University Students' Perceptions of the Environmental Issue and its Solution

D. E. Aggelis[1*], St. Avgoloupis[2], D. Vavougios[1], N. C. Zygouris[1]

[1] University of Thessaly
Lamia, Greece

[2] Aristotle University of Thessaloniki
Thessaloniki, Greece

[1] University of Thessaly
Volos. Greece

[1] University of Thessaly
Lamia, Greece

[*]*Corresponding author's email: dangelis [AT] cs.uth.gr*

ABSTRACT— *Ecological crisis management is related to the knowledge of the environmental issues and their impact. The evaluation of young people opinion on the factors, the burden grade and the public briefing concerning the solution of the current problems were studied through a questionnaire addressed to students of two university departments in Greece. The significance of the environmental education and the legislation as well as the need of responsible public information are crucial for the protection of nature from deleterious anthropogenic activities.*

Keywords—Environmental issues solution factors, burden grade, ozone layer depletion, greenhouse effect

---

1. INTRODUCTION

The reckless anthropogenic activities during the industrial revolution and after the Second World War caused extensive environmental problems with severe and probably irreversible impacts on the balance of ecosystems, natural resources, climate, human health and life, making urgent the immediate solution of the persistent environmental issue (IPCC 2014, Aggelis 2013).

2. DATA AND METHODOLOGY

The knowledge and understanding of the most intense impact of the ecological problem substantially contribute to its solution (UNESCO 1978; Sarabhai 2007). The aim of this study is to capture the extent to which young people are aware of the contemporary environmental issues and evaluate their potential solution through interviews and questionnaires, considered as flexible tools for this purpose (Ekborg & Areskoug 2006, Bird 2009). This study investigated the results of a questionnaire survey that was conducted among the students and graduates of the School of Primary Education of the Aristotle University of Thessaloniki and also students of Computer Science in the University of Thessaly. The students were informed that the questionnaire served research purposes and were asked to answer it individually and anonymously after a course. The distributed questionnaire was an extended development of the questionnaire used in Bob Simpson's Environmental Awareness Survey (Simpson, 1998), focusing on specific major environmental problems suitably adjusted to university students' level, in order to include not only major issues but also their impacts, factors and actions related to these impacts. Additionally the questionnaire aims to clarify the knowledge of the stratospheric ozone depletion and the greenhouse effect severe consequences since they are two of the most prominent global issues (Papadimitriou 2004, Negev 2010, Yang 2013).

The questionnaire consists of four sections (Appendix). The first section includes the factors that determine the solution of the environmental issue and a scale of evaluation in order to estimate the grade of importance of each factor related to the issue. The second section refers to the general perceptions of contemporary environmental issues and the grade of burden on the natural environment caused by a certain impact. The sections 3 and 4 deal with two specific issues: the stratospheric ozone depletion (ozone hole) and the enhanced greenhouse effect.

The procedure was conducted twice: preliminary and final part. The duration was set at 30 minutes in two phases: In the first phase the questionnaire was distributed in order to be completed within 15 minutes, without giving any information or clarification. After collecting the responses an explanatory text was given to be read within 5 minutes. In the second phase the initial questionnaire was redistributed to be completed again in 10 minutes. The preliminary part was conducted in February 2014 on 41 first year students from the Department of Primary Education of the Aristotle University of Thessaloniki (AUTH) and the Department of Computer Science of the University of Thessaly.

The same procedure with the new questionnaire and explanatory text was repeated in October 2014 on a new sample of 89 (1st Semester) students of the Department of Primary Education, AUTH, 28 Master Thesis students from the Department of Primary Education – AUTH and 31 (1st Semester) students of the Department of Computer Science.

The evaluation of the results of each section was performed by Statistical Package for Social Sciences (SPSS v.21). The Pearson correlation analysis was conducted to compare answers of the participants before and after reading the explanatory text. The result was considered statistically significant when Pearson's correlation coefficient $r \geq 0.7$, at a significance level of $(1-p){\cdot}100\% \geq 99.99\%$ or $p \leq 0.01$. Cronbach's Alpha coefficient "a" was also used to determine the internal consistency among the items of the test. Cronbach's Alpha was used in order to show how well the questions of the test measure a single – dimensional latent construct. If "a" value was above the satisfactory level 0.70 it means that the items measured the same construct and the test is reliable. The point biserial correlation was additionally included in the analysis since it determines the quality of the items in the test and thus revealed the extent to which they measured the same construct. The first estimation of "a" took into account all items in each section. The second estimation of "a", when one of the items was deleted in the analysis, made clear the contribution of each item to the consistency of each section and each phase in the test. This kind of item analysis was used to determine the internal consistency of the test and was related to the factors concerning the solution of the environmental problem (section 1), the major environmental issues (section 2), and certain aspects of the ozone depletion and the enhanced greenhouse effect (sections 3 and 4), which were the items included in the preliminary questionnaire (Appendix). The depiction of the aggregated results of each phase was drawn using the Origin v.8 and the correct answers in sections 3 and 4 are indicated with a positive sign.

