies are generally focused on wood production (Sainz et al., 2010). However, a report published by FAO (2009) for West Europe forecasts an increase of competitiveness in the forest non-wood products and services sector to the detriment of the wood industry.

Due to its geographic location, varied climate and diverse relief forms and soil types, our county presents a large range of non-wood forest products. In spite of this, they still represent a low volume in comparison with wood products based on the data provided by the National Forest Administration (NFA) (Cofari, 2010).

Within the Romanian forest economy, the quantity and percentage of NWFPs are variable factors from one county to the other, mainly influenced by the surface covered with forest. Amongst the counties with large forest surfaces known for mobilizing high resources and diverse non-wood forest products we mention Maramureș (Enescu et al., 2017), Prahova (Enescu et al., 2018), and Bihor (Timiș-Gânsac et al., 2019).

Recent studies (Cântar et al., 2018; Cioacă and Enescu, 2018; Enescu et al., 2018) have shown that normally, counties with a deficit of forest vegetation present a less variable range of non-wood forest products which leads to a lack of interest regarding their harvesting and commercialization.

According to the last statistics, Arad is among the counties with a deficit of forest funds, having an afforestation percentage of only 27% (MWF, 2017).

## 2. Material and Method

Arad County is situated in the country's West extremity, extending from one side to the other of Mureș and Crișul Alb rivers (Fig. 1). Based on its surface, the county occupies the sixth place at a national level.

The relief is distributed on three altitude levels, namely the mountain level, the hill, basin and chute level and the plain level. Each level represents approximately one-third of the county's total surface (Arad County's Monography). From a climate point of view, the county has a temperate continental climate, with oceanic influences. The vegetation presents a tier visible from West to East, due to the

predominant influence of West wind masses. Multiannual average isotherms vary between 6 and 10°C, while the quantities of annual precipitation are gathered between 560-1200 mm.

Arad County's forest fund surface has reached 211561 ha at the end of 2017 (NIS, 2018). Amongst this, 101669 ha are public state property, being managed by the National Forest Administration through Arad Forest District (NFA, 2018), namely approximately 13% of the county's whole surface. In regard to the area's specific, broad-leaved stands prevail (oak, cherry, plain maple, and more rarely ash, poplar or common beech). Furthermore, the arbustive layer is well developed, being composed of species such as corn, hawthorn, spindle tree, hazel, etc.



Fig. 1. Location of Arad County

Taking into account the indented purpose, a list of the main NWFPs available in Arad County was first and foremost created. This preliminary identification was realized by consulting management plans from all subunits managed by Arad Forest District, as well as annual statistical reports published by NFA and NIS.

The analytical hierarchic process (AHP) was used in order to emphasize the most promising non-wood forest products from Arad County. The method was thoroughly described in the specialty literature (Wind and Saaty 1980; Saaty, 2008) and consists in decomposing a complex decision in a hierarchy, resulting in the establishment of the best alternative. One of the first steps includes defining the criteria, then comparing on pairs the elements from a certain hierarchy level in order to evaluate their relative percentage in regard to each element from the immediately superior level. In order to facilitate the comparison, a scale of eight points regarding the importance of criteria was used.

The present study has used a set of 19 criteria, namely: harvesting period, harvested quantity/ worker/8 hours, harvesting cost, harvesting knowledge, tools needed for harvesting, the complexity of the harvesting process, development of the harvesting process, distribution range, biotic threats, abiotic threats, perishability, market potential, market demand, “celebrity” of the product on market, the price of the raw product, the price of the derived product, portfolio of derived products and transport (harvesting - storage center).

According to the study’s structure, NWFPs were grouped into four categories that were conceived in the COST FP1203 European project *European Non-Wood Forest Products (NWFPs) Network*: mushrooms and truffles, tree products, understory plants and animal origin products.

Subsequently, AHP results were applied in the Choice Expert Desktop v.11.5.1683 software package.

### 3. Results and Discussions

As such, the purpose of this study is to analyze and establish the most promising non-woof forest products from Arad County.

