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WHAT IS THE POTENTIAL OF TULCEA COUNTY AS REGARDS THE NON-WOOD FOREST PRODUCTS?

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Abstract
Tulcea County has the largest diversity of relief forms, the greatest degree of biodiversity and the highest number of the protected areas from Romania. The purpose of the research was to determine the most important non-wood forest products (NWFPs) for Tulcea County. By taking into account the forest management plans of the eight forest districts managed by Tulcea Forestry Directorate and other relevant data, a selection of the most ten important NWFPs was done. Four categories of NWFPs proposed within the FP1203 COST Action European non-wood forest products network were taken into account and twenty five criteria were used. The Analytic Hierarchy Process (AHP) was used to assess the performance of selected alternatives (the ten selected NWFPs) by means of pairwise comparisons. The analyses were carried out using the Expert Choice Desktop software package. The most important NWFPs in Tulcea County were the acorns of greyish oak, followed by the honey and nettle, while the less promising products were represented by the penny bun and honey fungus.

Keywords: AHP, honey, Non-wood forests products (NWFPs), Tulcea County.

1. INTRODUCTION

Recent findings showed that non-wood forest products (NWFPs) played an important role in the Neanderthal Era: no meat traces were detected in the diet of Neanderthals from El Sidrón cave, Spain, but instead signs of dietary components of mushrooms, pine nuts, and moss were found (Weyrich et al., 2017). Forests and forest products are fundamental to the health and well-being of the vast majority of the world's human population. They are playing a critical role for the local communities leaving in and around forests that represent sources of food, medicines, fuel, construction materials, ornamentation and others. Some of these products can be directly harvested and used by simple techniques. Others are not well represented and they require the most advanced technology to produce certain products in high quantities. A much broader view of the management of the NWFPs is needed so that the immediate needs of rural and native people will be fulfill.

In Romania, according to the Article 58, paragraph (3) of the Forest Code (Law 46/2008), non-wood forest products (NWFPs) include fauna of hunting interest, fish from mountain waters, forest fruits, forest seeds, truffles and edible mushrooms, medicinal and aromatic plants, resin, a.s.o. As regards the first category (*i.e.* game species), the harvesting and marketing of these products have a contribution to the turnover of the Romanian forest districts less than 1% (Enescu and Hălălişan,

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2017).

At the end of 2016, a proposal of a ministerial order aimed to provide instructions regarding the harvesting of the NWFPs from the national forest fund was published on the website of the Ministry of Environment, Waters and Forests (MEWF, 2016a). The proposal contained a list of 120 mushroom species and 171 herbaceous, shrub and tree species that were considered as a high interest. Moreover, as regards the category of fauna of hunting interests, in Romania the hunting is permitted to 39 species of birds and 18 species of mammals. The list of these species is provided by the Law no. 407/2006.

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

2. MATERIALS AND METHODS

Tulcea County is situated in the south-eastern part of Romania and in the northern part of the region Dobrogea, where the Danube river meets the Black Sea (Figure 1). The landscape of the Tulcea County is characterized by two distinct geographical units: an elevated one in the central-western part where the oldest landscape from Romania is found, formed out of Hercynian orogeny units, and a newer, lower one, dating from the Quaternary period in the north, north east and east. The climate is temperate with a broad continental character described by hot summers, cold winters, with frequent snowstorms, high temperature variations and low amount of rainfall.

