

What are the Causes of Forest Fires? The Views and Attitudes of Students in Public Senior Schools in the Prefecture of Drama, Greece

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Abstract: *The present research investigates the views and the attitudes of students in public senior schools regarding the responsibility for human choices and actions that cause forest fires in the Prefecture of Drama. The recording of attitudes and views gave positive results. Reliability Analysis was used to study the properties of measurement scales and the items that compose the scales and provide information about the relationships between individual items in the scale. Factor Analysis was used to identify underlying variables or factors that explain the multidimensional variable "causes of forest fires in the Prefecture of Drama" and also to reduce the data identifying a small number of factors that explain most of the variance that is observed in a much larger number of manifest variables .*

Keywords: forest fires, environmental problems, environmental education, attitudes

1. Introduction

Today, forest fires present a major global threat for forests because they can quickly destroy large areas of forest vegetation. Forest ecosystems shape the climate as they are natural sinks of carbon dioxide and they produce fresh oxygen and the quality of human life, and their destruction by fires has various harmful effects like economical, social, even the loss of human lives, cultural and environmental problems. Forest fires in Greece are considered to be a complex, permanent and continually worsening environmental problem which occurs due to climate change, human activities, lack of Land Registry, lack of institutional measures, inadequate equipment of fire-fighting forces and combinations of the above factors [1]. The analysis of the forest fire phenomenon is a prerequisite for any attempt to improve its system of treatment and requires a high degree of reliability of historical data. The timeless evolution of fires leads to the conclusion that the number of forest fires has almost doubled in the 1980s and 1990s and the burnt areas nearly tripled in the 2000s and 2010s compared to the 1970s. There is an exponential increase of burned woodlands in the 1970s, '80s and '90s, which aggravates in times of drought and political activities [2].

2. Method and Research

The research attempts to explore the views and attitudes of students about the causes of the forest fires that occurred in the Prefecture of Drama. For the analysis of the data, the statistical package SPSS was used. The students were asked to evaluate the causes given to them by a 10th-grade rating scale. The research regarding students was conducted in March 2016 and the sample consisted of 466 students aged 15-18.

The total of the questions on causes of forest fires constitute a multi - theme variable on which reliability is tested (**Reliability Analysis**). In order to find the internal reliability of a questionnaire, the Alpha coefficient

(Cronbach's Alpha) was used, in order to find if the data have the tendency to measure the same thing. When the α Cronbach is $\alpha > 0,70$ it is regarded as satisfactory and when it is greater than 0.80 it is regarded as very satisfactory [3]. In practice, smaller α - coefficients with values not less than 0.60 may also be accepted [4]. The testing must be reliable in order to be useful. However, it is not enough to be reliable. It, must also be credible and this can be done through the application of Factor Analysis[4]. Factor Analysis is a statistical method which aims to find the common factors within a group of variables[5]. Its goal is to reproduce the correlation between the variables to the highest degree by using the smallest possible numbers of factors and thus lead to a solution which is unique and easily interpreted [4].

3. Results - Discussion

From the reasons proposed for evaluation the "Negligence of the citizens" (Table 1) having a mean of evaluation 7.40 and 442 responses is the largest while the "Natural cause - lighting" is the smallest cause with evaluation mean 5.18 and 436 replies.

Table 1: The frequency of students answered the question, averages and standard deviations of the causes of forest fires that took place in the Prefecture of Drama

Variable	N	Mean	Standard deviation
Citizens' negligence	442	7,40	2,883
Random event	437	5,34	2,878
Natural cause - lightning	436	5,18	2,940
Financial expediency	436	6,54	3,181
Political expediency - elections	436	6,12	3,237
Lack of cadastre	427	5,41	2,797
No timely extinction of fires at their initial stage	436	6,34	2,800
No arrangement or Removal of combustible matter	432	6,37	2,821
Something else	63	6,92	3,189

Programs to inform citizens about the prevention and control of forest fires should be intensified in Mediterranean countries so that they can contribute to the gradual reduction of forest fires caused by negligence [6].

