

## APPLICATION OF THE ANALYTIC HIERARCHY PROCESS IN SELECTION OF THE MOST IMPORTANT NON-WOOD FOREST PRODUCTS FOR DOLJ COUNTY

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### ABSTRACT

*In Romania, non-wood forest products (NWFPs) are mainly represented by wildlife species of hunting interests, fish from the waters included into the forest fund, forest berries, forest seeds, edible mushrooms, medicinal and aromatic plants and resin. The NWFPs belong to their owners with the exception of the first two categories.*

*The aim of this study was to highlight the most important NWFPs from Dolj County. The analyze model was based on Analytic Hierarchy Process and 19 criteria and 8 alternatives (NWFPs) were used. The processing of the data was done using Expert Choice Desktop software.*

*The eight selected NWFPs consisted in parasol mushroom, milk-caps, oak seeds, black berries, berries of common hawthorn, Saint John's wort, European hare and common quail. According to the AHP results, the most important non-wood forest product for Dolj County is the European hare, while the less important one is Saint John's worth. The results of this study represent an important contribution to the evaluation of the potential of the NWFPs for Dolj County with a special view on their harvesting, marketing and other linked activities.*

### INTRODUCTION

Non-wood forest products (NWFPs) represent one of the main categories of forest products, edible mushrooms, forest berries and medicinal plants being the most common products worldwide. In Romania, according to Article 58, paragraph (3) of the Forest Code (Law no. 46/2008), the non-wood forest products are represented by wildlife species of hunting interests, fish from the waters included into the forest fund, forest berries, forest seeds, edible mushrooms, medicinal and aromatic plants and resin. The NWFPs belong to their owners with the exception of the first two categories.

Across Romania the distribution of NWFPs is uneven, in most of the cases being dependent on the presence of the forest sites. As a consequence, in the counties situated in mountainous and hilly regions where the forests are well represented, the potential of harvesting NWFPs is higher in comparison with the counties situated in plain regions.

By taking also into consideration that the forest management in Romania is focused on timber production and little attention is given to the management of NWFPs (Enescu 2017), in countries with low wood resources, NWFPs could represent an important source of income

both for forest owners and forest managers. This is also the case of Dolj County, which is situated in the southern-western part of Romania (Figure 1), having an area of 7.414 km<sup>2</sup> and bordering with Vâlcea and Gorj Counties in the North, with Mehedinți County in the West, with Olt County in the East and with the Danube in the South (Popescu 2013).

The total forest area in Dolj County accounts for approximately 84.400 hectares

(INS 2016), that is around 11% of the total area of the county, most of them being managed by Dolj Forestry Directorate, a territorial branch of National Forest Administration Romsilva, through its nine forest districts, namely Amaradia, Calafat, Craiova, Dăbuleni, Filiași, Perișor, Poiana Mare, Sadova and Segarcea, and only a few of them being managed by private forest districts (Abrudan 2012).