The eight products taken into account for Arad County were: *Boletus edulis*, *Lactarius* spp., *Tilia* flowers, *Prunus avium* fruits, *Cornus mas* fruits, *Urtica dioica* leaves, fox (*Vulpes vulpes*) and quail (*Coturnix coturnix*). The product’s organization was based on the 19 chosen criteria and experts’ opinions (Tab. 1).

From the data rendered in the following graphic representation (Fig. 2) it can be observed that the top of promising NWFPs is occupied by animal products, namely quail and fox.

Quail (*Coturnix coturnix*) is the only migrating bird from the *Galliformes* Order, being a summer guest (from April until September) and passage guest (in spring and autumn) in our country. Romania is one of the few European Union countries where the hunt of quails is authorized (Directive 2009/147/CE, Law 407/2006), even though this species is included in SPEC 3 category (species whose global population is not concentrated in Europe, but which is in an unfavorable conservation stage) (Perennou, 2009).

On our country’s territory, this species distribution is not uniform, being more frequent in Dobrogea, East Muntenia and West Plain (Cotta and Bodea, 1969). As such, it is not a main game species (the annual national quota reaches 15000-20000 individuals), but is highly appreciated for its meat taste.

If we analyze the AHP appreciation level for quail, we can observe that it has the lowest harvesting cost, the lowest raw product cost, is easy to recognize and does not present high risks from harmful biotic or abiotic factors. Instead, in

comparison with the other selected products, the quantity harvested by one worker in eight hours is low, while the spreading areal is relatively limited.

Tab 1. AHP alternative ranking

Criterion		Mushrooms		Tree products	Understory plants			Animal origin	
		<i>Boletus edulis</i>	<i>Lactarius</i> spp.	<i>Tilia</i> flowers	<i>Prunus avium</i>	<i>Cornus mas</i>	<i>Urtica dioica</i>	fox ( <i>Vulpes vulpes</i> )	quail ( <i>Coturnix coturnix</i> )
		1	2	3	4	5	6	7	8
1	Harvesting period	3	2	1	5	4	8	7	6
2	Harvested quantity / worker / 8 hours	6	5	4	8	3	7	1	2
3	Harvesting cost	3	4	5	6	2	1	7	8
4	Knowledge for harvesting	7	5	2	1	4	3	6	8
5	Tools needed for harvesting	2	3	4	1	6	5	8	7
6	Complexity of harvesting process	3	2	4	5	6	1	8	7
7	Development of harvesting process	5	4	3	2	6	1	8	7
8	Knowledge for recognition	8	7	4	1	5	3	2	6
9	Distribution range	4	3	5	6	1	7	8	2
10	Biotic threats	5	6	3	7	4	2	1	8
11	Abiotic threats	4	5	7	6	3	1	2	8
12	Perishability	8	3	6	4	2	1	7	5
13	Market potential	7	4	5	8	1	3	2	6
14	Market demand	7	6	5	8	1	2	3	4
15	“Celebrity” of the product on market	7	3	4	8	1	2	5	6
16	The price of raw product	6	5	3	4	2	1	7	8
17	The price of the derived product	5	4	2	6	3	1	8	7
18	Portfolio of derived products	7	4	6	8	1	3	2	5
19	Transport (harvesting - storage centre)	6	7	2	5	3	1	8	4

Based on the same work methodologies, quail proved to be a species with potential for Dolj County where it has occupied the second place after *Lepus europaeus* (Cântar et al., 2018).

From the understory plants category, a real potential is represented by *Prunus avium* fruits. In our country, bird cherry is a disseminated species, with an estimated surface of 7600 ha (Dincă and Dincă, 2003). It has early maturity, the fructification starting at 8-10 years, with annual periodicity and high quantities (Șofletea and Curtu, 2007). It is estimated that a tree can provide 20-35 kg of fruits at harvesting, reaching sometimes even 50 kg if the conditions are favorable (Beldeanu, 2008).

The fruits are easy to harvest, the harvesting productivity being high, a fact emphasized by the grade obtained for the second criteria (harvested quantity/worker/8 hours). Furthermore, the species is the most popular from the selected NWFPs, with the highest market potential and request.

In addition, it has the most varied portfolio of derived products, its fruits being used for natural and alcoholic drinks, syrup, compote, marmalade, confiture, candied fruits or liquors.