Urban and tourist areas were developed at the expense of the forest, and fire was used as a "tool" for the land to appear as agricultural so that these lands could be exploited for commercial purposes [7]. In times of national disasters, political crises and elections, we are generally witnessing an increased trend of forest fires [8]. Preventing the expansion of forest-building activities is essentially an indirect method of protecting these areas because the easiest way to remove vegetation is recurrent forest fires. Indeed, the best way to achieve this goal is to create a forest cadastre [6].

According to the Forestry Department of Drama and the Drama Forestry, the occurrence of forest fires due to natural causes (lightning strike) is relatively small in the area of responsibility of the Forestry in Drama. For this reason, in the Prefecture of Drama, the effective treatment requires the adoption of measures aimed at removing the causes of human activities and making the work of repression more effective.

The high standard deviations recorded (Table 1) show a great dispersion in responses and therefore the averages should be interpreted with caution. The cause of something else that 63 students stated as a possible cause the cigarette that could fall into the negligence of citizens, the arson that would also stem from some motivation such as economic or political feasibility. Perhaps we could also see here as an incentive the personal benefit beyond financial or even mental illness (pyromania) as causes to start an arson which could end up in a forest fire.

A. Reliability Analysis

In order to check the internal consistency of the questions of the multidimensional forest fire causes we used the reliability analysis. The Cronbach's alpha index was used to investigate the internal reliability of the 8 statements proposed as a cause of the forest fires that occurred last year in the Prefecture of Drama. Looking at the Reliability Statistics table, the value of the α is 0.735 indicating that the 8 causes had a satisfactory internal reliability index (should be > 0.70 depending on the number of questions on the scale.) The larger the number, the higher the α indicator, i.e. a strong indication that the causes proposed relate to each other, in other words, they have the same meaning [4].

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,735	,734	8

Case Processing Summary

		N	%
Cases	Valid	421	90,3
	Excluded ^a	45	9,7
	Total	466	100,0

a. Listwise deletion based on all variables in the procedure.

In Table 2 we see that the arithmetic means range from 5.14 to 7.38 whereas the standard deviation values range from 2,798 to 3,251. These descriptive statistics must be checked to ensure that there are no large fluctuations among the variables.

Table 2: Item Statistics

	Mean	Std. Deviation	N
Cause - Citizens' negligence	7,38	2,890	421
Cause - Random event	5,34	2,885	421
Causes - Natural cause - lightning	5,14	2,932	421
Cause- Financial expediency	6,49	3,188	421
Political expediency- elections	6,06	3,251	421
Lack of cadastre	5,38	2,798	421
No timely extinction of fires at their initial stage	6,34	2,804	421
No arrangement or Removal of combustible matter	6,38	2,819	421

To investigate possible correlations between two variables, the correlation coefficient of two variables *Pearson's chi-square test* was applied. According to the above (Table3), the results showed that the greater positive correlation with each other is given by the variables "Financial expediency" and "Politician expediency - elections" $r = 0,665$ following by the "No timely extinction of fires at their initial stage" with "No arrangement or Removal of combustible matter" with $r = 0.636$. There is a statistically mild positive correlation between the causes: "Random event" and "Natural causes" $r = 0.460$, between "Financial expediency" and "Lack of cadastre" $r = 0.433$, between "Political expediency - elections" and "Lack of cadastre" $r = 0,430$, between "Lack of cadastre" and "No timely extinction of fires at their initial stage" $r = 0.405$, between "Lack of cadastre" and "No arrangement or Removal of combustible matter" $r = 0,371$, between "Political expediency - elections" and "No arrangement or Removal of combustible matter" $r = 0,335$, between "Financial expediency" and "No timely extinction of fires at their initial stage" $r = 0,333$, between "Political expediency - elections" and "No timely extinction of fires at their initial stage" $r = 0,331$.

On the other hand, there is a statistically negative correlation (that is, as the value of one variable increases, the value of the other is diminished) between the cause "Random event" and "Political expediency - elections" $r = -0,018$. Among the other pairs there is a small positive correlation that is not considered worth mentioning. (Table 3).