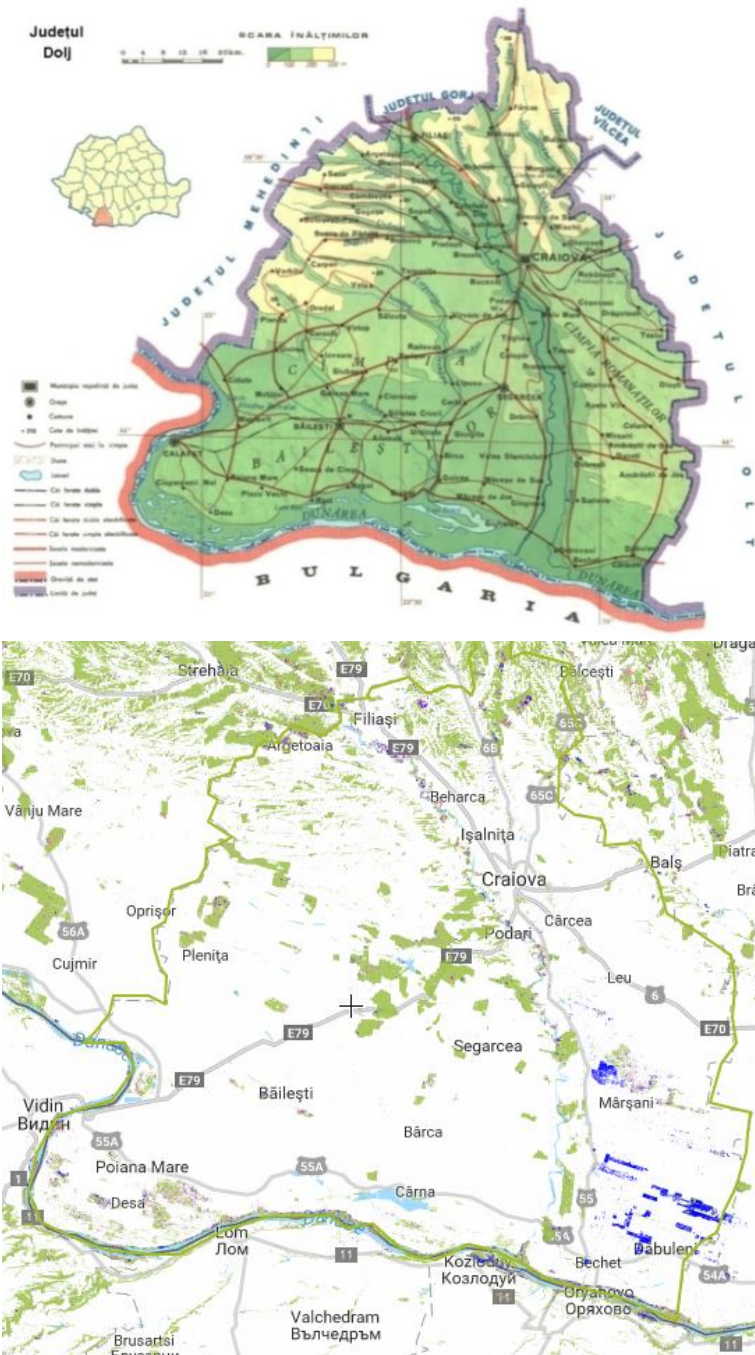


Figure 1. Location of Dolj County  
(Sources: <http://pe-harta.ro/dolj/>(up); <https://www.globalforestwatch.org>(down))

The main forest stands across the county are composed by oak species, especially Turkey oak (*Quercus cerris* L.) and Hungarian oak (*Q. frainetto* Ten.), but also pedunculate oak (*Q. robur* L.), black locust (*Robinia pseudoacacia* L.) and several willow and poplar species (Golea and Pleniceanu 2003). Pedunculate oak is less represented in comparison with the other two oak species, but its presence in the region is very important from a genetic point of view. Recently, within Sadova forest district a forest genetic resource for pedunculate oak was designated and included in the national catalogue of forest genetic resources (Budeanu et al. 2016). This stand that has more than 7 hectares is very important in the region for collecting the acorns that should be used to reintroduce this species in its former natural distribution range. Nowadays, across the county, there are still some old pedunculate oak individuals, such the one from Dioști, which is estimated to be 400-500 years old (Bolea and Vasile, 2011).

During the last two centuries, several experiments aimed at introducing other tree species in the region were conducted. In general, their aim was to stabilize the flying sands or to obtain productive cultures or even for ornamental purposes or in small scale forest plantations. As regards the latter case, an example is the introduction of the black walnut (*Juglans nigra* L.) in the

southern-western part of the county, near Segarcea (Nicolescu 1998).