3. RESULTS AND DISCUSSION

Preliminary part

In the first phase the environmental education, integrated information to citizens, control of industries and lifestyle attitude change were evaluated as the extraordinary important solution factors for the environmental issue (significance grade 8). The same factors were even more preferred in the second phase, with lifestyle attitude change slightly lower in the second phase. The environmental education, the integrated public information, the actions of non-governmental organizations (NGOs) and industries' control were again estimated as too important factors (7) in the first phase. In the late phase the governments' legislation, the actions of the NGOs, as well as the lifestyle attitude, the scientific assessments, the organizations decisions and the international protocols were considered as too important. In the first phase the organizations decisions emerged as a very important factor (6) while in the latter, beside the organizations decisions, NGOs actions and international are also evaluated with grade 6 and equal number of answers (Figure 1). Since the "Cronbach's alpha" coefficient value exceeds 0.8 in both phases and the Pearson correlation coefficient r statistically significant values, varying from 0.52 to 0.78, the factors, related to the environmental issue, can be reduced to less than nine, according to r values, revealing the correlation among them.
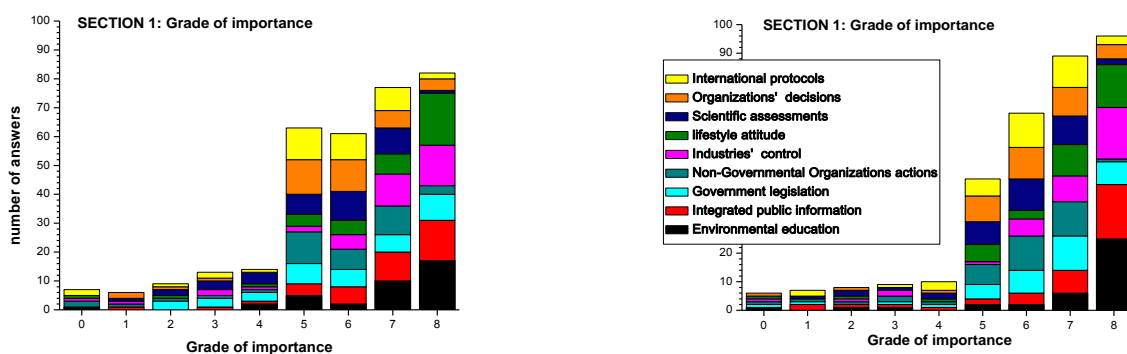

Figure 1: Histogram of growing significance grade for each factor in the first (left) and second (right) phase with the names of the nine factors concerning the solution of the environmental issue in the preliminary stage.

The results of item analysis presented in Table 1, referring to the nine factors concerning the environmental problem solution, showed that the test reliability was maximal at 0.825 and 0.800 in the first and the second phase respectively. The point biserial analysis for all these items - factors in columns II and III (Table 1) were above the satisfactory level of the intended consistency reliability 0.25 in both phases. The results showed that the questions included in the preliminary part - section 1 were of good quality (Alhajeri & Boyle, 2014; Hogen, 2007).

Table 1: Item analysis for items of the test referring to the nine factors-items concerning the solution of the environmental issue in the preliminary stage.

factor	*if* **Corrected item-Total Correlation**		***Cronbach's* Alpha if Item Deleted**	
	1st phase	2nd phase	1st phase	2nd phase
Environmental Education	0.45	0.38	0.82	0.80
Public Information	0.53	0.44	0.81	0.79
Government Legislation	0.57	0.53	0.80	0.78
NGOs Actions	0.30	0.31	0.83	0.81
Industries' Control	0.60	0.63	0.80	0.76
Lifestyle Attitude	0.63	0.50	0.80	0.78
Scientific Assessments	0.59	0.47	0.80	0.76
Organisations' Decisions	0/58	0.67	0.80	0.76
International Protocols	0.53	0.64	0.81	0.78

As for section 2, in the first phase students remarkably showed that the nuclear accidents and nuclear tests cause extremely great burden (13) on Earth's environment, while in the second phase the enhanced greenhouse effect was also estimated as extremely burdensome. In the second phase the impact of the greenhouse effect and the destruction of stratospheric ozone by chlorofluorocarbons were considered to have too great burden grade (12).The destruction of stratospheric ozone was estimated to have a very great burden (11) on the environment in both phases (Figure 2). Moderate values of both the two "Cronbach's alpha" coefficient estimations (a=0.5) and the Pearson correlation coefficient r indicate a grouping of the 14 mentioned individual problems based on other criteria.
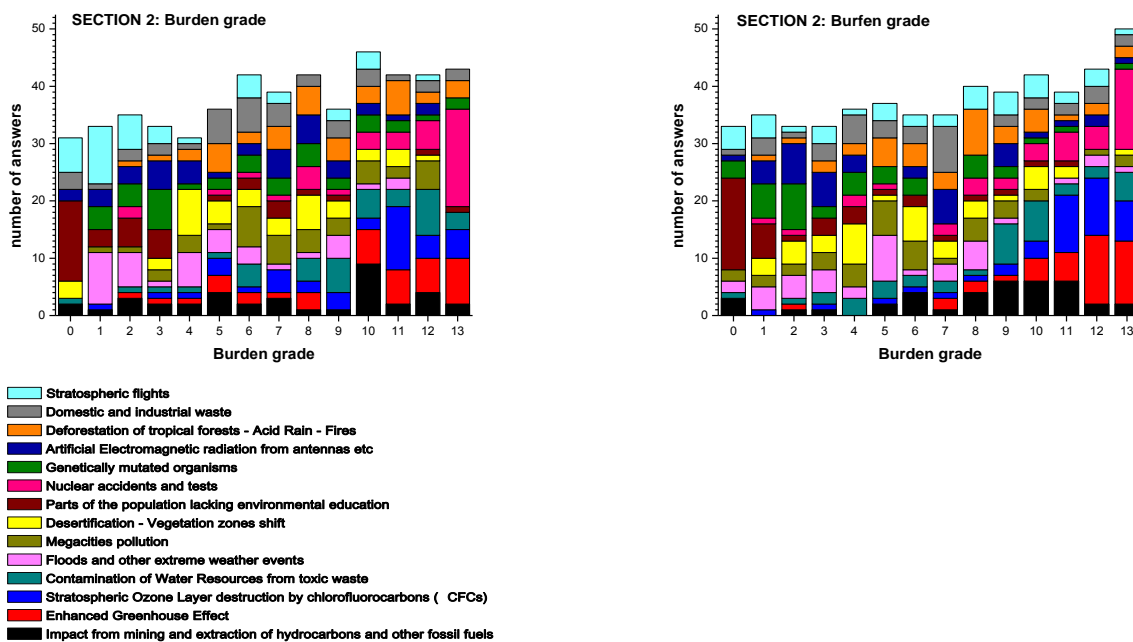

Figure 2: Histogram of growing burden grade for each environmental problem in the first (left) and second (right) phase with the names of the fourteen environmental problems in the preliminary stage.