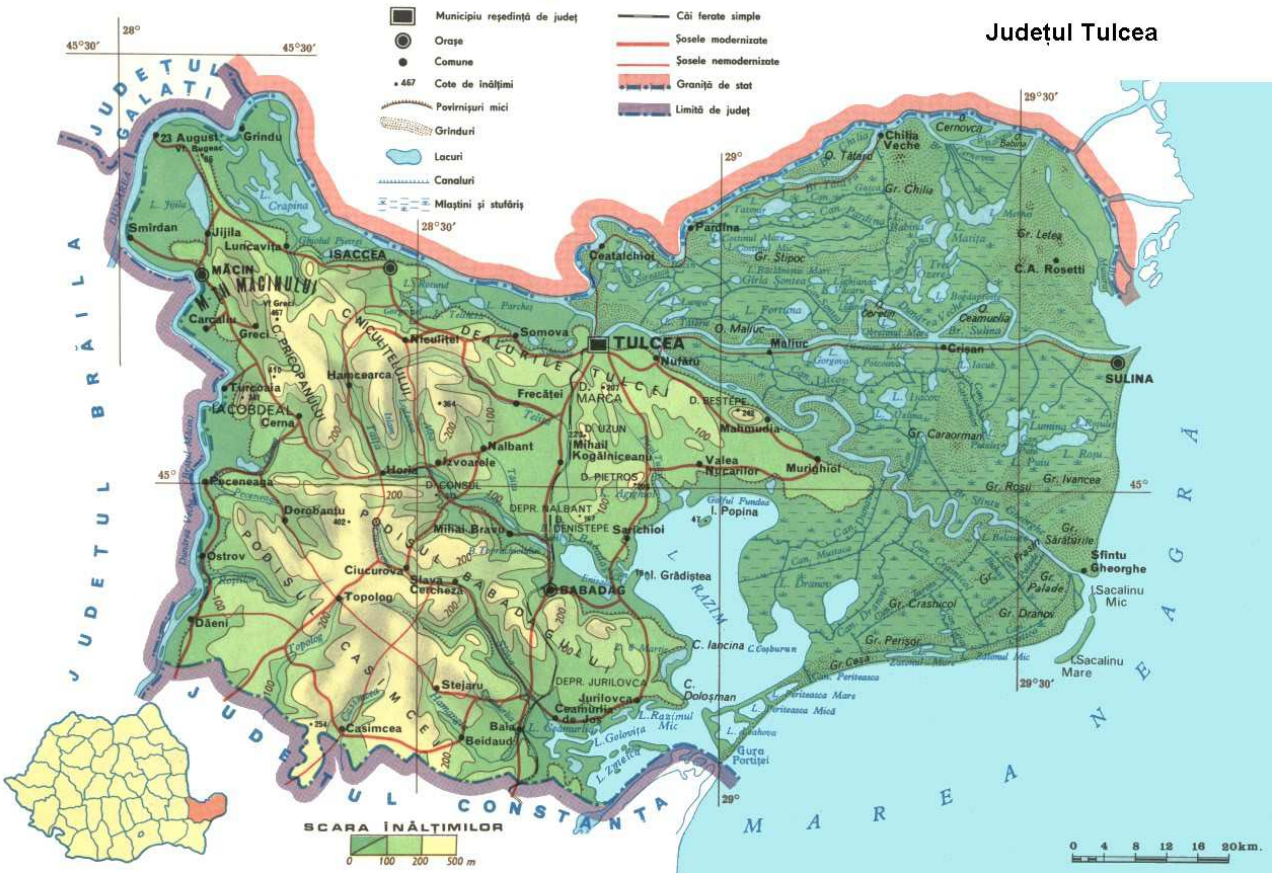

Figure 1. Location of Tulcea County (Source: http://pe-harta.ro/judete/Tulcea.jpg)

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The forest fund owned by the state and managed by Tulcea Forestry Directorate accounts for 105.000 hectares, that is about 12.2% of the total area of the county (NIS, 2017). According to the official statistics published in 2016 by the Ministry of Environment, Waters and Forests (MEWF, 2016b), Tulcea County holds the 11th position in the top with counties with forest deficit. The common species found in the hilly forest region are represented by: sessile oak [*Quercus petraea* (Matt.) Liebl.], greyish oak (*Q. pedunculiflora* K. Koch), pubescent oak (*Q. pubescens* Willd.), pedunculate oak (*Q. robur* L.) silver linden (*Tilia tomentosa* Moench.), small-leaved linden (*T. cordata* Mill.), large-leaved linden (*T. platyphyllos* Scop.), common ash (*Fraxinus excelsior* L.), manna ash (*F. ornus* L.), hornbeam (*Carpinus betulus* L.), oriental hornbeam (*C. orientalis* Mill.), Norway maple (*Acer platanoides* L.), field maple (*A. campestre* L.) and black locust (*Robinia pseudoacacia* L.). In the Danube Delta and the meadow area the most common species consist in black poplar (*Populus nigra* L.), white poplar (*P. alba* L.), white willow (*Salix alba* L.), *Fraxinus pallisae* (Wilmott.) and American ash (*F. americana* L.).

