

THE CONTRIBUTION OF EDUCATION FOR SUSTAINABLE DEVELOPMENT IN ADDRESSING ETHICAL ISSUES OF CLIMATE CHANGE

N. Tzaberis¹, S. Xenitidou², A. Mogias³

¹*University of the Aegean, Dimokratias 1, Rhodes, 85100, Greece*

²*Science Center and Technology Museum, Thermi, 75100, Greece*

³*Democritus University of Thrace, Alexandroupoli, 68100, Greece*

Abstract

The aim of this paper is to approach a combination of the material and spiritual culture that could meet the current challenges of climate change. Achieving this goal requires individual and collective responsibility based on values such as respect, justice and unity. The current culture, grounded on the values of expansionism of possessiveness and satisfaction of uncontrollable desires, applies a peculiar economic policy for decision making, ineffective in addressing environmental problems, ignoring the fact that the root causes are primarily moral and spiritual in nature.

Effective confrontation of the issue requires new ethics for the society based on trustworthiness, starting from a sustainable economy which in turn requires actions in accordance with the degree of development of those personality parameters that define moral behavior. In this context, sustainability essentially appears to be an ethical concept aimed at joining nature and humanity. Education on environmental issues and sustainability can substantially contribute in the direction of establishing a new ethical consciousness and philosophy of life to eventually change the current materialistic and egocentric attitudes in order to bring man in contact with his real, inner nature and the world surrounding him.

Keywords Ethical issues, climate change, Education for Sustainable Development

Introduction

Climate change, the accumulation of toxic chemicals, the energy deficit and the full utilization of the earth's photosynthetic capacity by humans are just some of the environmental problems humanity faces [1, 2]. In particular climate change provokes extreme weather phenomena, melting glaciers, water shortages, changing climate conditions for agriculture, rising sea levels, millions of environmental refugees, high costs of mitigation and adaptation to the effects, greater impact on the economically disadvantaged, and many other [3].

Natural systems are dramatically changing use [4] and planetary bio-diversity is largely threatened [5, 6]. People have been moving away from nature and gathering in urban centers, thus losing their sense of environmental awareness ("extinction of experience") [7, 8, 9]. Humanity is an integral part of the environment. As emphasized by Suzuki [10], science confirms the ancient idea that what humans do to the environment they do directly to themselves, and thus the environmental crisis is a crisis of human society.

The effects of these problems are global, affecting the quality of life and creating social inequalities [11]. The mainstream practice has been perpetuated by the capitalist, consumer system [12], which promotes the ever increasing pursuit for satisfying the materialistic human demands as its main tool [13]. Ethics, although an indispensable factor in taking the correct decisions for the community, seem to be inadequately supported, leaving many social and environmental problems unsolved [14].

A simple change is not enough to prevent this painful development. On the contrary, a profound differentiation is required, proportional to the size of the huge problems that the planet encounters [15]. In an effort to implement effective ways to solve environmental problems international organizations, governments and local communities have turned to science, research and education [16]. Especially, environmental education is considered to be a significant tool because it creates social dynamics, promotes a cooperative and critical approach to reality and enhances the creative understanding of environmental problems and the search for possible solutions [17].

The purpose of Education for Sustainable Development is to prepare students so that they can actively participate in securing that “such forms of political economy, democracy and citizenship will enable the world’s people to live sustainably with one another and the rest of nature” [18]. It envisages and sets the foundations for a different kind of school [19, 20, 21, 22], where children, adults and the whole community will interact and learn all together [23].

Climate change effects

There are thousands of publications on the explanation of climate change, what has an effect on and how big this effect is. References also contain a lot of information on the possibility of protection, how this can be achieved and if people can correct mistakes of the past.

The difference in temperature increase compared to the past is a result of solar radiation and volcanic activity of the last 1,000 years and also of human activities of the last 150 years [24]. Fossil fuel burning and forest destruction on one hand, agriculture, stock-raising and transportation on the other, intensify climate change by contributing considerably to green house gases. Changes on vegetation distribution, atmospheric and oceanic temperature are considered to have the atmospheric circulation and all physical and biological systems altered [25].