Table 3: Correlation Clause per Pair of Polythematic Variable Variants (Pearson's)

	A1	A2	A3	A4	A5	A6	A7	A8
A1	1,00	0,185	0,251	0,269	0,120	0,126	0,184	0,170
A2		1,000	0,460	0,054	-0,018	0,101	0,044	0,053
A3			1,000	0,169	0,112	0,197	0,209	0,270
A4				1,000	0,665	0,433	0,333	0,284
A5					1,000	0,430	0,331	0,335
A6						1,000	0,405	0,371
A7							1,000	0,636
A8								1,000

A1 = Cause - Citizens' negligence, A2 = Random event, A3 = Natural cause - lightning, A4 = Financial expediency, A5 = Political expediency - elections, A6 = Lack of cadastre, A7 = No timely extinction of fires at their initial stage, A8 = No arrangement or Removal of combustible matter

Table 4: Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	6,064	5,143	7,380	2,238	1,435	,563	8
Item Variances	8,705	7,831	10,570	2,739	1,350	1,134	8
Inter-Item Covariances	2,237	-,169	6,890	7,059	-40,695	2,384	8
Inter-Item Correlations	,256	-,018	,665	,683	-36,827	,028	8

As far as the scale is concerned, the mean variation is 8,705 with a maximum of 10,570 and a minimum of 7,831 and the average correlation coefficient per pair is 0,256 with a minimum coefficient per pair - 0,018 maximum of 0,665, with a ratio of maximum to minimum value - 36,827 (Table 4).

Table 5: Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
A1	41,13	164,211	,302	,137	,731
A2	43,18	171,855	,195	,230	,750
A3	43,37	157,853	,386	,294	,715
A4	42,02	143,073	,546	,504	,682
A5	42,45	146,491	,481	,489	,696
A6	43,14	152,408	,502	,304	,694
A7	42,17	151,509	,515	,450	,691
A8	42,14	151,717	,508	,448	,692

As can be seen from Table 5, the variable "Random event" with the sum of the other causes ratio has a relatively low correlation coefficient $r = 0.195$, whereas the " Financial expediency " variable has the highest relation $r = 0.546$ with the total of the variables examined.

Furthermore, the R^2 determination coefficient of the regression analysis was used to answer the predominant query if the regression line was the best method that could be used and whether the ultimately estimated regression is satisfactorily adjusted to the data. Values range from $0 \leq R^2 \leq 1$. If $R^2 = 1$ then there is an absolute mathematical relationship between the variables. Generally, as the coefficient approaches the 1, the more correct regression model has been chosen to make it better suited to the data. If $R^2 = 0$ means that the wrong model has been chosen or else between the variables there is no functional relationship.

From the multiple determinations R^2 of the regression analysis of each variable with the others (determinant to determine the exact number of independent variables interpreting the variables dependent variables), it should be noted that the " Financial expediency" variable is explained by the remaining 50 , 4% ($R^2 = 0.504$), while the variable "Citizens' negligence" is inadequate ($R^2 = 0.137$, 13.7%).

Particularly, looking at Table 4, we notice that if we subtract the "random" variable from the scale, the internal reliability index is 0.750, so we could say that the remaining seven queries tie more closely to each other. In general, however, the credibility ratios are high after deleting a subject, and thus no significant increase in the credibility coefficient is achieved.

Then the ANOVA with Friedman's Test statistic (Table 5) was applied. According to this, the zero assumption was that

there were no differences in the results of the 8 variables. For each variable the significance level was calculated (significance level p is the error rate for generalization of results in the population defined at $p < 0.05$). The result with significance level $p = 0.00$ rejects the zero hypothesis.

Table 6: ANOVA with Friedman's Test

	Sum of Squares	df	Mean Square	Friedman's Chi-Square	Sig	
Between People	10232,897	420	24,364			
Within People	Between Items	1658,266 ^a	7	236,895	236,365	,000
	Residual	19016,984	2940	6,468		
	Total	20675,250	2947	7,016		
Total	30908,147	3367	9,180			
Grand Mean = 6,06						

a. Kendall's coefficient of concordance $W = ,054$.