The explanatory text helped in choosing the correct answers referring to the ozone "hole", which is not related to near surface ozone produced by the nitrogen oxides in the presence of sunlight and is associated with the ozone layer at an altitude of about 25 km above sea level. The same text did not highlight the correct answers related to the mean temperature rise, the ice melting in Antarctica and the Moon phases. No changes were observed from one phase to the other concerning the relation of the ozone hole to the arrival of less ultraviolet solar radiation on the Earth's surface and the nuclear accidents (Figure 3). Neither internal consistency (a=0.1) nor statistically significant correlation was indicated in this sample reliability test. Questions should be rephrased.
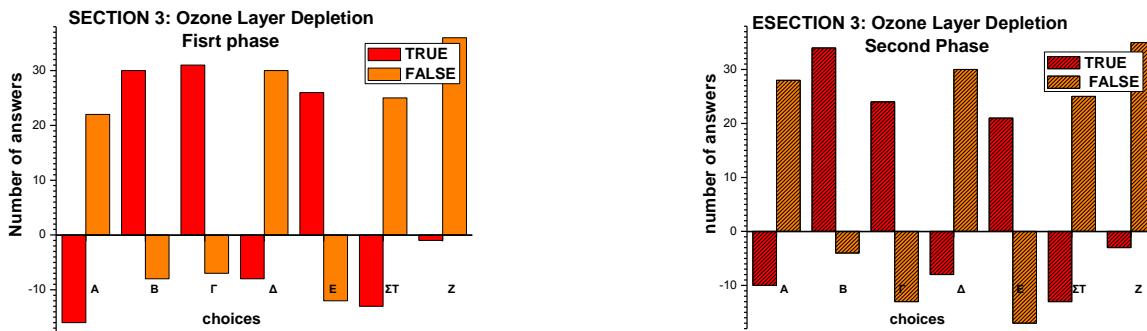
Figure 3: Histogram of answers referring to the ozone depletion layer in the preliminary stage
(The individual choices are assigned with the Greek letters A, B, Γ, Δ, E, ΣT and Z in order to be distinguished from the same choices in the final part).

The explanatory text helped in choosing the right answers concerning the relation of the enhanced greenhouse effect to: a) the ice melting, b) the cultivation of suitable plants using photosynthesis in order to withdraw carbon dioxide from the atmosphere, c) the mean surface temperature rise of the planet and d) the carbon dioxide and methane emissions increase in the atmosphere. The text failed to clarify the negative relation to the emission of greater amount of infrared radiation from Earth to space and the mean sea level reduction (Figure 4). High values of the "Cronbach's alpha" coefficient and moderate Pearson correlation coefficient, especially in the first phase, though statistically significant, proved to be misleading and of no physical meaning concerning the internal consistency of the sample.
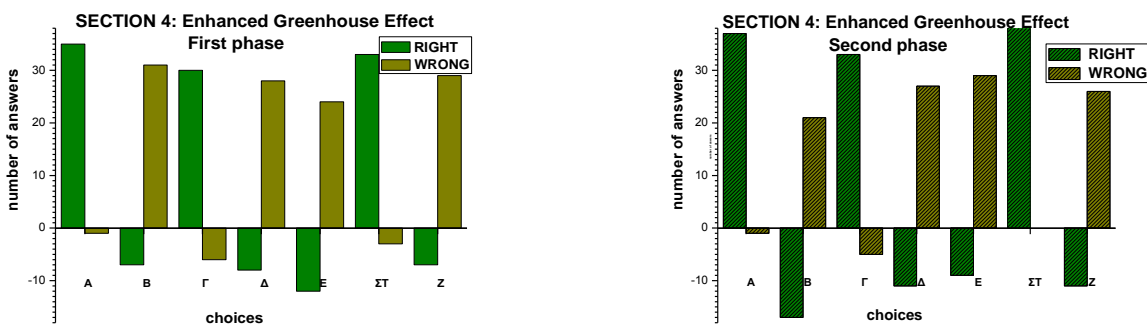
Figure 4: Histogram of answers referring to the enhanced greenhouse effect in the preliminary stage
(The individual choices are assigned with the Greek letters A, B, Γ, Δ, E, ΣT and Z in order to be distinguished from the same choices in the final part).

The preliminary study led to the grouping of the initial nine factors in the first section to three factors in the new questionnaire version: environmental education-information, legislation, scientific assessments-actions.

For a better validation of the degree of burden in Section 2 four criteria were combined: the (ir) reversible, the extent and duration of the impact of environmental problems, leading to four groups of environmental issues: ground-water contamination, pollution-extreme weather, stratospheric ozone depletion, nuclear accidents and tests.

The effects of the artificial electromagnetic radiation by antennas and other sources were not included in the final version of the questionnaire because such an issue may be studied as an independent one because of its local character. This issue was also strengthened by the fact that alpha became higher when this item was excluded in the calculation process.

The explanatory text does not fully cover all sections, but mainly sections 3 and 4, for which special knowledge is required. In these sections, the options YES or NO were preferred instead of the initial TRUE/FALSE or RIGHT/WRONG. Additionally the questions were rephrased in order to clearly indicate if the is any relation to the ozone hole or the enhanced greenhouse effect respectively. The new distribution of answers and the comparison were done by assessing the correlation coefficient between the individual samples (Appendix).

Final part

The environmental education and the public information were considered to play the most important role in the environmental issue management in both phases. The grouped factors display similar behaviour in the three samples (Fig. 5).

The nuclear accidents and nuclear tests were proved to exercise the most severe impact on nature. The soil and water resources contamination seem to have a not negligible share of burden grade (3) mainly in the first phase. A similar result stands for the stratospheric ozone destruction in the first phase and the greenhouse effect-pollution-extreme events group in the second phase. In the second phase there was a tendency of equal-balanced numbers of responses concerning the greater grade of burden (4) in all samples. This tendency implied that students realised the crucial consequences of all grouped environmental problems (Fig. 6).