An anthropocentric approach of climate change could be developed based on water, health, urbanisation and security, environment and economy.

Concerning water resources, there is an increase of salinization of ground waters [26]. The increase of the frequency of warm days, of the daily temperature variation and the frequency of high precipitation are all worldwide phenomena [25]. In addition, winter snowfall decreases and the high spring runoff has moved to an earlier stage causing fast erosion in late winter [27] and farmland loss. Climate change will affect people that live in basins where groundwater table and rivers feed from snowfall [29, 30]. Project CC Waters (Global water Partnership, OECD, IPCC) estimates 20% decrease of available water resources by the end of the century, and 20% increase of water needs due to land use changes and extend of summer period. UNEP reports that in the year 2000 four hundred million people suffered from serious water shortage and the organization predicts that by the year 2050 four billion people will be affected by serious decrease of water reserves. Research argues as to whether climate change has reached a point that practically nothing can reverse the current conditions.

In relation to health, increased use of nitrates, phosphates and agrochemicals will lead to eutrophication of surface and coastal waters [31]. Excess precipitation causes strong surface runoff and extensive ground erosion, thus resulting in nutrient removal and pollution of surface waters, depletion of dissolved oxygen and growth of toxic cyanobacteria that in turn will threaten human and ecosystem health [32]. Furthermore, increases of drought and temperature have the potential to increase microbial loading in the ground and water reservoirs [33]. To state an example, in New York after heavy rainfall 380,000 – 7,500,000 m³ of mixed water and sewage pollutes surface and ground water with toxic substances [34].

Climate change also has been affecting urbanization and safety since the 70’s by increasing considerably the cost of compensation for flood damages on coastal settlements and for human losses [25, 35]. Other effects refer on tourism and transportation [36]. On one hand, world food production contributes to climate change through the increase of fertilizer use and CO₂ emissions; on the other, climate change has an impact on food production by salinization of groundwater, extreme weather conditions and floods [37, 38]. As a result, the UN cannot achieve its main goal, which is good quality and low-cost food for all people.

Climate change causes extensive alteration or even complete loss of habitats, changes in animal and plant species composition and diversity with distinct impact on endemic species [39, 29]. Diversity and composition of ecosystems directly relate to temperature and precipitation. The raise of the level of the lowest temperature and the extremely high precipitation will affect both diversity and composition of ecosystems [40, 41].

In the economy sector, water power stations will decrease their production and consumers will modify their habits as Eurobarometer foresees [42]. The US EPA and FAO predict a significant decrease of farmers’ income at world level with an exemption of mid latitudes where temperature raise of 1-2°C might have a positive effect. Some crops at certain areas around the world will be positively affected while at others, such as South Asia and South

Africa, will not be enough to cover people's needs for food [43]. Fast agriculture development will continue until the year 2050 and by then around 10 billion hectares of natural ecosystems will have shifted to farmland [31]. Many researchers predict a significant decrease of agricultural production (in some scenarios 20%) and a price increase of irrigated crops and particularly of cereals [44]. The famous financial research Stern Review proposes that 1% of the world's GAP should be invested, otherwise economic damage due to climate change will be higher than both world wars and the crash in the 1930's. According to this research the annual cost of climate change will exceed 660 billion dollars (5-20% of world's GAP). About 40% of species will disappear, 550 million people will starve, and drought and desertification will cause huge immigration waves [45]. IPCC considers this an underestimation and that damage on natural environment will be more severe.

