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THE ROLE OF FORESTS IN THE SUSTAINABLE DEVELOPMENT OF ROMANIA

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ABSTRACT

The aim of our paper is to analyze the factors that play an important role in adopting a sustainable management strategy for the Romanian forests. The underlying methodology of our research is based on the review of mainstream literature and on the quantitative analysis of national and international statistical data in order to design a model of sustainable development. Research findings show that critical factors contributing to environmental degradation fall into three categories: human factors, national legislation and environmental factors. Our findings reveal that forest management in Romania display several peculiarities that have a negative impact on the degradation of the ecosystem, reduction of the renewable capacity of forests and lowering of the quality of life. In conclusion, drafting a sustainable development strategy is not effective if we do not take into consideration the factors that could turn into challenges and barriers in the implementation of the strategy.

INTRODUCTION

The development of agriculture represents one of the European Union's priorities, with 56% of the population of the European Union living in rural areas, these areas accounting for more than 91% of the EU territory (EUROSTAT, 2011, p. 6). Romania is one Member State that has large areas of forests. Sustainable development strategies should therefore be based on building a healthy environment by finding an optimal balance between sustainable forest management and efficient water management. Forests are important resources for creating sustainable development by contributing to reduce pollution (glasshouse emissions) and to supply raw material for the wood industry.

In the EU-28 there are approximately 182 million hectares of forests and other wooded land corresponding to 43% of its land area (EUROSTAT, 2017, p. 113), and the Forest Fund in Romania was of 6555.0 thou hectares in 2015 (Statistical Yearbook, 2016, p. 522).

The resource management is a complex process involving an interdisciplinary approach because the management of natural resources has become a challenge at all levels, starting with the individual one (the cultural and educational background plays an important role in the conservation and rational use of natural resources), continuing with national institutions (which must be concerned with ensuring the quality of life at the national level) and last but not least including international institutions (which have the role of developing internationally applicable standards, policies and management strategies for resources). Other authors, such as Cheng and Sturtevant (2012) or

Gieske, van Buuren and Bekkers (2016), consider that there is a close link between resource management and risk management through the capacity to collaborate at three levels: individual (a level which finds itself also in the resource management on account of the fact that the individual is the key element in achieving sustainable development), the organizational (or institutional) level and the network level (establishing the connection between individuals and organizations, among actors involved in resource and risk management).

Researchers such as Norby, Wullschleger, Gunderson, Johnson, and Ceulemans (1999); Ostrom, Janssen and Anderies (2007); Cardenas, Janssen, and Bousquet (2013) conducted a series of studies to determine the factors that influence resource management and how individuals react to the challenges of sustainable development.

Forests, waters and glasshouse gases are ubiquitous in sustainable development strategies (eg EU forest strategy (COM (2013) 659)), but the legislation in force and the set of sustainable development plans and strategies all over the world cannot prevent natural disasters to take place.

Romania, as a Member State of the EU, faces massive forest cutting, a phenomenon that will have a negative long-term impact on Romania's sustainable development. Despite measures taken at the national level (in accordance with strict legislation in this respect - Strategic Objective 1. Improvement of the institutional field and regulatory activities in the forest domain of the National Forest Strategy 2018-2027 (Romanian Government, 2017, p. 4) and locally (with the help of monitoring forests - strategic Objective 2. sustainable management of national forest fund from the National Forest Strategy 2018-2027 (Romanian Government, 2017, p. 4) illegal logging continues.

One of the weaknesses of the National Forest Strategy 2018-2027 is that its strategic objectives have not been designed in connection with water resources and glasshouse gas emissions. Therefore, based on statistical indicators, we shall develop a model that will help strengthen the role that forests play in sustainable development.

The first part of the paper will analyze the threefold relationship: forest - water - gas emissions, and the second part will be devoted to the development of a sustainable development model for Romanian forestry.

The threefold relationship: forests - water - gas emissions

In the mainstream literature, there are few studies focusing on the impact that forests have on water quality growth and on glasshouse gas emissions reduction. Frone and Frone (2015) conducted a study on the importance of water security for sustainable development in Romania and concluded that it is very important to pay close attention to increasing the quality of water resources and the wasted water recycling process.