As for the ozone "hole", section 3, the majority of students chose the correct answers but no significant differences were observed between the two phases (Fig. 7).

In section 4, the explanatory text didn't improve the understanding of the greenhouse effect, though the majority of choices were correct. Preferable answers in majority were the correct ones in all samples (Fig. 8).
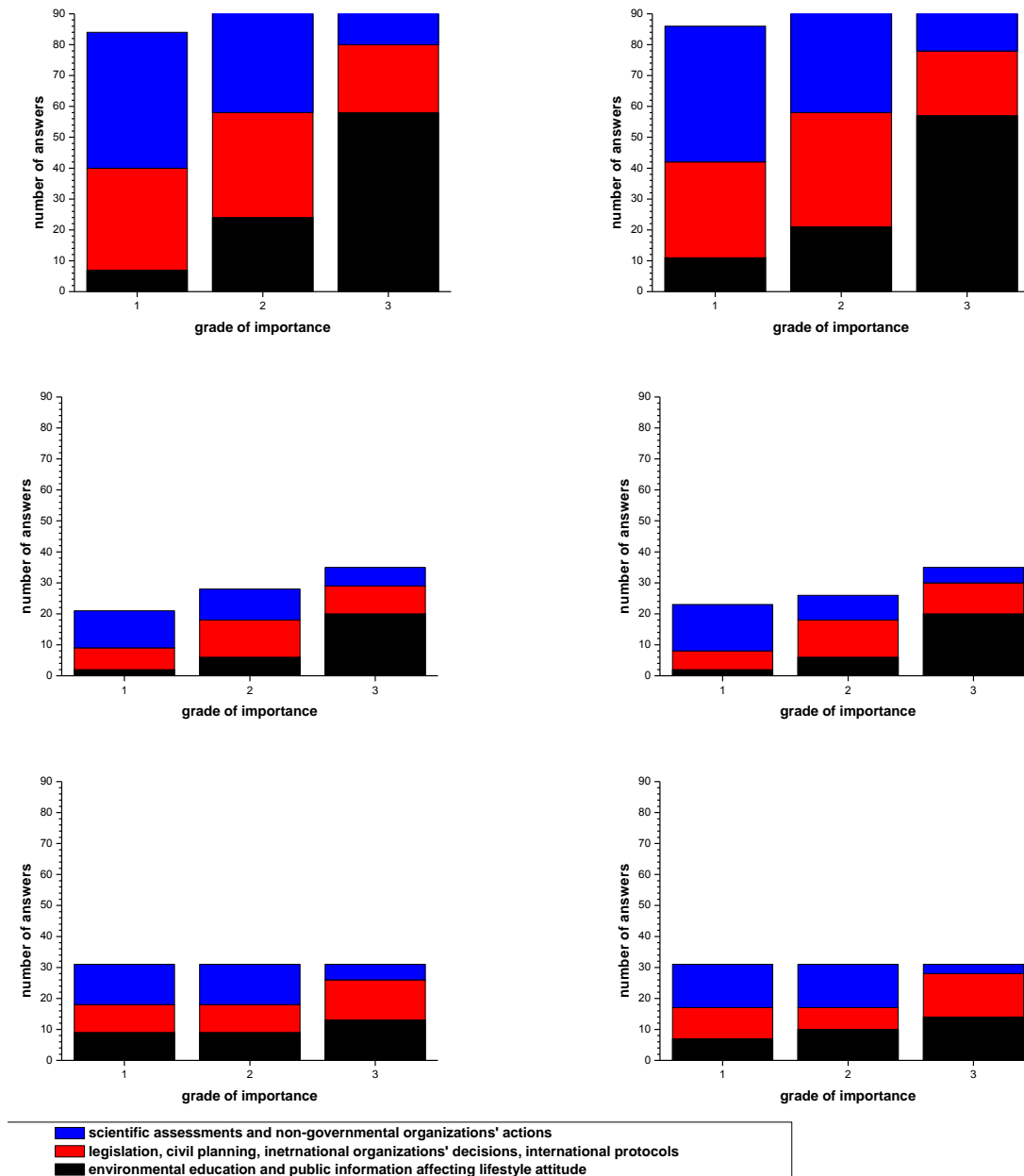
Figure 5: Histogram of growing grade of importance for each grouped factor in the first (left) and second (right) phase with the names of the three grouped factors concerning the solution of the environmental issue in the final stage from Dept. of Primary Education in AUTH (top) Master Thesis Dept. of Primary Education in AUTH (middle) and Department of Computer Science in the University of Thessaly (bottom).