In order to structure and highlight the most important NWFPs for Tulcea County, four categories of NWFPs were used (*i.e. Mushrooms*, *Understory plants*, *Tree products* and *Animal origin*). The categories were selected according to the model recently used in the European project COST FP1203 *European Non-Wood Forest Products (NWFPS) Network*.

The list of the most ten common NWFPs in Tulcea County was done by taking into consideration the data from the latest versions of the forest management plans of the eight forest districts managed by Tulcea Forestry Directorate, namely Babadag, Cerna, Ciucurova, Măcin, Niculițel, Rusca, Stejaru and Tulcea.

In order to make a top of the most important NWFPs, an Analytic Hierarchy Process (AHP), promoted by Thomas Saaty in the late 1970's was carried out. AHP is a multi-criteria decision analysis that is based on a theory of measurements through pairwise comparisons (Saaty, 2008). Within AHP, the decision problem (*i.e.* the aim of the research) is decomposed into a hierarchy sub-problem (*i.e.* the selected criteria) which can be independently analyzed. The AHP method was implemented in computer software called Expert Choice Desktop (version 11.5.1683). In order to build the hierarchy, the following 25 criteria were used, namely: Criterion 1: *Harvesting period* (1: the shortest harvesting period … 10: the longest harvesting period); Criterion 2: *Portfolio of derived products* (1: the smallest number of derived products … 10: the highest number of derived products); Criterion 3: *Harvested quantity by one worker in 8 hours* (1: the lowest quantity … 10: the highest quantity); Criterion 4: *Harvesting cost* (1: the lowest cost … 10: the highest cost); Criterion 5: *Knowledge for recognition* (1: the most recognizable product … 10: the hardest recognizable product); Criterion 6: *Knowledge for harvesting* (1: the less knowledge necessary … 10: most knowledge necessary); Criterion 7: *Tools needed for harvesting* (1: lesser… 10: the most); Criterion 8: *Complexity of harvesting process* (1: the lowest … 10: the highest); Criterion 9: *Distribution range* (1: the lowest … 10: the highest); Criterion 10: *Market potential* (1: the lowest … 10: the highest); Criterion 11: *The price of raw product* (1: the lowest … 10: the highest); Criterion 12: *The price of the derived product* (1: the lowest … 10: the highest); Criterion 13: *Transport from the harvesting point to the storage center* (1: the most easy … 10: the most complicated); Criterion 14: *Perishability* (1: the lowest … 10: the highest); Criterion 15: *"Popularity" of the product on the market* (1: the least known … 10: the most popular); Criterion 16: *Market demand* (1: the lowest … 10: the highest); Criterion 17: *Biotic threats* (1: the fewest threats … 10: the most threats); Criterion 18: *Abiotic threats* (1: the fewest threats … 10: the most threats); Criterion 19: *Development of the process of harvesting* (1: undeveloped … 10: extremely developed); Criterion 20: *Post processing waste* (1: the lowest … 10: the highest); Criterion 21:

