

## AN PARTICULAR CASE OF IMPLEMENTING THE ANALYTIC HIERARCHY PROCESS IN THE CASE OF NON-WOOD FOREST PRODUCTS FROM TELEORMAN COUNTY, ROMANIA

### UN CAZ PARTICULAR DE IMPLEMENTARE A PROCESULUI IERARHICO-ANALITIC ÎN CAZUL PRODUSELOR NELEMNOASE DIN JUDEȚUL TELEORMAN, ROMÂNIA

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**Abstract.** *The harvesting importance and the introduction in economic circuit of non-wood forest products, especially forest fruits, mushrooms, game reside both under economic aspect, representing a proportion over 10% from the business number realized by many County Forest Administrations and mostly from the social point of view, through the capital amount in rural zones where the population incomes come almost exclusive from agricultural activities. The aim of this paper was to highlight the most important non-wood forest products from Teleorman County and to analyze the social and economic impact of those from Teleorman county, Romania. The NWFPs were grouped in four categories, namely Mushrooms (*Boletus edulis* and *Lactarius piperatus*), Tree products (Linden flowers, oak seeds), Understory plants (*Rubus idaeus*, *Mentha piperita*) and Animal origin (*Lepus europaeus*, *Squalius cephalus*). Within the research method it was used the analytic hierarchy process (AHP) which use an interface of multi-criteria system. Based on the processing data in the Expert Choice Desktop software, it was found that the most important non-wood forest products were forest fruits (raspberries), mushrooms (Penny bun) and those of animal origin (European hare). This kind of analysis it can be addressed to the managers who wants to perform the activities inside of the company such as making some statistics about the relative consumption of some products.*

**Key words:** non-wood forest products, alternatives, analytic hierarchy process, market demand

**Rezumat.** *Importanța recoltării și introducerea în circuitul economic a produselor nelemnoase, în special a fructelor de pădure, ciuperci, vânat rezidă atât sub aspectul economic, reprezentând o proporție de peste 10% din cifra de afaceri realizată de numeroasele Direcții Silvice și cel mai mult din punct de vedere social, prin creșterea capitalului în zonele rurale unde veniturile*

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populației vin aproape exclusiv din activitățile agricole. Scopul acestei lucrări a fost de a evidenția cele mai importante produse nelemnoase din județul Teleorman, România și analiza impactului socio-economic a acestora. Produsele nelemnoase au fost grupate în 4 categorii, numite Ciuperci (*Boletus edulis* și *Lactarius piperatus*), produse din arbori (flori de tei, semințe de stejar), plante din subetaj (*Rubus idaeus*, *Mentha piperita*) și de origine animală (*Lepus europaeus*, *Squalius cephalus*). În cadrul metodei de cercetare, a fost utilizat procesul ierarhico-analitic (AHP) care folosește interfața unui sistem multicriterial. Pe baza datelor prelucrate în programul software Expert Choice Desktop, s-a găsit că cele mai importante produse nelemnoase sunt fructele de pădure (zmeura), ciupercile (hribul) și cele de origine animală (iepurele comun). Acest model de analiză se adresează managerilor care doresc să-și perfecționeze activitățile în interiorul companiei, precum realizarea unor statistici despre consumul relativ al unor produse.

**Cuvinte cheie:** alternative, cererea pe piață, procesul ierarhico-analitic, produse nelemnoase

## INTRODUCTION

Non-wood forest products have numerous uses (Cântar and Dincă, 2020; Dincă and Timiș-Gânsac, 2020; Vechiu *et al.*, 2018).

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

National Forest Administration Romsilva has a heavy tradition in terms of the non-wood forest products valorification, in special medicinal and aromatic plants, mushrooms, forest fruits (rosehips, blackthorns, hawthorns), game and so on.

The importance of harvesting and introduction in economic circuit of these products reside both of economic aspect, representing a proportion over 10% from fiscal value by some County Forest Administrations (eg. Vaslui county, [www.romsilva.ro](http://www.romsilva.ro)), and especially from social point of view, through capital intake in rural zones where the population income, comes almost exclusively from agricultural activities, but also through the placing on the market of high quality natural products, which are not affected in any way by the effects of industrialization and pollution.