Due to its content in sugar, organic acids, pectin and vitamins (Ferretti et al., 2010) the product also has medicinal usages, being recognised for its antioxidant properties (Serra et al., 2011), as well as the depurative, sedative and laxative ones (Bastos et al., 2015).

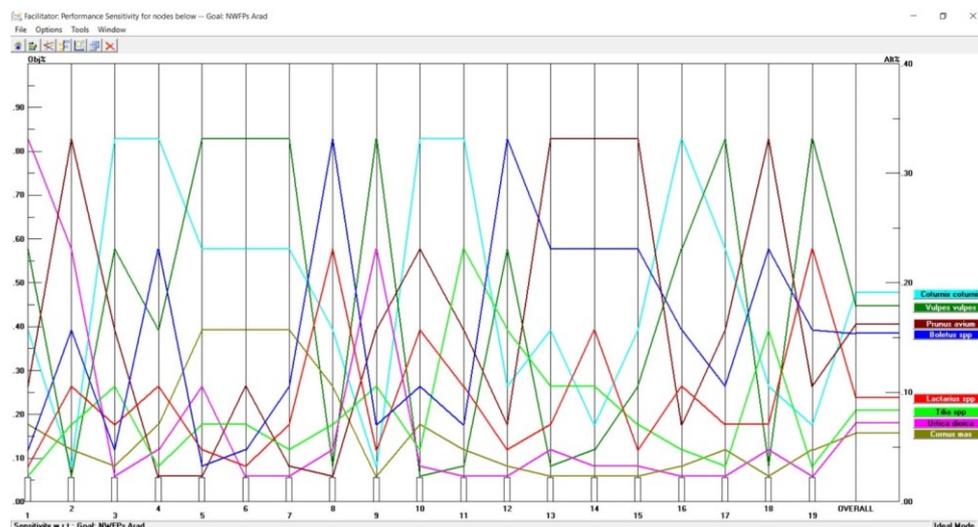


Figure 2. Ranking of the selected NWFPs

Together with *Prunus avium*, the understory plants category also includes the nettle (*Urtica dioica*) and corn (*Cornus mas*). However, they have very low potential, being situated in the last positions.

Significant nettle quantities are harvested in Argeş, Vaslui and Tulcea Forest Districts (Vasile et al., 2015).

*Urtica dioica* (stinging nettle or common nettle) is a perennial herbaceous plant with a vast natural areal in Europe and Asia (Taylor, 2009), from where it was introduced and naturalized in the entire world (Preston and Hill, 1997). It contains diverse chemical substances (vitamins, amino acids, beta-carotene, fat acids, etc.) (Rutto et al., 2013) capable of determining pharmacodynamics effects with therapeutic actions.

From all the NWFPs, it has the longest harvesting period. However, for medicinal usages it is recommended to be gathered during the summer (Fiol et al., 2016). Due to the undeveloped harvesting process, low market potential and request, we can see that it has the lowest price for its raw and derived products, all these influencing the place occupied within the hierarchy.

If we refer to the nature of non-wood forest products capitalized from the forest of the 10 subunits found in Arad Forest Directorate, we can see that game meat and medicinal plants are appreciated. Based on the data recorded, 19,6 tons of game meat were harvested in 2018, followed by 1859 kg of rattle flowers, 790 kg linden flowers, 315 kg yarrow leaves and 185 kg hawthorn fruits (NFA, 2018).

#### 4. Conclusions

Due to relief and vegetation conditions, the range of non-wood forest products from Arad County is very varied. However, just a part of these natural resources is capitalized and the harvested quantities do not reach their true potential.

The present study has analyzed and established the potential of the most important eight NWFPs from Arad County by using a multi-criteria decision method.

The obtained results show that the most economic benefits can be obtained by capitalizing animal origin products (quail and fox). These NWFPs are in the hierarchy's top due to their following characteristics: high price for their raw and derived products, a low number of instruments necessary for harvesting, high complexity for their harvesting process as well as very developed harvesting processes.

The priority of NWFP's potential is important because it shows the direction that must be adopted by future management actions for these resources in order to develop the socio-economic sector from Arad County.

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