Among the introduced allochthonous tree species, the black locust is by far the most representative one. The first plantations were established in Dolj County almost 200 years ago (Enescu and Dănescu 2013) and in some regions, such as Ciurumela-Tunari Forest, one may still find nowadays some of the first stands established to stabilize the flying sands (Geacu et al. 2018). Black locust was and continue to be one of the best choice to reclaim the sandy soils, being well known that Dolj County is one of the counties that are affected by drought (Lupu et al. 2010; Marinică and Marinică, 2014), the decreasing of the rainfall amount and the increasing of the temperatures being the main factors causing the desertification (Popa 2018). Unfortunately, in the last three decades the uncontrolled logging caused the reduction of the black locust-dominated shelterbelts and compact cultures and the expansion of the sandy soils (Iordache and Ciuiel, 2013; Dumitrașcu et al. 2014; Prăvălie et al. 2014; Vijulie et al. 2017), being estimated that the forest area decreased with almost three thousand hectares (Prăvălie 2013).

The aim of this study was to highlight the most important non-wood forest products from Dolj County.

## MATERIAL AND METHODS

In order to determine the most important NWFPs for Dolj County, an Analytic Hierarchy Process (AHP) was performed. AHP represents a multi-criteria decision analysis developed by Thomas Saaty four decades ago (Saaty 2008).

AHP is one of the most used decision support model worldwide to solve complex decision-making problems in several domains, including biological sciences (Aras et al. 2004; Wang et al. 2004; Park et al. 2013). Analytic Hierarchy Process uses pairwise comparisons of

selected criteria aimed at assessing how much more important one is than the others (Huang et al. 2011). Thus, the complex problem (*i.e.* the purpose of this research) is hierarchically structured, the goal being at the top of the hierarchy, while the criteria (and sub-criteria, if any) at the levels of the hierarchy and the alternatives (*i.e.* the eight selected non-wood forest products) at the bottom of the hierarchy (San Cristóbal 2011).

The analysis model (*i.e.* 19 criteria, 8 alternatives – the selected non-wood forest

products and 4 categories of NWFPs; Figure 2) used was the one developed within COST Action FP1203: *European Non-Wood Forest Products (NWFPs) Network*, being recently used for similar

studies in the case of Maramureș, Prahova, Timiș and Bihor counties (Enescu et al. 2017; Enescu et al. 2018a; Enescu et al. 2018b; Timiș-Gânsac et al. 2018).

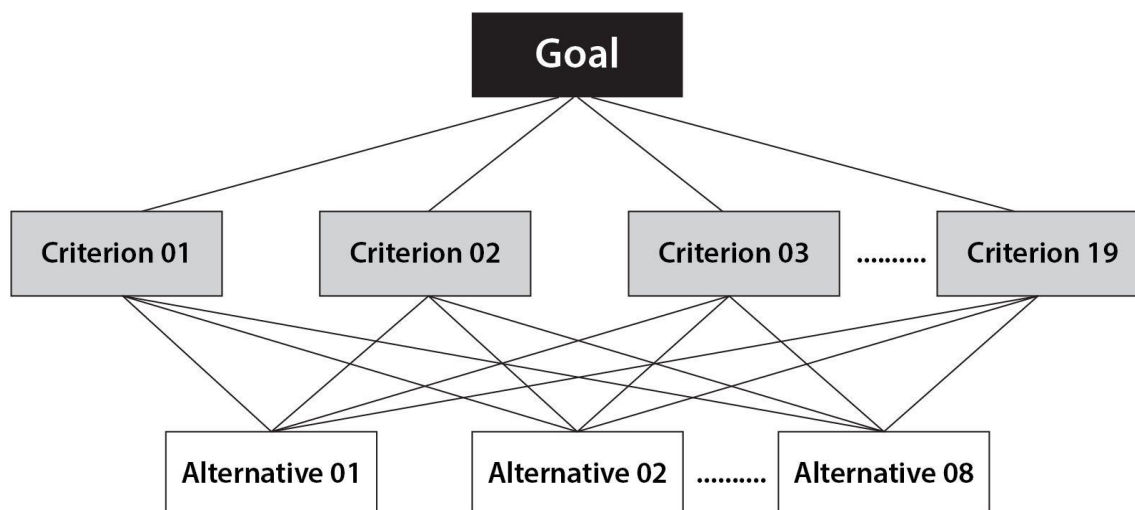


Figure 2. AHP model

The most important non-wood forest products from Dolj County were selected based on the data available in the forest management plans of the nine forests districts above-mentioned. For selecting the wildlife species of hunting interest, the data available on the website of Ministry of

Waters and Forests regarding the population size and the hunting quota was taken into account (MAP 2017). The processing of the data was done using Expert Choice Desktop software package (v. 11.5.1683).