B. Factor analysis

Taking into account the correlation Table 3, it is obvious that the correlations between the variables are satisfactory, in most cases, we see moderate to high values in the single correlation coefficients.

In order to determine whether the data complied with the requirements for sample analysis and correlation among queries, the KMO (Keiser-Meyer-Olkin) index was used. The KMO measures the suitability of the sample and Bartlett's Test of Sphericity determines the presence of correlations among the variables.

In our sample Keiser-Meyer-Olkin has a value of 0.710. The pointer gets values $0 \leq KMO \leq 1$. Values below 0.50 are considered unsatisfactory and may mean that more data is needed, up to 0.60 satisfactory, up to 0.80 good, up to 0.90 very good and higher than 0.90 excellent [4].

Also, Bartlett's Test of Sphericity shows that the sample is statistically significant with $p = 0.00$ (If $p < 0.05$ rejects the assumption of no significant correlations, at a 5% significance level indicating that the data is suitable for (control function 883,328, degrees of freedom $\kappa(\kappa-1) / 2 = 28$, $\kappa = 8$). The correlation matrix is the same as the correlation matrix. Thus, we have the magnitude of the correlations to be adequate for conducting the factorial analysis. (Table 7).

Table 7: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	,710	
Approx. Chi-Square	883,328	
Bartlett's Test of Sphericity		
	df	28,000
	Sig.	,000

In addition the MSA (Measures of Sampling Adequacy) index allows us to examine the suitability of each variable separately for its use in factorial analysis. Values near 1 are indications that the variable is very good to use. We observe

in our sample that the data on the matrix diagonal of the correlated correlation coefficients are high to very high, supporting the view that the model of factorial analysis is acceptable. Finally, the multiplication factors R^2 of each variable with the others have relatively high values from 0.367 to 0.814. The "Citizen negligence" variable has the shortest link to the others, but it was not considered appropriate to move away from the variable set.

Factors with an eigenvalue of > 1.0 were kept. The Varimax process was chosen to rotate the axes and for easier interpretation of the analysis, charging values greater than 0.40 was preferred. For each factor that emerged, the Internal Trust Index was also calculated as mentioned in the Reliability Analysis.

In Table 8 we note that the analysis showed that three factors had eigenvalues greater than 1.0, they interpreted comparatively larger dispersion than the others and that after rotation these factors interpreted 67,403% of the variance. The second column of the table shows the percentage of variance due to each factor after rotation.

The Scree Plot latent diagram is another way in which we can deduce how many factors will eventually remain. Thus, in Figure, after the three dots there is a smooth slope change.

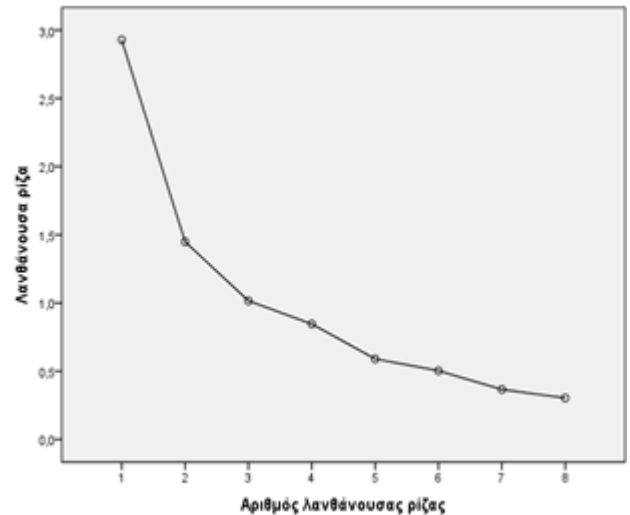


Figure 1: Scree Plot (diagrammatic control of smooth slope change)

Table 8: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,929	36,607	36,607	2,929	36,607	36,607	1,961	24,511	24,511
2	1,448	18,104	54,712	1,448	18,104	54,712	1,811	22,636	47,147
3	1,015	12,691	67,403	1,015	12,691	67,403	1,620	20,255	67,403
4	,846	10,572	77,974						
5	,590	7,372	85,347						
6	,503	6,287	91,634						
7	,366	4,575	96,209						
8	,303	3,791	100,000						
Extraction Method: Principal Component Analysis.									