At the international level, particular attention is paid to reducing glasshouse gas emissions (GHG) which come from various sources, including forestry, agriculture and waste, through the involvement of the community, but especially the governments (Bulkeley, 2013, Musco, 2010; Rayner, 2010).

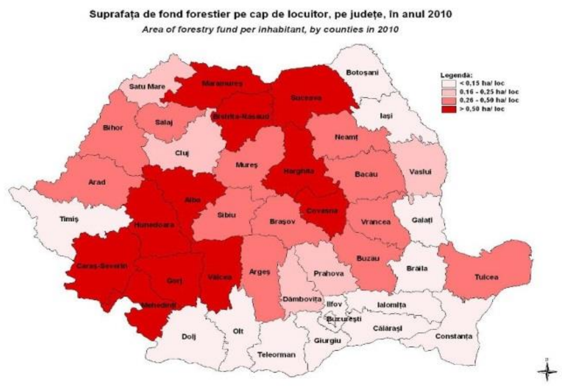
At the European Union level, there are a number of legislative initiatives aimed at protecting forests, as they have an important role to play in damping climate change. Forests contribute to:

• protecting the quality of water and rivers;
• Absorbing carbon and storing it in trees and forest soil;
• preventing soil erosion.

In Romania, national legislation has presented a number of gaps, which allowed for the reclaiming of large land plots by former owners. According to the report of the Ministry of Waters and Forests (2017, p. 2) on the condition of forests in 2016, the structure of the forestry fund by type of ownership at the end of 2016 was the following: out of the total of 6,559 thousand hectares forestry fund, 48.7 % public property of the state, 33.9% private property - natural and legal persons, 16.0% public property of territorial administrative units, 1.4% private property of territorial administrative units.

An analysis of the forest fund area per inhabitant in parallel with the surface area of the virgin forests in Romania (figure 1) leads us to the conclusion that the virgin forests are located in the counties (Maramures - 4,700 ha, Gorj - 4,000 ha, Mehedinti - 2,100 ha , Caraş-Severin - 800 ha, Hunedoara - 600 ha, Covasna - 400 ha and Bistriţa năsăud – 100 ha) where the area of the forest fund per inhabitant exceeds 0.50 ha / person, except for Sibiu (2,800 ha) and Braşov (4,300) where the area of the forest fund per inhabitant ranges between 0.20 and 0.50 ha / place. At the beginning of 2016, the forest area per inhabitant was of 0.29 ha / place, close to the European one of 0.31 ha / place (Ministry of Waters and Forests, 2017, p. 11).

Romania's forest resources are considerable and the large area of virgin forests is an important asset for a high level of air and water quality.



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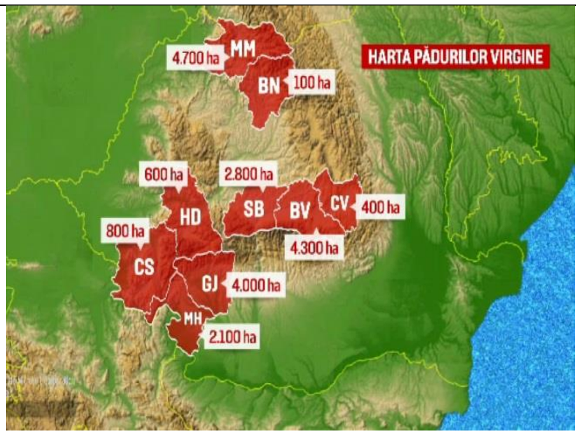

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Sources: 1. http://www.insse.ro/cms/files/IDDT2012/index_IDDT.htm
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Figure 1. Area of forest fund per inhabitant and surface of virgin forests in Romania

Forests have the potential to retain significant amounts of carbon in biomass and soil, but they can conserve carbon by burning fossil fuels that contribute to the production of firewood (Lal, 2004; Montagnini and Nair, 2004). In addition to carbon sequestration, these systems can contribute to both carbon preservation and carbon replacement (through reducing fossil fuel combustion).

Forests are a source of water quality improvement because they contribute to the reduction of nutrient loading from non-point sources. Jose *et al.* (2004) believe that the deeper and broader tree roots take up more nutrients from the soil in comparison with the deeper root crops, because of the "safety-net" effect.