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Packaging costs (1: the lowest … 10: the highest); Criterion 22: *Depositing costs* (1: the lowest … 10: the highest); Criterion 23: *Ripeness's stage* (1: the lowest … 10: the highest); Criterion 24: *The quantity of allergens contained by the raw product* (1: the lowest … 10: the highest); Criterion 25: *The quantity produced by a mature individual* (1: the lowest … 10: the highest).
The following scenarios were considered: **Scenario 1**: all criteria received an equal weight (4%); **Scenario 2**: *„The most profitable culture"*, criteria *harvesting cost, tools needed for harvesting, the price of raw product* (12.2%), criteria *transport from the harvesting point to the storage center* and *market demand* (9.6%), criterion *harvested quantity by a worker in 8 hours* (6.9%), criterion *complexity of harvesting process* (6.3%), all other criteria had an equal weight (0.9%); **Scenario 3**: *„The most advantageous crop to develop"*, criteria *harvested quantity by a worker in 8 hours, harvesting cost, the price of raw product* (11%), criteria *harvesting period* and *distribution range* (8.2%), criteria *tools needed for harvesting, perishability, the quantity produced by a mature individual* (6%), criteria *market demand* and *biotic threats* (4.5%), criteria *complexity of harvesting process* and *development of the process of harvesting* (3.6%), criteria *market potential* and *transport from the harvesting point to the storage center* (3%), all other criteria received an equal weight (0.6%).
In addition, a survey, based on a questionnaire, was conducted between 25-10-2017 and 15-11-2017 in the center of Tulcea city, Greci and Niculițel localities. The respondents were randomly selected on the street. The questionnaire was composed by two different set of questions, the first was aimed at gathering information about the respondent: Sex (M / F), Age, Profession, Level of studies (Medium / Superior), Origin (Urban / Rural), and the second set of questions were focused on different aspects regarding the NWFPs, namely: Question 1: *Which of the following categories of NWFPs are the most common in you region?* (a. Forest fruits, b. Mushrooms, c. Medicinal plants, d. Honey, e. Game, f. Other); Question 2: *When do you use NWFPs, you do it with the following purpose?*: (a. Culinary, b. Therapeutic, c. Mostly culinary but also therapeutic use, d. Mostly therapeutic but also culinary, e. I don't use NWFPs in any purpose, f. Other purpose); Question 3: *What do you use most frequently?* (a. Honey, b. Forest fruits, c. Mushrooms that grow spontaneously, d. Medicinal plants, e. Other NWFPs, f. I don't use in any purpose NWPFs); Question 4: *Usually do you consume NWFPs?* (a. Fresh, b. Processed, c. Both but usually fresh, d. Both but usually processed); Question 5: *How often your family consume products, fresh or derived from NWFPs?* (a. Daily, b. 3-4 time a week, c. Once a week, d. Once a month, e. Several times a year); Question 6: *Which one of the NWFP is that you appreciate the most? Please provide a justification;* Question 7: Do *you usually buy NWFPs from?* (a. Hypermarket, b. Local market, c. Health store, d. Individuals, e. I obtain them myself); Question 8: *When do you buy a NWFP, you give attention / importance to information regarding:* (a. Producer/distributor, b. Content, c. Label/Packing, d. The manner it was produced/processed); Question 9: *If you have to choose, would you buy a product:* (a. Originating from Tulcea County, b. Originating from other regions of Romania, c. Imported); Question 10: *Do you think that harvesting NWFPs in Tulcea County is efficiently done?* (a. Yes, b. No); Question 11: *What is the amount of money that you have spent in the last year on NWFPs?* (a. Over 1000lei, b. Between 500 and 1000lei, c. Between 100 and 500lei, d. Under 100lei, e. I haven't bought); Question 12: *In terms of prices, do you think that the NWFPs in the Tulcea county are:* (a. Very expensive, b. Expensive, c. Moderate, d. Low); Question 13: *You consider that the diversity of the NWFPs in Tulcea County is:* (a. Very high, b. High, c. Low, d. Very low); Question 14: *This autumn are you planning to buy or you have bought already any of following products?* (a. Forest fruits, b. Honey, c. Medicinal plants, d. Mushrooms that grow

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spontaneously, e. It's not the case, f. Other products); Question 15: *Which of the next derived products is you favorite one?* (a. Honey, b. Jam, c. Marmalade, d. Syrup, e. None).

3. RESULTS AND DISCUSSIONS

The 10 selected NWFPs, according to the data from the forest management plans, consisted in**:** penny bun (*Boletus edulis* L.) and honey fungus [*Armillaria mellea* (Vahl) Kumm.] for the *Mushrooms* category; greyish oak acorns (*Quercus pedunculiflora* K. Koch) for the *Tree products* category; sea-buckthorn (*Hippophae rhamnoides* L.), rose-hip (*Rosa canina* L.), common nettle (*Urtica dioica* L.) and mint (*Mentha sp.*) for the *Understory plants* category; linden honey (*Tilia sp.*), black locust honey (*Robinia pseudoacacia* L.) and goose (*Anser* sp.) for the *Animal origin* category. The ranking alternatives for AHP are presented in table 1.

