

# Assessing the Benefits of the Forest: the Views of Loggers, Forestry Students, and Citizens

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## Abstract

This paper is an assessment of tangible and intangible benefits of the forest by three groups of people: loggers, university students of forestry and environmental management, citizens of Greece. The paper compares and contrasts the views of the above groups of people. According to the research, the loggers think that the most important functions of the forest are the production of wood products and the creation of opportunities for work. In contrast, forestry students think that the most important benefits of the forest are the production of oxygen and the ability to clean the atmosphere from pollutants. At a national level, citizens think that the most important benefits of the forest are the protection of wildlife and the production of oxygen.

**Keywords:** benefits of the forest, loggers, students, citizens, assessment

## Introduction

The natural environment has always been the base upon which humans developed all the necessary activities for their survival and evolution [1]. The forest, as the most important terrestrial ecosystem on earth, provides fundamental services for humans [2]. In particular, forests provide many essential goods and services, such as clean groundwater, habitat for diverse species, recreational space for humans, clean air and timber [3]. The forest was one of the first resources to be regarded as a natural resource. In addition, mountain economies were for many centuries based on the exploitation of forest goods [4].

The annual production of wood in Greek forests is only 2,707,000 m<sup>3</sup>, from which only 786,000 m<sup>3</sup> are destined for timber while the rest is intended for firewood [5]. The contribution of the timber production sector to the national economy is small, while, the sector of silviculture employs about 35,000 people [6].

However, the value of our forests cannot only be assessed from the point of view of wood production or other products [7]. In recent years many important changes have been observed in the different roles of forests regarding the sectors of watershed control, protection of farmland from the effects of weather, development of wildlife, development of the aesthetic values of landscapes and protection of the environment, recreation in forests, development of mountain tourism, and protection of biodiversity in plants and animals [8, 9]. The demand by the public for various forest goods and services has often been studied [10]. Considerable attention has also been paid to the subject of quantification and valuation of forest ecosystem services [11].

Forests and woodlands are part of the environment in which tourism and recreation take place. There are few outdoor settings for recreation that do not have trees, either close up or in the background, and there are also few tourist activities that cannot take place in a forest environment [12]. In developed industrialized countries the forest has become the preferred area for leisure and recreation [13, 14]. Ever growing demands from the general population

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make landscape planners and foresters pay more attention to the subject of recreation than to other subjects such as wood production [15].

To individuals and societies, wildlife, as an important element of the natural environment, has represented and continues to represent an immense diversity of values. The disappearance of wildlife is related to the destruction and degradation of its inland and water ecosystems, which is mainly attributed to human intervention [1]. A long history of ecological experimentation and theory supports the postulate that ecosystem goods and services, and the ecosystem properties from which they are derived, depend on biodiversity, broadly defined [16]. In recent decades people seem to be sensitized with regard to the issue of wildlife protection, and this becomes obvious in the creation of organizations such as the Greek Ornithological Society, the World Wildlife Federation, the Association for the Welfare of Wild Animals, etc.

In addition, important functions of the forest include the protection of soil from erosion and the enrichment of underground water layers. The irregular topography of our country renders the largest part of its land vulnerable to erosion. This sensitivity is intensified:

- (1) by the dry climate of Greece, which slows down the restoration of the protective mantle
- (2) by the small depth of the soil
- (3) by the irregularity of rainfall [17].

The forest, therefore, protects the soil and is the main collector and water movement mediator with regard to underground water layers [18, 19]. A large amount of the water available for the world population as drinkable water comes from existing reserves in natural and artificial forests. Forests regulate quality as well as quantity of water, being the base for an integrated management of hydrological resources in forested watersheds [20].

Finally, due to the degradation of the environment we live in, the cleaning of the atmosphere and the production of oxygen are perhaps the most important benefits the forest provides to human society. The environment purification functions are beneficial to peoples' health [21]. The forest acts as the storage or drainage system for huge quantities of pollutants. In particular, leaves hold a large amount of industrial dust [22]. Under conditions of low atmospheric pollution, forest ecosystems can act as sewers of air pollutants. Low atmospheric pollution creates visible (possible to record) results in forest ecosystems, while with regard to high doses of atmospheric pollution the effects are visible even to the lay observer [23]. Forests can also reduce GHG concentrations by sequestering atmospheric carbon in biomass and soil, and the carbon can remain stored in any wood products made from the harvested trees [24].