Pandey (2002) concludes that agroforestry practices in countries with temperate climates such as Romania have the potential to store carbon in the range of 15 to 198Mg C ha-1 (mode: 34Mg C ha-1).

Palm *et al.* (2002) claim that the international deforestation process estimated at 17 million ha yr-1 is expected to cause the emission of 1.6 pg (peta gram = 1015g = 1 billion tons) C ha-1 yr-1 and one hectare of agroforestry could save five hectares from deforestation.

MATERIAL AND METHOD

The model of our research (figure 2) has as central point the climate change and it is built on three variables:

1. Forestry – with two items: Harvested wood volume (1000 m.c.) and Gross annual increment of standing timber - (1000 m.c.)
2. Water – with the following items: Total of water resources (mil. m3) and Total length on monitored rivers (km)
3. Emissions – with two items: Emissions of organic matter (CBO5) in the form of biochemical oxygen demand in rivers – (tons/day) and Total GHG emissions – (thousand tons)

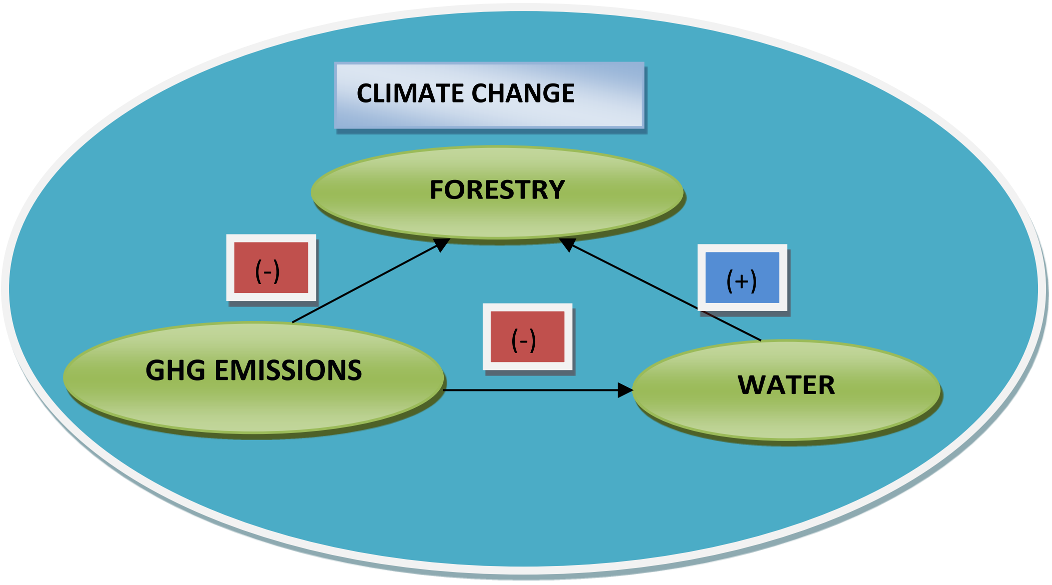

Figure 2. Theoretical model of factors influencing sustainable development

Our theoretical model is based on the assumption that climate change is the result of glasshouse gas emissions, which have a negative impact on the water and air quality. The relationship between water quality and forestry one is positive.

We shall test this model on the basis of the statistical data for the period 2008-2016, in relation with three variables (Table 1).

Table 1

Statistical indicators regarding the forestry-water-emission triad, 2008-2016

Year	Harvested wood volume (1000 m.c.)	Gross annual increment of standing timber - (1000 m.c.)	Total resources of water (mil. m3)	Overall length of monitored rivers (Km)	Emissions of organic matter (CBO5) in the form of biochemical oxygen demand in rivers – CBO5 (tons/day)	Total GHG emissions – (thousand tons)
2008	16,705	24,523	39,406	26,513	311	127,632
2009	16,520	24,765	34,480	26,347	323	108,192
2010	16,992	25,021	61,878	41,116	278	102,403
2011	18,705	25,268	30,678	21,161	267	108,188
2012	19,081	25,476	24,612	31,621	176	106,481
2013	19,282	25,671	35,571	31,892	145	97,157
2014	17,889	25,874	42,188	31,263	138	97,155
2015	18,133	26,078	34,827	37,111	139	98,168
2016	17,198	26,137	34,827	37,612	137	98,169

Source: http://www.insse.ro/cms/files/Web_IDD_BD_ro/index.htm

Analyzing the data in Table 1, we see an increase in both the Harvested wood volume in 2008 (16,705,000 cubic meters) by 2013 when it reaches the maximum (19,282,000 cubic meters) and the Gross annual increment of standing timbe, from 24,523,000 cubic meters in 2008 to 26,137,000 cubic meters in 2016.