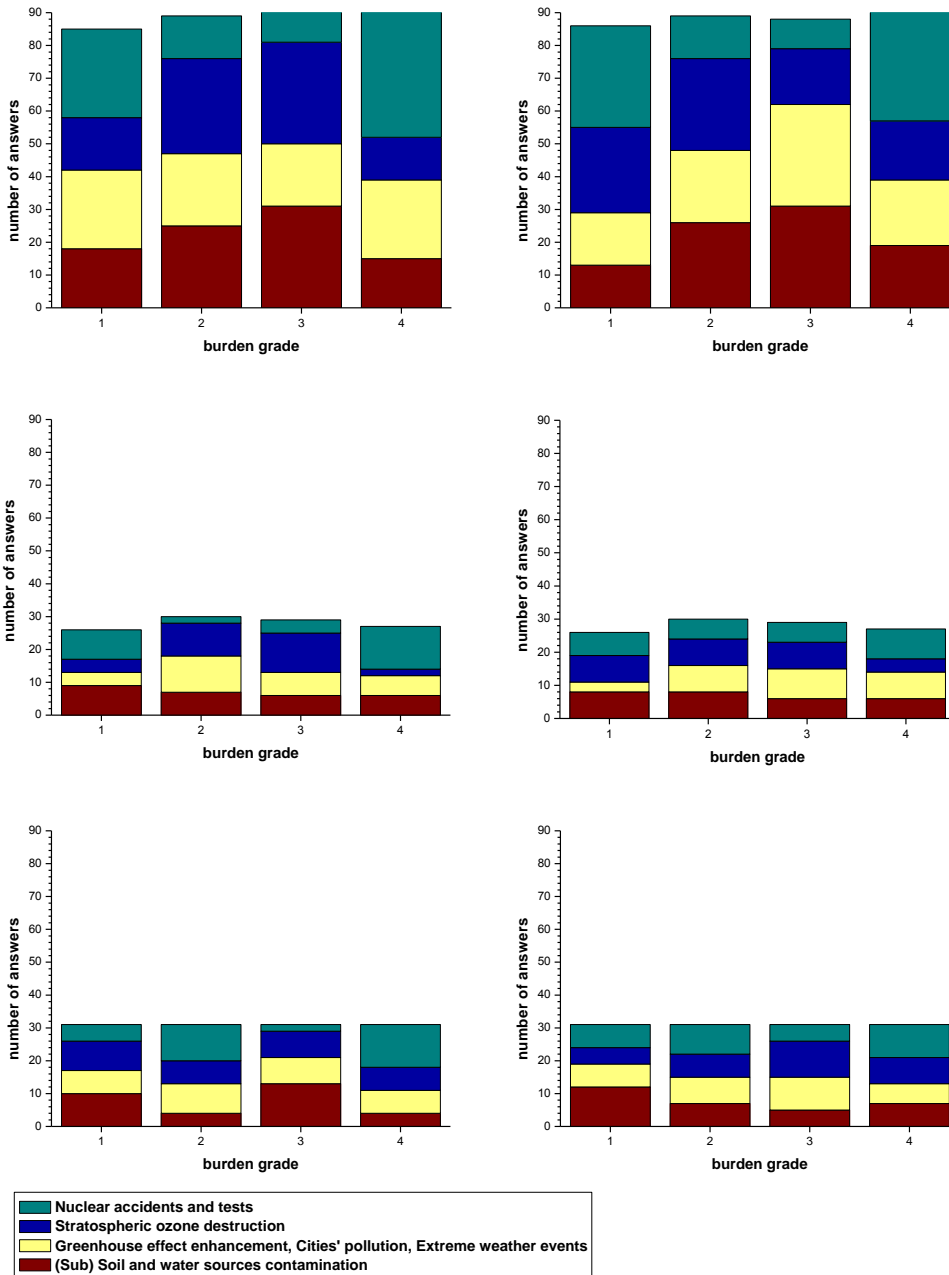
Figure 6: Histogram of growing burden grade for each environmental problem group in the first (left) and second (right) phase with the names of the fourteen environmental problems in the final stage from Dept. of Primary Education in AUTH (top) Master Thesis Dept. of Primary Education in AUTH (middle) and Dept. of Computer Science in the University of Thessaly (bottom).
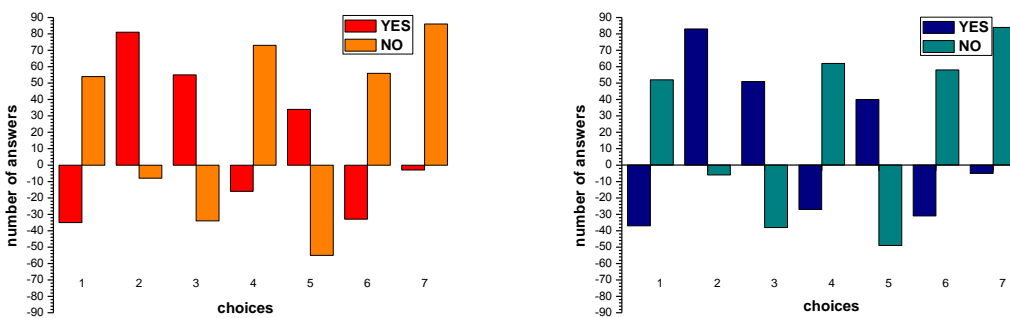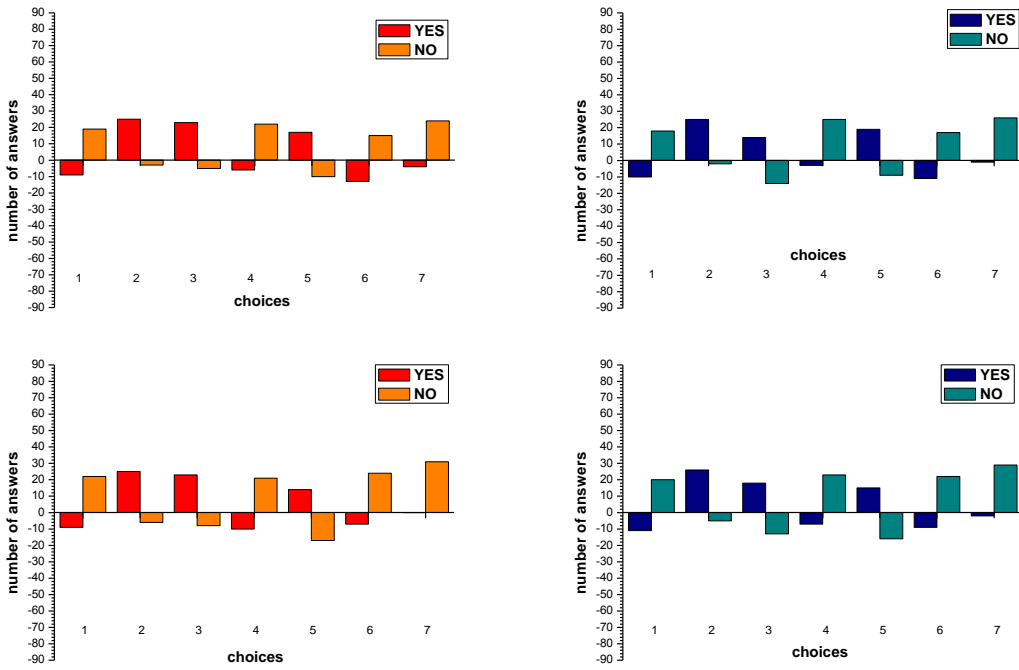
Figure 7: Histogram of answers referring to the ozone depletion layer in the final stage from Dept. of Primary Education in AUTH (top) Master Thesis Dept. of Primary Education in AUTH (middle) and Department of Computer Science in the University of Thessaly (bottom).