Therefore, the benefits forests offer to us are important and are directly and indirectly related to our existence. The aim of this paper is to investigate the views of loggers, students of forestry, and citizens with regard to the importance of forest goods and services. In particular, we investigate the views of the above groups with regard to: production of water, protection from floods, erosion of soil, opportunity for work, possibilities for recreation, production of oxygen,

cleaning of atmosphere, and protection of wildlife. The aforementioned groups of people were asked to assess the above functions in a scale of 1 to 10. The goal of this paper is to extract useful conclusions that could be considered in the planning of forest policy with the aim of protecting and improving our forest ecosystems.

## Method of Research

This paper is a combination of three independent research projects. The choice of the population to be investigated was made on the basis of making known the views of two population groups:

- 1) the loggers of a mountainous area of Greece who live and work in the forest
- 2) the citizens of the country who in their biggest part constitute an urban population.

For the formation of forest policy for forest ecosystems it is important to take into account the views of different population groups, as well as discover differences between them. Finally, as the students of forestry will in the future serve in governmental and non-governmental organizations that shape and apply forest policy, it is important to know how they assess the benefits of the forest and how such an assessment is linked to the other two projects, as well as how it is differentiated according to their year of study.

The first research project is about loggers and was carried out in 2006 in Arnaia, Chalkidiki. The sampling method used was simple random sampling [25-27]. The "population" under study was the total of the loggers who were members of the Union of Forest and Agricultural Cooperatives of Arnaia, i.e. 254 individuals.

In order to calculate the arithmetic mean and the standard error or sampling error of the population, we used the formulas of simple random sampling [26, 27]. Indeed, in the second formula, due to finite population the correction (1-f) was used.

For the calculation of the size of the sample we carried out pre-sampling with the size of the sample being 50 individuals. The size of the sample was estimated on the basis of the formulas of simple random sampling without correction [26-28]. It should be noted that correction of a finite population cannot be ignored because the size of the sample  $n$  is large when compared to the size of the population  $N$  [29]. The size of the sample was determined to be 154 loggers.

The second research project refers to the citizens of Greece and was completed in 1997. The research area was the entire country and the sampling method applied was stratified random sampling [27, 28]. Furthermore, geographical strata taken into account for the strata formation in all the prefectures of the country were also used [27].

The estimated mean and the estimated standard error or sampling error ( $s_y$ ) of the mean (without the correction of the finite population) was calculated through the use of the formulas of stratified sampling. However, as the sizes of the layers were not known, we used the legitimate population of the 1991 general population census. This decision was based on the fact that if in every layer the sampling fraction

is small, then the precise sizes of the layers should not necessarily be known.

In order to calculate the size of the sample, we carried out pre-sampling with the size of the sample being 510 individuals. Also, through the use of the formula "equal samples in every layer," the size of the sample was determined to be 2091 individuals, i.e. 41 individuals in every layer.

The participants in the third research project were the "active" students of the Department of Forestry and Management of the Environment of the Democritus University of Thrace at Orestiada. Due to the importance of selecting the right time for the participants to complete the questionnaire [30], the research with regard to the students was carried out during the examination periods of the academic year 2005 and the participating students were the ones we call "active students." Therefore, those asked were all the "active students" (that is, a census was carried out), and these students comprised the population under study. The registered students in the department were 391, while the ones who participated in the research, i.e. the active students, were 297.

For all three populations and with regard to the multi-themed variable that refers to the benefits of the forest, factor analysis was applied. Factor analysis is a statistical method that aims to discover the existence of factors that are common in a group of variables [31]. Factor analysis aims to interpret structure rather than variability [32]. Its aim is to reproduce in the largest degree the correlations among variables using the smallest possible number of factors. Its aim is also to lead to a solution that is "unique" and which can be easily interpreted [33].

In particular, we used the method of the principal components based on spectrum analysis of the variance table (correlation) [32]. The selection of the number of factors is a dynamic process and presupposes the evaluation of the model in a repeating fashion. In particular, we can use Kaiser's rule, the variance percentage of which can be explained on a screen plot [32]. In this paper we used the solution of two factors.

The rotation of the matrix of the main factors was done via Kaiser's method of maximum variance rotation [34]. The aim of this method is the appearance in the main factors of loadings with high values and of loadings with zero or almost zero values, i.e. the maximizing of variance in each factor [33].

Finally, we investigate the factors that can interpret the correlations among the variables of our data, as well as attempt to interpret them (if this is possible) [35]. According to Frangos [36], the variables that "belong" to each factor are those whose loading in the table showing the factor loadings, after rotation, is bigger than 0.5 in this factor. The analysis of our data was done through the use of the statistical package SPSS.