RESULTS AND DISCUSSIONS

The methodology of scientific research is based on the data provided by the National Institute of Statistics.

For our data processing we used the SPSS program and we performed the factor analysis.

On a first stage we have compiled the descriptive statistics (Table 2) and the results indicate that the highest standard deviation is recorded in the Total water resources (mil. M3) - 10,365.596, followed by Total GHG emissions - 9,731.763 .

Table 2

Descriptive Statistics

	Mean	Std. Deviation
Wood	17,833.89	1,037.875
Gross Annual	25,423.68	574.002
Water	37,607.44	10,365.596
SurfWater	31,626.22	6,321.658
EmisOrganic	212.67	80.401
GHGEmiss	104,838.33	9,731.763

The Kaiser-Meyer-Olkin test (KMO) indicates that the factor analysis is appropriate (Table 3), since its value of 0.595 is greater than 0.5 (Cerny and Kaiser, 1977).

Table 3

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		,595
Bartlett's Test of Sphericity	Approx. Chi-Square	30,418
	Df	15
	Sig.	,011

From the Correlation Matrix analysis (Table 4), we notice that there are correlations between our variables:

- positive: the Harvested wood volume item is positively correlated with the item Gross annual increment of standing timber (, 477); the item Gross annual increment of standing timber is positively correlated with item Total length of monitored rivers (, 470); the Total water resources item is positively correlated with Total length of monitored rivers (, 527) and Emissions of Organic Matter (CBO5) in the form of biochemical oxygen demand in rivers (259); the Emissions of Organic Matter (CBO5) item in the form of biochemical oxygen demand in rivers is positively correlated with Total GHG emissions (745).

- negative: the Harvested wood volume is negatively correlated with the Total water resources item (-, 492), with the Total length of monitored rivers (-, 118), with Emissions of Organic Matter (CBO5) in the form of biochemical oxygen demand in rivers -, 577) and Total GHG emissions (-, 401); the item Gross annual increment of standing timber is negatively correlated with Total water resources (-, 235), with the item Emissions of Organic Matter (CBO5) in the form of biochemical oxygen demand in rivers (-, 949) and Total GHG emissions (-, 821); Item Total water resources is negatively correlated to Total GHG emissions item (-, 069); Total length of monitored rivers is negatively correlated with the item Emissions of Organic Matter (CBO5) in the form of biochemical oxygen demand in rivers (-, 463) and is negatively correlated with Total GHG emissions (-, 545).

Table 4

Correlation Matrix[a]

Variables	Wood	GrossAnnual	Water	SurfWater	EmisOrganic	GHGEmiss
Wood	1,000	,477	-,492	-,118	-,577	-,401
GrossAnnual	,477	1,000	-,235	,470	-,949	-,821
Water	-,492	-,235	1,000	,527	,259	-,069
SurfWater	-,118	,470	,527	1,000	-,463	-,545
EmisOrganic	-,577	-,949	,259	-,463	1,000	,745
GHGEmiss	-,401	-,821	-,069	-,545	,745	1,000

a. Determiner = ,003

The analysis of the correlations between the indicators shows that within the same variable, the indicators correlate positively, the strongest of the correlations are recorded with the variable Emissions (745) followed by the variable Water (527) and the last place is assigned to the forestry variable (, 477).Our data reflects a worrying issue regarding gas emissions, because negative correlations mean negative influence that gas emissions have on forests and water.

On the other hand, the Harvested wood volume negatively influences water quality, and Gross Annual Increment of Standing Timber presents the strongest of the negative correlations occurring in the case of Emissions of Organic Matter (CBO5) in the form of biochemical oxygen demand in rivers -, 949) and Total GHG emissions (-, 821).