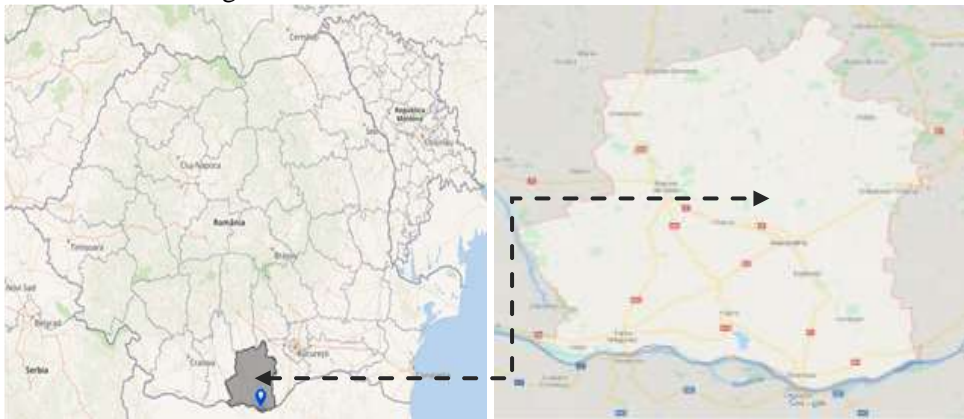
In Romania, due to the fact that the variability of the environmental conditions have an high level, the potential in harvesting these is products become overestimated (Enescu *et al.*, 2017).

Whereas the presence of some non-wood forest products depends of the forest presence and taking into consideration the fact that those distribution is not uniform in whole country, it exists counties/zones with an higher potential in harvesting and marketing of some products categories, such as edible mushrooms (Vasile *et al.*, 2017). In the zones with degraded lands, it is utilised at afforestation a heavy variety of shrubs species (sea buckthorn, common hawthorn, dog rose, blackthorn and so on) which capitalize efficiently these lands (Constandache *et al.*,

2016; Dincă *et al.*, 2018) and at the same time they are sought for their medicinal value, food and so on. Also of interest are leaves, flowers, buds, seeds, resin of some species of trees and shrubs (e.g linden, locust and elder flowers; leaves, bark and buds of silver birch). All of these, according to article 58 from Forest Code (updated Law 46/2008), are non-wood products specific to the National Forest Fund. Among the categories of non-wood forest products (NWFPs) of global interest are: berries, medicinal plants, edible mushrooms (Cântar *et al.*, 2018), honey, game, trout and so on.

The aim of the paper was to analyze the social and economic impact of non-wood forest products in Teleorman County-Romania and the actual contribution on the market and in human well-being.

County Forest Administration Teleorman administrates a total surface of 28.074 hectares of forests (from which 21.098 hectares state forests and 6.976 hectares private forests), from the total surface of 30.000 existent hectares within County Forest Administration. The area occupied by the forest represents less than 5% of the county's surface, being among the last counties from the country in terms of the area occupied with forest. Most of the county's forests are made up of deciduous species, in a percentage of over 95% (oaks, poplar, willow, locust, ash, maple and other deciduous species from the range of aid species and shrubs). Given the small area of forests, the expansion of forest vegetation outside the National Forest Fund (especially through afforestation of degraded lands), is one of the priority objectives, given the multiple ecological, economic and social effects of forest vegetation.