The Tables 9, 10 illustrate the loads which are the partial correlation coefficients of the eight variables with each of the two factors that emerged from the analysis before and after the rotation. The greater the load of a variable on a factor, the more this factor is responsible for the overall variance of the variable we consider. Indeed, it becomes clear that the same result would have been produced even if we did not move the factors

After the rotation, the first factor includes the variables "Financial expediency", "Political expediency - elections", "Lack of cadastre". The second factor includes the variables "No timely extinction of fires at their initial stage" and "No arrangement or Removal of combustible matter". Correspondingly the third factor includes the variables "Citizen negligence", "Random event" and "Natural cause - lightning",

Table 9: Component Matrix^a

	Component		
	1	2	3
Cause - Citizens' negligence	,403	,363	,271
Cause - Random event	,234	,789	,123
Causes - Natural cause - lightning	,459	,684	-,041
Cause- Financial expediency	,726	-,233	,482
Political expediency - elections	,699	-,369	,373
There is No cadastre	,690	-,144	,023
Not timely extinguishing fires at their initial stage	,716	-,110	-,504
Non-arrangement - Removal of combustible matter	,704	-,056	-,547
Extraction Method: Principal Component Analysis.			
a. 3 components extracted.			

The variables belonging to each factor are those for which the load (column 1,2,3) is greater than the value of 0,50 in this factor.

Table 9: Component Matrix^a

	Component		
	1	2	3
Cause - Citizens' negligence	,305	,016	,523
Cause - Random event	-,065	-,024	,829
Causes - Natural cause - lightning	,025	,256	,784
Cause- Financial expediency	,884	,125	,128
Political expediency - elections	,850	,204	-,026
There is No cadastre	,538	,441	,116
Not timely extinguishing fires at their initial stage	,212	,854	,064
Non-arrangement - Removal of combustible matter	,156	,873	,102
Extraction Method: Principal Component Analysis.			
Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 5 iterations.			

4. Conclusions

Forests that have been destroyed by fires, illegal land clearing, natural causes, pests, diseases or insects have been the subject of research for many years, both for the significance of the above-mentioned causes of destruction and for ways of preventing and restoring them.

The recording of pupils' attitudes and opinions on issues of responsibility for human choices and actions against the natural environment and especially at the local level regarding the causes of forest fires in the Prefecture of Drama gave positive results.

After the factor and reliability analysis of our data, three factors were exploited. The first factor includes the variables "Financial expediency", "Political expediency - elections", "Lack of cadastre " and we can call it: "**The expediency as the cause of the forest fire in the Prefecture of Drama** ". It consists of three variables and interprets the 24,511% of the dispersion. The second factor includes the variables "**No timely extinction of fires at their initial stage** " and "**No arrangement or Removal of combustible matter** ", and It consists of two variables interpreting 22,636% of the dispersion and we can call it:

"**Incorrect management of forest fires in the Prefecture of Drama**". Correspondingly to the third factor are the variables "Citizens' negligence", "Random event" and "Natural causes - lightning", interpreting the 20,255% of the dispersion and we can call it: "**The mistake or luck as a cause of the forest fires in the Prefecture of Drama** ".

The results of the research lead to findings that can enhance the implementation of Environmental Education programs in public schools. Programs having specific objectives, meeting the needs of the local community in environmental issues, enhancing collaboration with the community and also pushing the student to act as an active member in the natural environment using his/her knowledge and adopting values and attitudes towards a responsible environmental behavior, while at the same time supporting the teachers with the appropriate training skills to set and achieve the goals of the programs.

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