Table 5

Commonalities

Indicators	Initial	Extraction
Wood	1,000	,722
GrossAnnual	1,000	,926
Water	1,000	,845
SurfWater	1,000	,873
GHGEmiss	1,000	,928
EmisOrganic	1,000	,824

Extraction Method: Principal Component Analysis.

The values of the common character for all six indicators show that they are well represented by the applied factorial model. The highest values are recorded by Emissions of Organic Matter (CBO5) in the form of biochemical oxygen demand in rivers (928) and Gross annual increment of standing timber (926).

Table 6

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,301	55,014	55,014	3,301	55,014	55,014	3,273	54,552	54,552
2	1,818	30,298	85,311	1,818	30,298	85,311	1,846	30,760	85,311
3	,441	7,349	92,661						
4	,277	4,609	97,270						
5	,136	2,265	99,535						
6	,028	,465	100,000						

Extraction Method: Principal Component Analysis

Analyzing the information in the table above, we note that 6 main components were generated - factors, of which only the first two factors meet the selection criteria (value> = 1).

The variance explained by each factor is distributed as follows: the first factor, 55.014% and the second factor, 30.298%, and both factors account for

85.312% of the value of the variance analyzed.

After applying the rotation procedure, in the context of the same total variation (85.312%) a redistribution of the variance explained by each factor is observed: the first factor, 54.552% and the second factor, 30.760%. Thus, by the rotation method, the first factor loses the saturation level (, 462) in favour of the second factor.

Table 7

Rotated Component Matrix[a]

Indicators	Component	
	1	2
Wood	,608	-,594
GrossAnnual	,962	-,009
Water	-,190	,899
SurfWater	,523	,774
GHGEmiss	-,961	,068
EmisOrganic	-,879	-,229

Extraction Method: Principal Component Analysis
Analysis a. 2 component extractions

The Rotated Component Matrix contains the data obtained after applying the rotation of the factors in order to approximate the given structure.

Negative values for component 1 are recorded for the Total water resources item (-, 190) and for both of the Emissions factors: Emissions of Organic Matter (CBO5) variables in the form of biochemical oxygen demand in rivers (-, 879) and Total GHG emissions (-, 961).

The high negative values of Emissions items show that gas emissions have a negative impact on the quality of life and water resources are deficient compared to Forestry variables.

For component 2, the highest negative value is recorded for the Harvested wood volume (-, 594) indicator, and the lowest negative value is recorded for the Gross annual increment of standing timbe indicator (-, 009).

The results of our research show that it is necessary for forestry deficient areas to be afforested because 29 counties are deficient in forests, among the most disadvantaged counties being Dâmboviţa 29%, Bihor - 28%, Arad - 27%, Buzău - 26 %, Salaj - 25% and Cluj - 24% (Ministry of Waters and Forests, 2017, p. 12).

CONCLUSIONS

The findings of this research show that the critical factors contributing to the degradation of the environment fall into three categories: the human factor, because of the chaotic and intensive exploitation of the privately owned forest land, as well as the irresponsible exploitation of the publicly owned forest land; national legislation with multiple gaps in property form, forest exploitation, forest distribution by functional types; as well as environmental factors (water quality and glasshouse gas emissions).

Our findings reveal that for an efficient management of forests it is necessary, first of all, to strengthen national legislation in line with EU and international law and, secondly, it is important to resolve the situation of the forests in question as soon as possible , at the end of 2016 there were 16,561 ha of forest land litigation (Ministry of Waters and Forests, 2017, p. 15).

In the statistics presented by the Ministry of Waters and Forests (2017, p. 10), only 3% of the forest land is of Functional Type I (forestry interventions are not allowed, only by exception, the interventions can be done following the approval of the Romanian Academy); 21% of the forest land is Functional Type I (only conservation works are allowed). In conclusion, 76% of the forest land is exploited because: 8% of the forest land is functional type III and 21% functional type IV (intensive treatments promoting natural regeneration.) Exceptionally, spruce, pine, acacia, willow are the allowed species); 5% of the forest land is Functional Type V and 42% of the forest fund is Functional Type VI (all types of treatments are allowed).

All these deficiencies have a negative impact on the degradation of the ecosystem, the reduction of the renewable capacity of the forests and the reduction of the quality of life. In conclusion, developing a sustainable development strategy is not effective if we do not take into consideration the factors that could turn into challenges and barriers in the implementation of the strategy.

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