Figure 8: Histogram of answers referring to the enhanced greenhouse effect in the final stage from Dept. of Primary Education in AUTH (top) Master Thesis Dept. of Primary Education in AUTH (middle) and Department of Computer Science in the University of Thessaly (bottom).
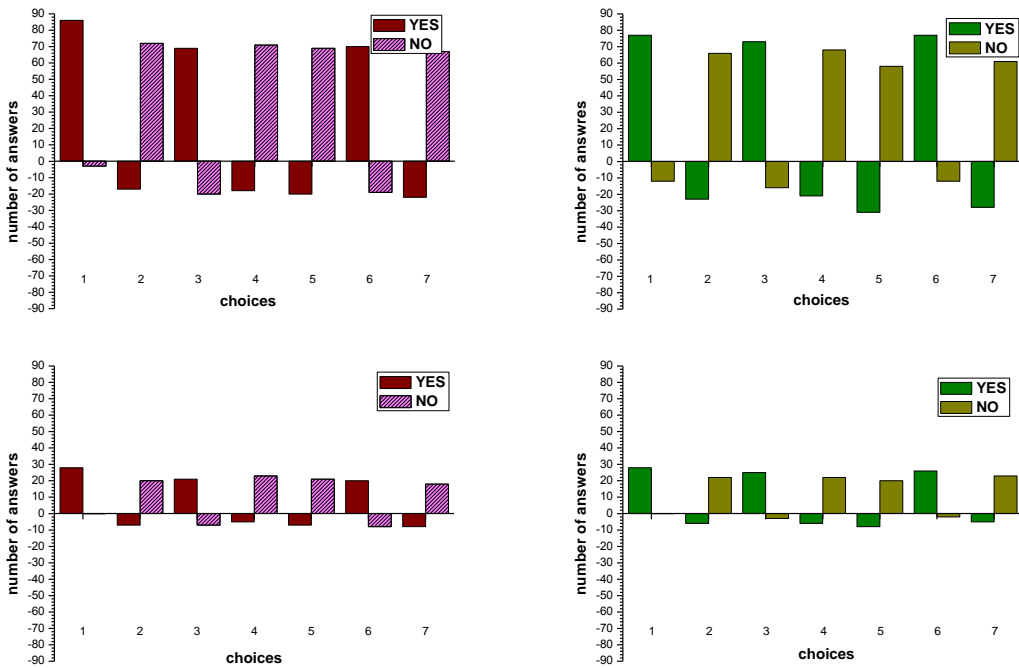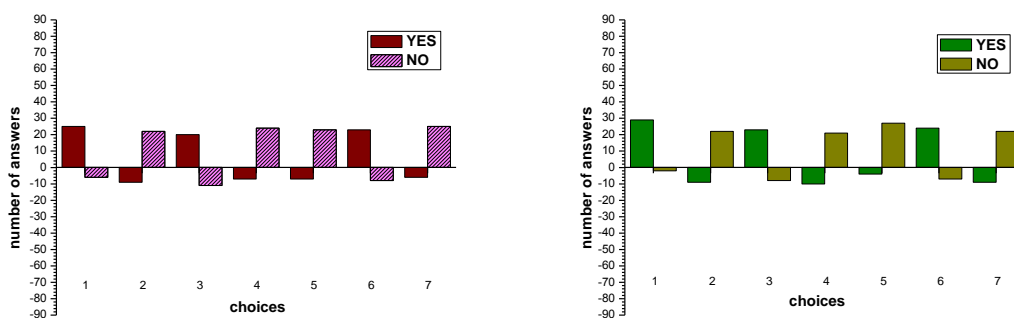
4. CONCLUSIONS AND RECOMMENDATIONS

The environmental education and the public information related to the lifestyle attitude were considered to be essential in the environmental issue solution, although there are other factors that influence the understanding of environmental issue (Abbas 2014, Boon 2011). The results in this study also indicated that legislation could contribute more to this purpose if the implementations of laws, civil planning and protocols were successful.

The students understood well the terms extension and duration of an environmental problem concerning the burden grade. It might be better to replace the scale "(ir) reversible, extensive and long/short-lasting" with the scale "(non) permanent, extensive and long/short-lasting".

Although the vast majority of the students gave the correct answers concerning the ozone "hole" and the enhanced greenhouse effect, a thorough comprehension of these phenomena and the related terms is required beyond a careful reading of information introduced in the explanatory text. Confusion and misunderstanding on the characteristics of the ozone depletion and the greenhouse effect still seem to exist even among the Primary Education Master Thesis students, findings which require the introduction of more effective methods in environmental training (Boon 2011, Maffia 2011, Çimer 2011).

5. REFERENCES

[1] Abbas, M.Y., Singh R. A Survey of Environmental Awareness, Attitude, and Participation amongst University Students: A Case Study International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Impact Factor (2012): 3.358 Volume 3 Issue 5, May 2014.

[2] Aggelis, D., Zanis, P., Zerefos, C.S., Bais, A.F., Nastos, P.T. Mapping of Surface Ozone Seasonality and Trends Across Europe During 1997–2006 Through Kriging Interpolation to Observational Data. Water Air and Soil Pollution 224:1501. doi: 10.1007/s11270-013-1501-9, 2013.

[3] Alhajeri, A.A., & Boyle, J. Development of a Diagnostic Instrument to Identify Reading, Writing and Numeracy Difficulties in Arabic before Entry to Primary School in Bahrain. International Journal of Learning Management Systems, 2, 1, 1 – 19, 2014.

[4] Bird, D.K. The use of questionnaires for acquiring information on public perception of natural hazards and risk mitigation – a review of current knowledge and practice. Nat. Hazards Earth Syst. Sci., 9, 1307–1325, 2009 www.nat-hazards-earth-syst-sci.net/9/1307/2009.