**Fig. 1** Location of Teleorman County (source: wikipedia.org, google maps)

## MATERIAL AND METHOD

As materials for this study it were used the projects, documents and reports which consists in activities elaborated by the Teleorman Directorate. The main activities which are sustained by the directorate consisting in: hunting, fishing, game species and another services which rely on the actual regeneration of forest (forestry seedlings, ornamental seedlings and so on). The NWFPs were grouped in four

categories, namely Mushrooms, Tree products, Understory plants and Animal origin (tab. 1) and based on the above-mentioned data the most promising NWFPs were selected. These four categories were designed in the European project COST Action FP1203 and were taken also into consideration in similar studies recently conducted in many counties of Romania: Arad (Plesca *et. al.*, 2019), Bacau (Blaga *et. al.*, 2019), Bihor (Timiș-Gânsac *et. al.*, 2018), Dâmbovița (Bragă and Dincă, 2019), Vrancea (Tudor and Dincă, 2019), Satu-Mare (Tudor *et. al.*, 2019). As methods, for describing the all alternatives of all of these products, it was used the AHP- analytical hierarchy process, which is based on 19-well established criteria: 1) harvesting period, 2) harvested quantity/ worker/8 hours, 3) harvesting cost, 4) knowledge for harvesting, 5) tools needed for harvesting, 6) complexity of the harvesting process, 7) development of the harvesting process, 8) knowledge for recognition, 9) distribution range, 10) biotic threats, 11) abiotic threats, 12) perishability, 13) market potential, 14) market demand, 15) “celebrity” of the product on market, 16) the price of the raw product, 17) the price of the derived product, 18) portfolio of derived products and 19) Transport. Every category was evaluated with absolute numbers situated in the interval (1...8). The arabic numbers define the level of importance intensity (e.g number 1 define an equal importance for the analyzed product) being designed and implemented by the expert Thomas Saaty, using a examination on relative consumption of drinks in USA by judgements from the part of 3 specialists (Saaty, 2008). Using this scale, once the alternatives for making decisions were set, the numbers will be distributed more or less to the criteria of the products which are more reliable in the process of attributing. This evidence will be important for all users, making an hierarchy with all NWFPs that are having alternatives which suits best for the decision making process. Furthermore, the ranking of the NWFP was analyzed by using Expert Choice Desktop (v. 11.5.1683) software package.

## RESULTS AND DISCUSSIONS

For each category were analyzed a series of the most important and requested non-wood forest products (NWFPs) from Teleorman County. In the mushrooms category it were selected 2 types of products: *Boletus edulis* (penny bun, grey penny bun) and *Lactarius piperatus* (peppery milk cap). In the Tree products category, it were analyzed two products: linden flowers and oak seeds. In the third category characterised by Understory plants have been included two species: *Rubus idaeus* (raspberry) and *Mentha piperita* (mint or peppermint). Also, there was some particularities related to the products of Animal origin, such as *Lepus europeus* (European hare) derived from the hunting activity and *Squalius cephalus* (chub) derived from the fishing activity. The relationship between the analyzed products and attributed criteria (tab. 1) and the potential alternatives established which were taken into consideration for the products analysis from Teleorman County. Based on the AHP process, it was observed that the demand and the maximum potential in the market zone are assured especially by forest fruits such as raspberry (*Rubus idaeus*), followed of those from the mushrooms category (*Boletus edulis*) and those of animal origin (*Lepus europeus*). Those three products present negative aspects, being exposed to biotic and abiotic threats, causing the quality depreciation of those (perishability). Beside the results

obtained and mentioned in the Table 1, it was calculated the ranking of the eight NWFPs (fig. 2) and the mean of alternatives for each species (fig. 3).