Table 1. AHP alternative ranking

Criterion	Mushrooms		Tree products	Understory plants				Animal origin		
	Penny bun	Honey fungus	Greyish oak acorns	Sea-buckthorn	Rose-hip	Common nettle	Mint	Linden honey	Black locust honey	Goose
1	8	6	4	1	4	8	6	1	2	10
2	7	4	1	10	6	10	8	4	2	3
3	3	4	9	8	6	7	10	1	1	5
4	5	5	2	4	8	1	7	10	10	3
5	10	9	7	4	3	2	1	5	6	8
6	7	6	5	4	3	2	1	9	8	10
7	10	10	1	5	3	3	6	10	10	2
8	3	3	1	10	9	5	2	6	6	8
9	1	2	3	4	9	9	5	10	7	6
10	3	4	1	7	6	5	8	10	10	2
11	8	3	10	5	3	1	2	7	9	5
12	1	3	10	8	6	4	7	2	5	9
13	7	7	1	10	9	6	5	3	3	2
14	9	5	3	10	4	5	5	1	1	8
15	1	2	3	7	8	5	6	10	10	4
16	4	3	1	8	6	5	7	10	10	2
17	7	4	3	10	9	5	6	1	1	8
18	6	6	3	9	8	4	5	1	1	10
19	1	1	1	8	6	1	7	10	10	1
20	4	4	8	10	9	6	1	1	1	7
21	9	9	10	1	5	5	5	9	9	1
22	1	1	1	10	1	1	1	1	1	10
23	1	2	10	7	6	4	4	9	8	5
24	1	8	1	1	9	10	1	1	1	1
25	4	3	10	6	5	1	1	8	9	7

Results in scenario 1

The most important NWFPs for Tulcea County were the greyish oak acorns, which had a share of 14.7%, followed by the linden honey with 14.3% and black locust honey by 13.9% (Figure 2).

Results in scenario 2

By raising the weight of the criteria *harvesting cost, tools needed for harvesting, the price of raw product* to 12.2%, criteria *transport from the harvesting point to the storage center* and *market demand* to 9.6%, criterion *harvested quantity by a worker in 8 hours* to 6.9%, criterion *complexity*

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of harvesting process to 6.3%, it resulted a percentage of 18.6% for the greyish oak acorns, followed by black locust honey with 14% and linden honey with 13.9%.

Results in scenario 3

By raising the weight of the criteria *harvested quantity by a worker in 8 hours*, *harvesting cost*, *the price of raw product* to 11%, criteria *harvesting period* and *distribution range* to 8.2%, *criteria tools needed for harvesting*, *perishability*, *the quantity produced by a mature individual* to 6%, criteria *market demand* and *biotic threats* to 4.5%, criteria *complexity of the harvesting process* and *development of the process of harvesting* to 3.6%, criteria *market potential* and *transport from the harvesting point to the storage center* to 3%, it resulted a percent of 16,8% for the greyish oak acorns, followed by black locust honey and linden honey both with 13.8% and common nettle with 11.1%.

Figure 2. Ranking on the ten NWFPs in scenario 1

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The survey was conducted on a total number of 71 respondents. As regards the gender distribution, 56.3% were men and 43.7% were women. The age of the respondents varied from 16 to 64 years old, most of them being between 26 and 33 years old. 50.7% of the respondents have a university degree and 49.3% graduated medium studies. Most of the respondents live in urban area (87.3%) and only 12.7% in the rural area.

Based on the centralized answers, we can say that:

- the most common categories of NWFPs in the region are represented by honey (40%) and medicinal plants (26.7%);
- most of the respondents (47.9%) are using the NWFPs for culinary and therapeutic purposes;
- the most frequent used NWFPs were honey (50%) and medicinal plants (27.4%);
- the NWFPs are ussualy consumed fresh;
- the families of the respondents are consuming NWFPs once a week (36.6%) or 3-4 times a week (28.5%);
- the most appreciated NWFP was the honey due to its therapeutic properties;
- the people are ussualy buying NWFPs from the market (33%) and from individuals (29%);
- then they are buying NWFPs, the respondents are paying attention to the content of the product (34.7%) and to the way it was produced;
- almost two-thirds of the respondents prefer to buy products originating from Tulcea County;
- half of the respondents consider that the harvesting of the NWFPs in Tulcea County is not efficiently done;
- most of the people (42.9%) are spending yearly between 100 and 500 lei to buy NWFPs;
- the majority of the respondents (84.3%) are considering the prices of NWFPs to be moderate;
- the general opinion of the interviewed people was that the diversity of the NWFPs in Tulcea County is low;
- last time, the respondents bought honey (37.2%) and medicinal plants (28.9%).
- half of the interviewed people declared that their favorite product is the honey.