## Results

The loggers of Arnaia are people who live and work near the forests of their region. The assessment, therefore,

of the benefits the forest offers to them is directly related to the extent these forests improve the quality of their lives. Thus, according to them, the most important benefit is the production of wood products (mean=7.47 and  $s_y=1.222$ ), the creation of opportunities for work (mean=6.95 and  $s_y=1.045$ ), and the production of oxygen (mean=6.48 and  $s_y=1.701$ ). Next are the protection of soil from erosion (mean=5.95 and  $s_y=1.410$ ), the increase of water reserves (mean=5.92 and  $s_y=1.460$ ), the ability of the forest to clean the atmosphere (mean=5.91 and  $s_y=1.460$ ), and protection from floods (mean=5.88 and  $s_y=1.412$ ). Immediately afterward is the issue of forest recreation (mean=5.30 and  $s_y=1.429$ ), while the last position is occupied by the forest as a refuge for wildlife (mean=4.85 and  $s_y=1.590$ ).

Most of the citizens of Greece live in cities, and for this reason the representation of urban population in our sample is bigger. Thus, when we note the views of the citizens of the country about the benefits of the forest, we mainly refer to the views of the urban population. For this reason their assessment is different than the assessment of the loggers of Arnaia. In contrast, the views of the students of forestry are closer to the views of the citizens. This is expected, since the students are a small subtotal of the general population.

The citizens think of the most important benefit in the forest as a refuge for wildlife (mean=7.64 and  $s_y=0.016$ ) and the production of oxygen (mean=7.53 and  $s_y=0.025$ ). Next comes protection of the soil from erosion (mean=7.33 and  $s_y=0.019$ ), protection from floods (mean=7.33 and  $s_y=0.019$ ), the ability of the forest to clean the atmosphere (mean=7.21 and  $s_y=0.024$ ), and an increase of water reserves (mean=7.19 and  $s_y=0.021$ ). Less important are recreation (mean=6.97 and  $s_y=0.019$ ) and the production of wood products (mean=6.55 and  $s_y=0.021$ ) while the last position is occupied by the creation of opportunities for work (mean=6.00 and  $s_y=0.020$ ).

Students assess differently the benefits of the forest than the loggers of Arnaia. They (Table 1) think that the most important benefit of forests is the production of oxygen (mean=9.34), the ability of the forest to clean the atmosphere from pollutants (mean=8.56), protection from floods (mean=8.34), the increase of water reserves (mean=8.18), the protection of the soil from erosion (mean=8.16), and the fact that the forest is a refuge of wildlife (mean=8.01). According to the students, the production of wood products (mean=7.70), recreation (mean=6.79), and the creation of opportunities for work (mean=5.87) are regarded as less important. It is important to note that the students, as they advance in their years of study, perceive and assess the benefits of the forest more positively. The explanation here may be that the more the students, advance in their studies the more they know and appreciate the benefits of the forest (Table 1).

Although the three research projects are independent, it was thought important enough that the results derived from them are presented in Fig. 1 so that the readers will have a total picture of how each population group values the benefits of the forest. It becomes obvious that with regard to all

Table 1. Assessment of the benefits of the forest by students.

Variable	n	New sts.	1 <sup>st</sup> yr	2 <sup>nd</sup> yr	3 <sup>rd</sup> yr	4 <sup>th</sup> yr	5 <sup>th</sup> yr	Total
		54	50	49	46	41	57	297
Wood products	mean	6.81	7.71	7.81	7.85	8.05	8.05	7.70
	s.d.	2.80	2.48	1.88	2.24	1.77	2.27	2.31
Recreation	mean	6.06	6.61	6.79	6.46	7.46	7.42	6.79
	s.d.	2.63	2.61	2.60	2.61	2.10	2.55	2.57
Production of oxygen	mean	9.24	9.16	9.35	9.54	9.56	9.26	9.34
	s.d.	1.94	1.88	1.14	1.09	0.74	1.40	1.45
Increase of water reserves	mean	8.09	7.73	7.75	8.30	8.66	8.58	8.18
	s.d.	2.17	2.38	2.21	2.01	1.71	1.40	2.02
Soil protection from erosion	mean	7.46	7.53	8.00	8.50	8.98	8.65	8.16
	s.d.	2.39	2.28	1.83	1.76	1.70	1.52	2.01
Protection from floods	mean	7.91	8.27	8.29	8.15	9.05	8.49	8.34
	s.d.	2.03	1.94	1.81	1.91	1.02	1.62	1.79
Creation of opportunities for work	mean	5.52	5.39	5.79	5.96	6.54	6.16	5.87
	s.d.	2.55	2.65	1.96	2.03	2.36	2.32	2.34
Wildlife refuge	mean	7.59	7.47	8.27	8.22	8.54	8.12	8.01
	s.d.	2.38	2.21	1.89	2.09	1.49	1.79	2.03
Clean atmosphere from pollutants	mean	8.63	8.24	8.44	8.74	8.88	8.49	8.56
	s.d.	1.76	2.00	1.62	1.67	1.31	1.64	1.69