## RESULTS AND DISCUSSION

The selected NWFPs were the following ones: the parasol mushroom [*Macrolepiota procera* (Scop.) Singer], the milk-caps (*Lactarius* spp.) for *Mushrooms* category, oak (*Quercus* spp.) seeds for *Tree products* category, black berry (*Rubus fruticosus* L.), common hawthorn (*Crataegus monogyna* Jacq.), Saint John's wort (*Hypericum perforatum* L.) for *Understory plants* category and European hare (*Lepus europaeus* Pallas.) and common quail (*Coturnix coturnix* L.) for *Animal origin* category, respectively.

The AHP alternative ranking for the 19 criteria taken into consideration is shown in Table 1.

Based on the AHP results, the most important non-wood forest products for Dolj County were the European hare and the common quail, while the less important ones were the common hawthorn and Saint John's wort (Figure 3). The latter two NWFPs ranked also on the last positions in a similar study conducted in the case of Timiș County (Enescu et al. 2018b). According to the results of this study, European hare has a long harvesting period, a large portfolio of derived products, a significant distribution range and a high market demand. In comparison with the other products, the biggest challenge regarding this species consists in its harvesting, that not in all the cases is easy to be done.

### AHP alternative ranking

**Table 1**

Criterion	Mushrooms		Tree products	Understory plants			Animal origin		
	<i>Macrolepiota procera</i>	<i>Lactarius</i> spp.	Oak seeds	black berry ( <i>Rubus fruticosus</i> )	hawthorn ( <i>Crataegus monogyna</i> )	Saint John' wort ( <i>Hypericum perforatum</i> )	hare ( <i>Lepus europaeus</i> )	quail ( <i>Coturnix coturnix</i> )	
	1	2	3	4	5	6	7	8	
1	Harvesting period	2	1	7	4	5	3	8	6
2	Portfolio of derived products	6	7	1	4	3	2	8	5
3	Harvested quantity / worker / 8 hours	4	5	8	6	3	7	2	1
4	Harvesting cost	5	4	2	6	3	1	8	7
5	Knowledge for recognition	7	8	1	2	5	3	4	6
6	Knowledge for harvesting	6	5	1	3	4	2	7	8
7	Tools needed for harvesting	5	4	2	3	6	1	7	8
8	Complexity of harvesting process	5	6	2	3	4	1	7	8
9	Distribution range	2	1	6	5	4	3	8	7
10	Market potential	6	5	1	8	2	4	7	3
11	The price of raw product	5	4	1	6	3	2	7	8
12	The price of the derived product	5	6	1	4	3	2	7	8
13	Transport (harvesting - storage center)	8	7	6	3	1	2	4	5
14	Perishability	8	7	1	6	3	2	5	4
15	“Celebrity” of the product on market	5	4	1	8	2	3	6	7
16	Market demand	6	5	1	7	2	4	8	3
17	Biotic threats	4	3	6	5	2	1	8	7
18	Abiotic threats	8	7	6	4	2	1	5	3
19	Development of harvesting process	5	6	2	3	4	1	7	8

As regards the oak seeds, even if in this study this non-wood forest product did not ranked in the top, we believe that its importance is expected to grow in the future mainly due to the fact the oaks record abundant fructification very rare (the

interval between significant fructifications can reach 5-6 or even 8 years) and the need to reintroduce these species in some (more or less) degraded terrains from the southern part of Romania or even to make plantations inside the forest fund. The

mushrooms taken into consideration within this study recorded similar results, the parasol mushroom being a little bit more

preferable than the milk-caps, mainly due to its distribution range and market potential.