[5] Boon, H.J. Climate Change? Who Knows? A Comparison of Secondary Students and Pre-service Teachers. Australian Journal of Teacher Education, vol. 35(1). DOI: 10.14221/ajte.2010v35n1.9, 2010.

[6] Çimer, S.O., Çimer, A., Ursavas, N. Student Teachers' Conceptions about Global Warming and Changes in Their Conceptions during Pre-Service Education: A Cross Educational Research and Reviews 6(8),592-597, 2011.

[7] Ekborg, M., & Areskoug, M. How student teachers' understanding of the greenhouse effect develops during a teacher education programme. Nordic Studies in Science Education. Vol 2, No 3, 2006.

[8] Hogan, T. Psychological testing: A practical introduction (2nd ed). U.S: John Willey & Sons Inc., 2007.

[9] Intergovernmental Panel on Climate Change. Climate Change, IPCC 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2014.

[10] Maffia, A.M.C., Silva, E., Jacovine, L.A.G. Environment and environmental awareness: how university students conceive and act Acta Scientiarum. Biological Sciences Maringá, v. 33, n. 2, p. 209-214, 2011 DOI: 10.4025/actascibiolsci.v33i2.7570.

[11] Papadimitriou, V. Prospective Primary Teachers' Understanding of Climate Change, Greenhouse Effect, and Ozone Layer Depletion. Journal of Science Education and Technology. June 2004, Volume 13, Issue 2 , pp 299-307, 2004. DOI: 10.1023/B:JOST.0000031268.72848.6d.

[12] Negev, M., Garb, Y., Biller, R., Sagy, G., and Tal, A. Environmental Problems, Causes, and Solutions: An Open Question. The Journal of Environmental Education, 41 (2), 101–115, 2010. DOI: 10.1080/00958960903295258.

[13] Sarabhai, K.V., Pandya, M., Namagiri, R.. Tbilisi to Ahmedabad: The journey of environmental education. Ahmedabad: The Center for Environmental Education, 2007.

[14] Simpson, R. Global Issues in Language Education Newsletters: Issue 30. March 1998. (p. 12 - 14) reprinted by permission from Green Teacher Magazine, Issue 27 (p. 10).

[15] The Tbilisi Declaration. UNSCO/UNEP Environmental Education Newsletter, Vol. III, No. 1 (January 1978). Final report: Intergovernmental Conference on Environmental Education organized by UNESCO in cooperation with UNEP, Tbilisi, Georgia, USSR, 14–26 October 1977. Paris: UNESCO, 1978.

[16] Yang, Y. Analysis of Solution to Environmental Law Education for College Students. Beijing Law Review. Vol.4, No.3, 100-102, 2013. doi: 10.4236/blr.2013.43013.

6.   APPENDICES

A. The initial questionnaire:

Section 1. Evaluate from 0 (not at all important) to 8 (extremely important) the grade of importance which is considered to have each of the following factors implicated in the solution of the environmental issue.

A. The environmental education
B. The public information
C. The governments legislation
D. The non-governmental organizations (NGOs) actions
E. The industries control
F. The lifestyle attitude
G. The scientific assessments
H. The organizations decisions such as the EU, UN, etc
I. The international protocols such as Kyoto, Rio, Montreal, etc.

Scale of importance	Grade
Extremely important	8
Too important	7
Very important	6
Important	5
Moderately important	4
Relatively important	3
A little important	2
Minimally important	1
Not at all important	0

Section 2. Evaluate the increasing burden grade from 0 (minimal) to 13 extremely great) caused by the following environmental problems:

A. Impact from mining and extraction of hydrocarbons and other fossil fuels.	
B. Enhanced Greenhouse Effect	
C. Stratospheric Ozone Layer destruction by chlorofluorocarbons (CFCs)	
D. Contamination of Water Resources from toxic waste	
E. Floods and other extreme weather events	
F. Megacities Pollution	
G. Desertification - Shifting vegetation zones	
H. Sections of the population, who lack environmental education.	
I. Nuclear Accident - Nuclear Testing.	
J. GMOs.	
K. Artificial Electromagnetic radiation from antennas etc.	
L. Deforestation of tropical forests - Acid Rain - Fires.	
M. Household and industrial waste	
N. Stratospheric flights.	

Burden Grade Scale	Grade
Extremely great	13
Too great	12
Very great	11
Great	10
Irreversible severe	9
Reversible severe	8
Severe	7
Moderately severe	6
Moderate but not severe	5
Small	4
Annoying	3
Evident / visible measurable	2
Detectable	1
Minimal	0

Section 3. Classify as TRUE or FALSE the relationship of ozone hole:

A. the near surface ozone produced by nitrogen oxides in the presence of sunlight.
B. the ozone layer depletion about 25 km above sea level.
C. the mean temperature rise.
D. the arrival of less ultraviolet solar radiation on the Earth's surface.
E. the ice melting in Antarctica.
F. the nuclear accidents.
G. the moon phases.

Section 4. Classify which of the following statements are RIGHT or WRONG. The enhanced greenhouse effect is associated with:

A. the mean surface temperature rise of the planet.
B. the emission of greater amount of infrared radiation from earth to space.
C. the carbon dioxide and methane emissions increase in the atmosphere.
D. the mean sea level reduction.
E. the cultivation of suitable plants using photosynthesis in order to withdraw carbon dioxide from the atmosphere.
F. the ice melting.
G. radioactivity increase in the atmosphere.