n – no of persons, mean – average, s.d. – standard deviation

the benefits of the forest (except wood products and creation of opportunities for work) the citizens give higher marks than the loggers. Also, the students of forestry give higher marks to the benefits of the forest, with the exception of creating opportunities for work, which the loggers and the citizens regard as more important than the students, as well as recreation, which the citizens assess higher than the students.

Before the application of factor analysis to all three populations, our data were tested and found appropriate for factor analysis. Also, all of our variables were found appropriate for use in the model. The results are shown in Tables 2, 3, and 4. We see the loadings, which are partial correlation coefficients of the nine variables with each of the two factors that resulted from the analysis. The bigger loading of a variable in a factor, the more this factor is responsible for the total degree variance in the particular variable. The variables that “belong” to each factor are those for which the loading (columns 1, 2) is bigger than 0.5 in the particular factor.

According to the above results, the first factor includes the variable production of oxygen, increase of water reserves, soil protection from erosion, protection from floods, wildlife refuge, and the ability to clean the atmosphere from pollutants. This factor can be called “non-economic values of the forest”. The second factor, which can be

called “economic values of the forest,” includes the variables wood products, creation of opportunities for work, and recreation. In particular, valuable recreation can be characterized as indirect economic value because, among other things, it contains non-economic features. It should be

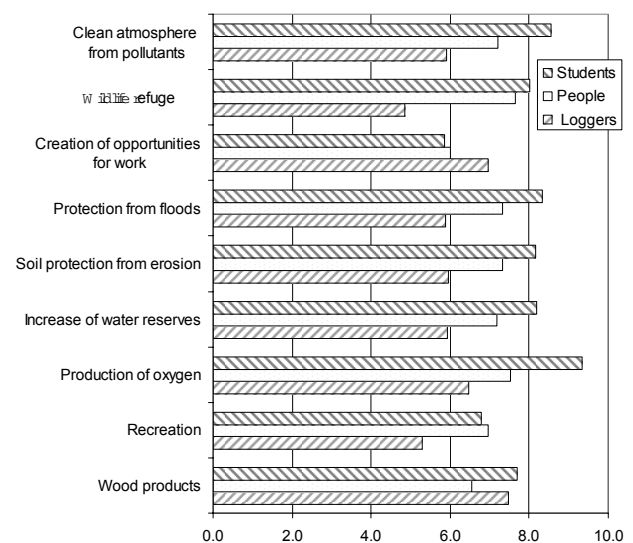


Fig. 1. Schematic representation of the benefits of the forest by loggers, citizens, and students of forestry.

Table 2. Table of factor loadings with regard to loggers before and after rotation.

Variable	Factor burdens			
	Before rotation		After rotation	
	1	2	1	2
Wood products	0.683	0.632	0.205	<b>0.908</b>
Recreation	0.801	0.161	<b>0.569</b>	<b>0.586</b>
Production of oxygen	0.840	-0.262	<b>0.841</b>	0.260
Increase of water reserves	0.829	-0.243	<b>0.821</b>	0.269
Soil protection from erosion	0.880	-0.228	<b>0.855</b>	0.310
Protection from floods	0.884	-0.191	<b>0.837</b>	0.344
Creation of opportunities for work	0.794	0.380	0.439	<b>0.763</b>
Wildlife refuge	0.844	-0.013	<b>0.703</b>	0.467
Clean atmosphere from pollutants	0.876	-0.069	<b>0.761</b>	0.439

Table 3. Table of factor loadings with regard to students of forestry before and after rotation.

Variable	Factor burdens			
	Before rotation		After rotation	
	1	2	1	2
Wood products	0.612	-0.496	0.106	<b>0.781</b>
Recreation	0.669	-0.493	0.150	<b>0.817</b>
Production of oxygen	0.457	0.555	<b>0.714</b>	-0.091
Increase of water reserves	0.741	0.201	<b>0.677</b>	0.361
Soil protection from erosion	0.751	0.077	<b>0.600</b>	0.459
Protection from floods	0.714	0.331	<b>0.747</b>	0.249
Creation of opportunities for work	0.746	-0.295	0.341	<b>0.729</b>
Wildlife refuge	0.663	0.056	<b>0.521</b>	0.414
Clean atmosphere from pollutants	0.536	0.223	<b>0.543</b>	0.205

noted that with regard to loggers, variable recreation is included in the first factor, which shows that it constitutes a bridge between the two factors.