4. CONCLUSIONS

Conclusions based on the data collected from forest management plans and other papers

After analyzing the forest management plans, we concluded that there is a lack of interest for these products and there is a poor commercialization.

The national statistics showed a clear decrease of the production and profit obtained from the NWFPs.

The sale of NWFPs is usually made as unprocessed material, for export.

The annual production is influenced by extremely variable climatic conditions each year due the climate changes.

Conclusions resulting from the AHP analysis

In all three scenarios, the greyish oak acorns obtained the highest scores. This non-wood forest product is characterized by the following characteristics: a very high price of the raw product, a very low harvesting cost, a low perishability, a high quantity to be harvested by a worker in 8h, a large quantity produced by a mature individual as well as a simple harvesting process.

The linden honey was ranked in scenario 1 and scenario 3 on the second place, and in scenario 2 on the third place. This product outstands by wide-spreading across the county, a high market potential, a very low perishability, a wide portfolio of derived products, a high market demand, being a popular product.

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The black locust honey was ranked in scenarios 2 and 3 on the second place, and in scenarios 1 on the third place. This product was characterized by a high market potential, a high market demand, a low perishability, a product that met the advantages of technological innovation.
The common nettle was ranked in scenario 3 in the third place, but also in the rest of the scenarios it has gained a high percentage, recommending it as a product with a possible value in the future.
The mushrooms were ranked last in all three scenarios, because they are products of low interest in Tulcea County, in terms of the quantities that can be harvested and valorized.

Conclusions from the questionnaire

The survey was carried out on a total number of 71 respondents, most of them being male (56.3%), aged between 16 and 64 (but most of them being 26-33 years old), with a majority of higher degree holders (50.7%), most of them living in urban areas (87.3%).
The results showed that honey is the most widespread (40%), the most used (50%), the most appreciated, the most bought (37.2%) and the most preferred product (49%). On the second place were situated the medicinal plants, on the third the forest fruits and on the last place the mushrooms from the spontaneous flora.
Participants in the study said that they use NWFPs mostly for culinary purposes, but also for their therapeutic properties, consuming products that are usually raw but also processed, with a weekly prevalence.
They prefer to purchase NWFPs from the local markets (33.6%) and individuals (29%), choosing to buy products from Tulcea County (62%), giving importance to the content (34.7%) and the way it was produced/processed (33.7%), considering that the price was moderate (84.3%), in the last year allocating between 100 and 500 lei (42.9%) for the products originating from the forests. Questioning the respondents about the efficiency of harvesting NWFPs in Tulcea County showed a prevalence of the affirmative response. The result shows that the efficiency of harvesting NWFPs is roughly equally appreciated (yes - 50.7%, no - 49.3%). The majority considered that the variety of NWFPs in Tulcea County is low (54.6%).
Based on the results of this study, we considered that the development of the market of the NWFPs should be done in rational socio-economic conditions by increasing the awareness among the forestry specialists and the general public regarding their potential.

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6. REFERENCES

Enescu, C.M., Hălălişan, A.F. (2017). The economic contribution of hunting products to the turnover of the forestry units in Romania. *Agriculture & Forestry*, 63(3), 147-153.

Ministry of Environment, Waters and Forests (MEWF) (2016a). Project of Ministerial Order for approving the Instruction regarding the harvesting and acquisition of non-wood forest products specific to national forestry fund. Retrieved March 10, 2018, from: http://mmediu.ro/app/webroot/uploads/files/2016-12-27_OM_produse_forestiere_nelemnoase.pdf.

Ministry of Environment, Waters and Forests (MEWF) (2016b). Report on the state of Romania's forests 2015. Retrieved March 10, 2018, from http://mmediu.ro/categorie/starea-padurilor/209.

National Institute of Statistics (NIS) (2017). The area of forest fund in Tulcea County in 2016. Retrieved March 10, 2018, from http://statistici.insse.ro/shop.

Saaty, T.L. (2008). Decision making with the analytic hierarchy process. *Int. J. Services Sciences*, 1(1), 83-98.

Weyrich, L.S., Duchene, S., Soubrier, J., et al. (2017). Neanderthal behaviour, diet, and disease inferred from ancient DNA in dental calculus. *Nature*, 544, 357-361.

*Corresponding author, E-mail address: mihaienescu21@gmail.com