Table 1

## AHP alternative ranking

| Criterion                                | Mush-rooms            |                            | Tree products  |           | Under-story plants  |                        | Animal origin         |                          |
|--|-----------------------|----------------------------|----------------|-----------|---------------------|------------------------|-----------------------|--------------------------|
|  | <i>Boletus edulis</i> | <i>Lactarius piperatus</i> | Linden flowers | Oak seeds | <i>Rubus idaeus</i> | <i>Mentha piperita</i> | <i>Lepus europeus</i> | <i>Squalius cephalus</i> |
| 1.Harvesting period                      | 4                     | 3                          | 1              | 5         | 2                   | 8                      | 7                     | 6                        |
| 2.Harvested quantity/worker/8 hours      | 7                     | 3                          | 2              | 1         | 8                   | 5                      | 6                     | 4                        |
| 3.Harvesting cost                        | 6                     | 3                          | 7              | 5         | 4                   | 8                      | 2                     | 1                        |
| 4.Knowledge for harvesting               | 5                     | 3                          | 6              | 4         | 2                   | 1                      | 8                     | 7                        |
| 5.Tools needed for harvesting            | 8                     | 4                          | 3              | 7         | 1                   | 2                      | 6                     | 5                        |
| 6.Complexity of harvesting process       | 5                     | 6                          | 3              | 4         | 2                   | 1                      | 8                     | 7                        |
| 7.Development of harvesting process      | 5                     | 4                          | 6              | 3         | 2                   | 1                      | 8                     | 7                        |
| 8.Knowledge for recognition              | 3                     | 5                          | 7              | 2         | 4                   | 1                      | 8                     | 6                        |
| 9.Distribution range                     | 6                     | 3                          | 4              | 5         | 2                   | 8                      | 7                     | 1                        |
| 10.Biotic threats                        | 7                     | 2                          | 6              | 1         | 8                   | 4                      | 5                     | 3                        |
| 11.Abiotic threats                       | 7                     | 4                          | 1              | 5         | 6                   | 2                      | 8                     | 3                        |
| 12.Perishability                         | 6                     | 4                          | 2              | 3         | 7                   | 1                      | 8                     | 5                        |
| 13.Market potential                      | 7                     | 5                          | 2              | 4         | 8                   | 1                      | 6                     | 3                        |
| 14.Market demand                         | 6                     | 5                          | 3              | 1         | 8                   | 2                      | 7                     | 4                        |
| 15.“Celebrity” of the product on market  | 8                     | 3                          | 6              | 1         | 7                   | 5                      | 4                     | 2                        |
| 16.The price of raw product              | 8                     | 2                          | 6              | 1         | 7                   | 5                      | 4                     | 3                        |
| 17.The price of the derived products     | 5                     | 3                          | 2              | 4         | 7                   | 1                      | 8                     | 6                        |
| 18.Portfolio of derived products         | 8                     | 6                          | 3              | 4         | 5                   | 1                      | 7                     | 2                        |
| 19.Transport (harvesting-storage center) | 4                     | 3                          | 5              | 2         | 6                   | 1                      | 8                     | 7                        |

The higher mean (6.58) was obtained in the case of the *Lepus europeus* (European hare) (fig. 3), having a consistent number of alternatives (8) because of the very strong importance intensity abundance in most of the criteria. From the total of 19 well-established criteria, within 7 criteria this species was evaluated at the high potential, European hare being an valuable game species with a high

distribution range in Teleorman county, being met in opened plaine zone, with izolated bushes which confere an favorable shelter. The process of capitalizing and identifying the variety of the European hare species requires a good knowledge during harvesting process which have complexity and special ways for achieving the development of the process. Also, it is necessary to have a based knowledge for recognition of the species, to see their natural behavior, the competition between one or more species varieties and to share the populations by their economic contribution. The price of the derived products is expensive, being a species with an diversified portfolio in the terms of derived products such as skin, meat and so on.

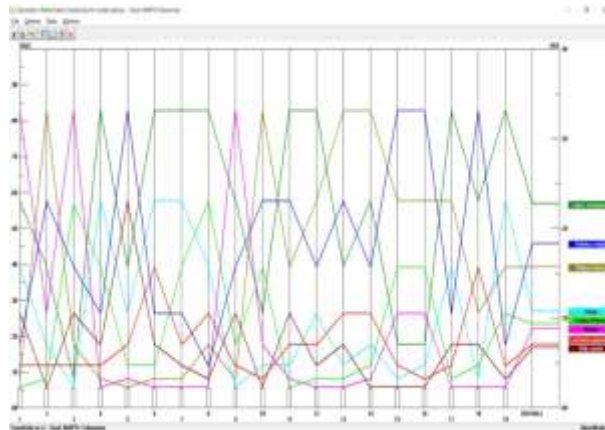


Fig. 2 The ranking of the eight NWFPs (diagram of sensivity)