## Discussion and Conclusions

The loggers of Arnaia in Chalkidiki think that the most important benefits of the forest, in descending order, are the production of wood products, the creation of opportunities for work, the production of oxygen, the protection of soil from erosion, the increase of water reserves, the ability of

Table 4. Table of factor loadings with regard to citizens before and after rotation.

Variable	Factor burdens			
	Before rotation		After rotation	
	1	2	1	2
Wood products	0.326	0.693	0.103	<b>0.759</b>
Recreation	0.381	0.632	0.174	<b>0.717</b>
Production of oxygen	0.794	-0.310	<b>0.850</b>	-0.058
Increase of water reserves	0.788	-0.156	<b>0.799</b>	0.088
Soil protection from erosion	0.788	-0.093	<b>0.779</b>	0.148
Protection from floods	0.833	-0.181	<b>0.848</b>	0.078
Creation of opportunities for work	0.240	0.747	0.004	<b>0.784</b>
Wildlife refuge	0.684	0.048	<b>0.638</b>	0.251
Clean atmosphere from pollutants	0.747	-0.115	<b>0.747</b>	0.115

the forest to clean the atmosphere from pollutants, and protection from floods. According to the loggers, the least important benefits of the forest are recreation and refuge for wildlife.

At a national level, the citizens of Greece think that the most important benefits of the forest, in descending order, are the protection of wildlife, the production of oxygen, the protection of the soil from erosion and floods, the increase in water reserves and the ability of the forest to clean the atmosphere. Recreation, the supply of wood products, and the creation of opportunities for work are regarded as less important goods.

Analysis of the results at prefecture level [37] with regard to the views of citizens reveals that:

- the forest as a wildlife refuge, especially in prefectures with wetlands and national parks, is in the two top positions
- in prefectures that suffer greatly from forest fires (in the south and island part of the country), the production of oxygen is regarded as the most important benefit of the forest
- the role of the forest as a water regulator ranks higher than its role in recreation, even in prefectures that host large urban centers, e.g. Attica, Thessaloniki, Achaia, etc.
- forest recreation is regarded as quite important in prefectures with winter tourism, while in prefectures with summer tourism the citizens are indifferent to issues of forest recreation.

Between the citizens of the country, most of which belong to the urban population and the loggers who constitute part of the mountainous population, there is significant differentiation with regard to the way they think of the forest. To the loggers the forest is a natural resource they use to make a living. On the other hand, the citizens who live in urban centers and do not depend on the forest for their liv-

ing think of the forest as a natural ecosystem that improves the quality of their life.

The students think that the most important benefits of the forest, in descending order, are production of oxygen, ability of the forest to clean the atmosphere from pollutants, protection from floods, increase of water reserves, protection of the soil from erosion, refuge for wildlife, production of wood products, recreation, and creation of opportunities for work.

Indeed, it seems that the students come closer to the forest because the more the students advance in their years of study, the more they get sentimentally involved with the forest.

Bloom and Krathwohl [38] accept two types of educational objectives: cognitive (transmission of knowledge and skills) and emotional (formation of values, attitudes and behaviors). Therefore, it becomes obvious that with regard to the latter the education of the students can be characterized as successful.

The fact that the issue of recreation occupies a low position with regard to the students shows that to them forest recreation is not an important subject in their program of studies, despite the importance of tourism for the development of the country. What is also negative is the fact that the creation of opportunities for work is last in the students' assessment, which shows that the students do not understand the role they will play in the future with regard to shaping forest policy for the development of the mountainous areas of the country.

The application of factor analysis on all three populations produces the same factors. The first refers to the "non-economic values of the forest," while the second to the "economic values of the forest." The issue of recreation is included in the economic goods the forest offers to us. It should be noted that with regard to the forests the issue of recreation is even included in the first factor, i.e. it serves as a bridge between the two factors.

Combining the results of the two methods, it becomes obvious that the citizens of Greece and the students of forestry think that the most important values of the forest are the non-economic ones. Our current policy regarding the management of our forest resources must turn to this direction. Our educational system seems to produce people who believe that the role of the forests has more to do with non-economic rather than economic goods.

For the loggers, on the other hand, economic goods such as the production of wood products and the creation of opportunities for work are more important than non-economic goods. The employment of the forest and semi-forest populations of our country should be an important goal of our forest policy because this way we keep mountain populations at home, as well as contribute to the development of these areas.

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