B. Results of the final questionnaire

Section 1: Growing grade of importance for each grouped factor

Grouped *Factor* →	1st phase			2nd phase		
	Education-Public information	*Scientific assessments-NGOs actions*	*Legislation etc*	*Education-Public information*	*Scientific assessments-NGOs actions*	*Legislation etc*
Grade of importance ↓	Department of Primary Education, AUTH					
1	7	33	44	11	31	44
2	24	34	35	21	37	32
3	58	22	10	57	21	13
	Department of Primary Education M.Sc.– AUTH					
1	2	7	12	2	6	15
2	6	12	10	6	12	8
3	20	9	6	20	10	5
	Department of Computer Science University of Thessaly					
1	9	9	13	7	10	14
2	9	9	13	10	7	14
3	13	13	5	14	14	3

Section 2: Growing burden grade for each environmental problem group

Environmental Problem group →	1st phase				2nd phase			
	Soil/water sources contamination	*Greenhouse effect-Pollution-Extreme events*	*Stratospheric ozone destruction*	*Nuclear accidents/ tests*	*Soil/water sources contamination*	*Greenhouse effect-Pollution-Extreme events*	*Stratospheric ozone destruction*	*Nuclear accidents/ tests*
Burden grade ↓	Department of Primary Education, AUTH							
1	18	24	16	27	13	16	26	31
2	25	22	29	13	26	22	28	13
3	31	19	31	9	31	31	17	9
4	15	24	13	40	19	20	18	36
	Department of Primary Education M.Sc.– AUTH							
1	9	4	4	9	8	3	8	7
2	7	11	10	2	8	8	8	6
3	6	7	12	4	6	9	8	6
4	6	6	2	13	6	8	4	9
	Department of Computer Science - Thessaly							
1	10	7	9	5	12	7	5	7
2	4	9	7	11	7	8	7	9
3	13	8	8	2	5	10	11	5
4	4	7	7	13	7	6	8	10

Section 3: Number of answers related to the Stratospheric Ozone Depletion. The correct answers are indicated with a positive sign.

Stratospheric Ozone Depletion

choice	1st phase		2nd phase	
	YES	NO	YES	NO
Department of Primary Education, AUTH				
1	-35	54	-37	52
2	81	-8	83	-6
3	55	-34	51	-38
4	-16	73	-27	62
5	34	-55	40	-49
6	-33	56	-31	58
7	-3	86	-5	84
Department of Primary Education M.Sc.– AUTH				
1	-9	19	-10	18
2	25	-3	25	-2
3	23	-5	14	-14
4	-6	22	-3	25
5	17	-10	19	-9
6	-13	15	-11	17
7	-4	24	-1	26
Department of Computer Science - Thessaly				
1	-9	22	-11	20
2	25	-6	26	-5
3	23	-8	18	-13
4	-10	21	-7	23
5	14	-17	15	-16
6	-7	24	-9	22
7	0	31	-2	29

Section 4: Number of answers related to the Enhanced Greenhouse Effect. The correct answers are indicated with a positive sign.

	Enhanced Greenhouse Effect			
	1st phase		2nd phase	
choice	YES	NO	YES	NO
Department of Primary Education, AUTH				
1	86	-3	77	-12
2	-17	72	-23	66
3	69	-20	73	-16
4	-18	71	-21	68
5	-20	69	-31	58
6	70	-19	77	-12
7	-22	67	-28	61
Department of Primary Education M.Sc.– AUTH				
1	28	0	28	0
2	-7	20	-6	22
3	21	-7	25	-3
4	-5	23	-6	22
5	-7	21	-8	20
6	20	-8	26	-2
7	-8	18	-5	23
Department of Computer Science - Thessaly				
1	25	-6	29	-2
2	-9	22	-9	22
3	20	-11	23	-8
4	-7	24	-10	21
5	-7	23	-4	27
6	23	-8	24	-7
7	-6	25	-9	22

C. Explanatory Text

Nuclear power itself is neither good nor bad. It is the use that highlights its nature, e.g. nuclear power plants (good) or nuclear bombs (bad). The same applies to our attitude towards our natural environment which we exploit irrationally, forgetting that we live in relationship and reference to it, and that its resources are not inexhaustible.

Understanding the consequences of two global phenomena, the greenhouse effect and the ozone layer depletion, we could have a clear picture of the current environmental problems and thus to realize the urgency of the solution of these problems.

The standard greenhouse effect makes possible the evolution of life on the Earth's surface keeping the average surface temperature at 15 ^{O}C, because carbon dioxide, methane, water vapor and other greenhouse gases in the atmosphere absorb the infrared radiation emitted from the earth into space.

An increase of these greenhouse gases concentration due to human activities disturb and ultimately enhances the existing greenhouse effect (enhanced greenhouse effect), leading to global warming, changes in the ocean currents, changes in the salinity of water, melting and reduction of ice cover in the Arctic, Antarctica, the Alps and elsewhere, as well as more frequent extreme weather events and irreversible climate changes such as floods, more powerful cyclones, desertification, etc.

Weather events are formed mainly in the lower atmosphere, the troposphere, up to the height of 11-12 km. Ozone is found in the stratosphere, above 25 km, acting as a shield to the incoming ultraviolet solar radiation, which is dangerous to human health and vegetation. The release of CFCs and other substances in the atmosphere, especially after the Second World War, as well as the flights of aircraft at very high altitudes are causing a substantial decrease in the amount of ozone in this height. The reduction (the depletion) of ozone is called "ozone hole" and was originally discovered in Antarctica.

The good (stratospheric) ozone should not be confused with the bad (tropospheric) ozone, which is formed near the earth's surface by nitrogen oxides in the presence of sunlight. Near surface ozone is associated with serious cardiovascular problems, materials corrosion, spread of epidemics, etc.

Climate change is also affected by:

a) Acid rain. Air pollutants containing carbon dioxide, sulfur oxides, water vapor and other elements, in the presence of sunlight, form acids which disperse in the atmosphere. These acids falling with rain drops destroy vast forest areas, degrade life in lakes and wetlands and affect cultural monuments.

b) Forest areas are also devastated by intensive deforestation, indiscriminate felling and the lack of planting, resulting in soil erosion, oxygen reduction which is produced by photosynthesis, ecosystems extinction, etc.

c) Even pesticides, insecticides and other toxic wastes penetrate in the groundwater and salty water entrance in cultivated soil, which lead to desertification, are factors that cause long-term climate change.