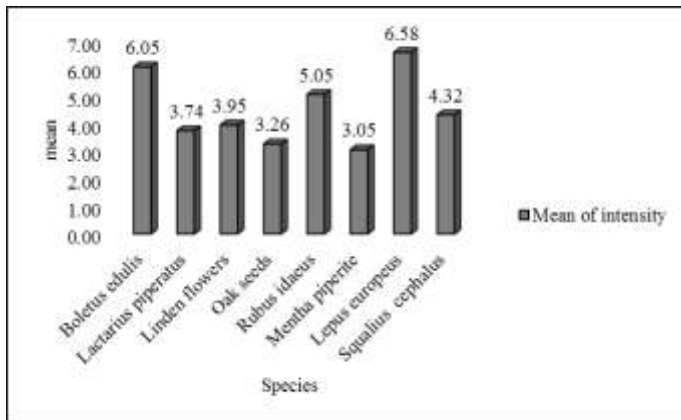


Fig. 3 The mean of importance intensity for the analyzed species

The second place is occupied by the *Boletus edulis* (penny bun) from the mushrooms category, which reached the maximum number of alternatives which covers a consistent number of criteria (mean = 6.05). Penny bun is very appreciated in 4 criterion types, where it was obtained a very strong importance intensity (8) such as: tools needed for harvesting, “celebrity” of

the product on market, the price of the raw product and portfolio of derived products (fig. 4). Furthermore, there are a lot of derived products which can be used in many domains. Penny bun is a product with an high importance in gastronomy, having an positive impact in ecotourism field. Also, the activity of harvesting mushrooms is considered to be recreative for many tourists and is practiced in different regions from Romania, especially in Bucovina, where managers made a lot of efforts to promote these activities regarding on recreation (Cîrnu and Nichiforel, 2014)

Another product from the Understory plants class is *Rubus idaeus* (raspberry) which scores the mean of 5.05, taking the third place. Raspberry fruits have registered an very strong intensity of the importance, within the criterion 2 (harvested quantity/worker/8 hours), criterion 13 (market potential) and criterion 14 (market demand). In the case of the last two categories of products (penny bun and raspberry) is essential to keep the products in safety, in special buildings, to monitor permanently the products with sensible character to avoid the possibility of installing the negative factors. The lower mean (3.05) was registered in the case of menta (*Mentha piperita*) and Oak seeds (mean 3.26). However, *Mentha piperita* recorded the maximum number of alternatives within harvesting operations, including harvesting period and cost. According to this, it must be respected the optimum period of harvesting for evaluating the maximum economic potential of the product. Also, this plant have an very large range. The oak seeds requires an high harvesting costs and a good recognition of these, because of the multitude of varieties of sessile oak species encountered in Romania.