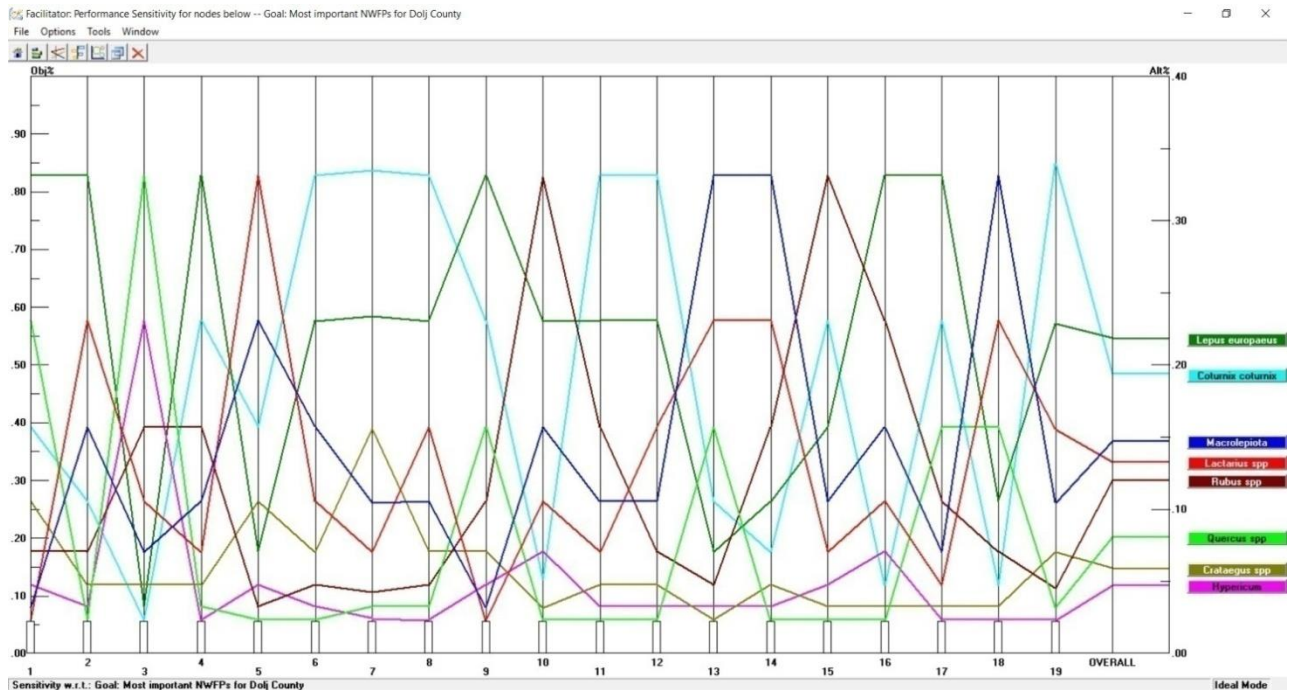


Figure 3. The ranking of the eight NWFPs

## CONCLUSIONS

The diversity and the potential of harvesting and marketing of non-wood forest products in Dolj County is not so high due to the fact that the forest area is not very well represented. Instead, if we take into consideration the protection functions against desertification of several forest stands, in the perspective of limiting/reducing the wood harvesting in the area, the harvesting and marketing of certain non-wood forest products could represent an important source of income, both for forest owners and the forest managers.

The results of this study represent an important contribution to the evaluation of the potential of the NWFPs, with a special view on their harvesting, marketing and other linked activities.

The combination between Analytic Hierarchy Process and Expert Choice Desktop proved to be a very easy-to-use tool to solve a complex decision problem. In order to obtain more representative results, future research studies should take into account additional criteria and to involve specialists and stakeholders from different fields.

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