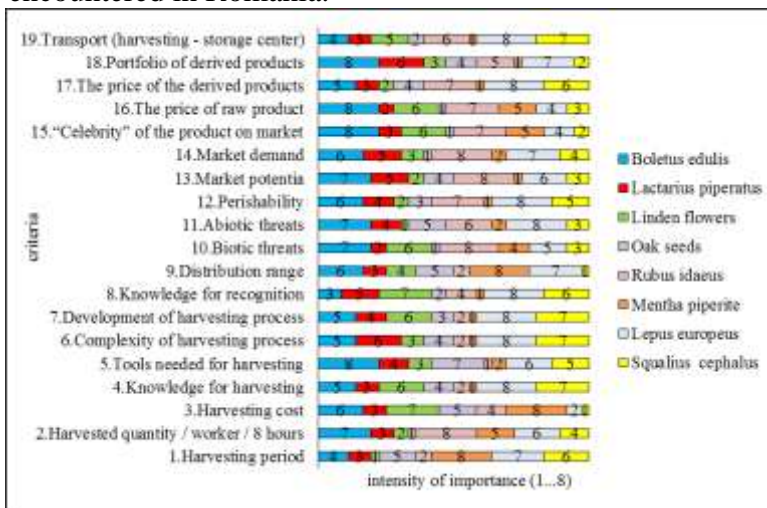


Fig. 4 The alternatives of every species distributed to each criteria

*Lepus europeus* (european hare) is a mammal from the *Leporidae* family. The european hare is one of the most important game species and it is estimated that only in Europe are hunted annually more than five million exemplars. This species inhabits open and semi-open lands with isolated thickets for shelter in the temperate zone of Europe and parts of Asia. They are very adaptable and thrive on mixed agricultural lands at altitudes of 100 - 250 m. They need shelter, such as forest strips, ditches and permanent shelter areas, because these habitats offer them a varied diet and presents a lower density in the large open fields. Intensive field processing leads to high mortality among young hares (Panek and Kamieniarz, 1999).

*Boletus edulis*, is an edible mushroom, from the *Basidiomycota* division, in the *Boletaceae* family, *Boletus* genus, in romanian language being popularly called "hrib" or "mânățarcă", meaning penny bun (grey penny bun) or "king bolete". He cohabits, being a mycorrhizal symbiont (it forms mycorrhizae on the roots of trees). The boletaceous family is widespread on all continents (except Antarctica). The headpiece (the mushroom hat) has a diameter of 8-20 (30) cm, is quite fleshy and consistent, at the beginning hemispherical with the edge turned down to the foot. The cuticle is dry, but sticky in wet weather, smooth at first, almost wrinkled at maturity, not velvety. The color varies from pale brown to dark brown. The robust foot, from a young age, is often thickened or barrel-like appearance; it has height of 5-15 (25) cm and thickness of 2-6 cm. It appears in August-October and grows solitary or in small groups of 2 or 3 exemplars, both in deciduous and coniferous stands. As the scientific name suggests, *Boletus edulis* is edible, and is considered a high-quality mushroom in flavor and texture. The flesh is white, strong, with a slight taste of hazelnuts and meat, with a pleasant smell and a fine, creamy texture. It is an important source of protein and minerals, fatty acids, amino acids and so on. *Rubus idaeus* (raspberry-bush) from the understory plants category, is a shrub, perennial shrub, with creeping shoots, with straight stems, arched towards the top, with straight spines, with the shape of needles, often placed only on the underside. Raspberry belong to the *Rosaceae* family. The fruits are called raspberries and are red, juicy, aromatic, sweet-sour polydrups. It grows spontaneously in rocky places, forest clearings, hilly and mountainous regions. It can be found on the entire territory of Romania, being a plant specific to areas with temperate climate. Although it grows spontaneously, raspberry have attracted the attention of farmers who have set up crops to for the fruits and leaves capitalization. Raspberries are cultivated for two reasons: for consumption of fresh fruits and for industrial processing.

Raspberries have an astringent, antidiarrheal effect, decreases gastric acidity, disinfectant, stomach tonic, aperitif, diuretic, depurative, laxative, refreshing. Xylitol is extracted from raspberries, which is an artificial sweetener used mainly in the treatment and prevention of dental caries.



## CONCLUSIONS

1. Non-wood forest products have a good economic and social contribution in Teleorman county. The total surface covered by forest can be well managed in order to obtain good results in promoting and valorifying the NWFPs, not only the wood.

2. Using the AHP based on alternatives (1...8) attributed to 19-well established criteria, it was shown that the best results are achieved by forest fruits such as raspberry (*Rubus idaeus*), followed of those from the mushrooms category (*Boletus edulis*) and those of animal origin (*Lepus europeus*). Those three products present negative aspects, being exposed to biotic and abiotic threats, causing the quality depreciation of those (perishability).

3. Beside the results obtained, it was calculated the ranking of the eight NWFPs and the mean of alternatives for each species. The higher mean (6.58) was obtained in the case of the *Lepus europeus* (European hare), having a consistent number of alternatives (8) because of the very strong importance intensity abundance in most of the criteria. The second place is occupied by the *Boletus edulis* (penny bun) from the mushrooms category. Another product from the Understory plants class is *Rubus idaeus* (raspberry) which scores the mean of 5.05, taking the third place. Knowing the potential of Teleorman county which is rich in NWFPs it is essential to implement a sustainable management for all of these resources.

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