Increase of temperature at the world level occurs mainly over land than oceans. According to IPCC [29] precipitation increased during 1900 – 2005 at the east part of North and South America, Northern Europe and Central Asia. During the same period it decreased in the Mediterranean, South Africa, South Asia and especially in Japan. Furthermore, heat waves have become more frequent, longer and more intense in North America and Europe during the second half of the 20th century [47]. There is also an Australian comprehensive up-to-date study (the Garnaut Review) [48], equivalent to the extent of the Stern Review, assessing current conditions and proposing several measures to tackle climate change. Drought in Australia has seriously affected fish populations in fresh waters [49] as well as in most estuaries and islands with low altitude. Climate change has altered the intensity of El Niño and La Niña [50] causing adverse effects on habitats [51], alteration of circulation [52] and biochemistry of oceans [53], increase of frequency, duration and intensity (category 4-5) of cyclones in the last 35 years [54]. In general, extreme weather phenomena have become more frequent [55].

Ethical issues

Fundamental ethical issues arise from climate change in relation to the above axes. Life, freedom and personal security are principal human rights that support other rights and are recognized by international legislation. These rights are violated in the biggest part of the world through climate change by a small percentage of privileged people in the name of technological innovations. It is extremely unfair that people in weak economies who have actually contributed very little to green house gases now suffer by the worst consequences. These same consequences will be inherited to the next generations without being responsible for. Another issue is the lack of international legislation and commonly accepted ethics in relation to human obligation for living organisms and natural environment protection [56]. Modern western civilization recognizes only a market price in nature.

As a result, the first issue rising is the responsibility which applies to all humanity. This responsibility goes to those who profit from fossil fuel burning, forest destruction, land use change and adopt overconsumption habits [57].

The ethical issues discussed at round tables -however without any actual progress achieved- concern mainly the participation in the costs and the benefits resulting from the allocation of responsibilities and rights. These discussions include sensitive issues in relation to climate change such as prevention and adaptation measures, compensation and participation in decision-making processes [58]. In any case, each state acts based on expected consequences on its own citizens, even though it is more feasible to assess global than local results and it is more difficult to predict the magnitude a certain area will suffer by climate change [59]. For as long as these negotiations do not take place in a spirit of unity that would serve justice, people will not participate in them and possibilities for a substantial solution will be diminishing [60].

Climate change actually highlights the problem of fundamental unbalances in modern society. While almost all people recognize that sustainability is an important subject and a significant long-term goal, merely nobody sacrifices short-term economic development. The politician who will attempt to introduce an alternative point of view will simply not be reelected. Modern economy is destructive in its base since it promotes the consumption culture and is based on material values and enlargement. Selfishness and rivalry are considered major virtues in the modern commercialized world. Greed is not merely widely accepted but it has attributed a social and economic value. Material values however are by nature evanescent and prosperity is not realistic when it is based on goals such as these [57].

As climate change is an issue of ethics, justice, responsibility and discipline are necessary in order to find a solution. The aim should be a deep change of human society on the basis of a connection of the modern man with the natural world [61]. There is a need for an ethical economy that will promote its real goal, which is to supply the means for the endless possibilities of human conscience to develop. New economic models should be altruistic and cooperative in order to secure general prosperity and poverty elimination. Since humans are the stewards of the planet, undoubtedly they are responsible for sustainable management and ought to assure biodiversity and habitat conservation [57].

The transition from frenetic consumerism to a sustainable culture may only be built on responsible living in accordance with ethical and spiritual values. The culture leading today's institutions, economy, communication and education agents, needs to be reformed through a public discussion between all parts of society concerning the moral ground of the systemic change necessary [62]. Development of these values can be achieved by appropriate education.

Education for the environment and sustainability

The problems concerning the environment and human society result from human choices and actions and not from natural or external sources [63, 64]. It is widely accepted that these issues are related to human values and behavior, and reflect the way people conceive their position in the ecosystem and their values. Therefore, if people wish to escape this situation and gradually apply sustainable methods it is necessary to modify their behavior with emphasis on the creation of a scale of values based on environmental ethics, respect and caring for all living organisms and ecosystems [65]. In this context, environmental education applies innovative ways, methods and techniques for a comprehensive understanding of sustainability, offering the opportunity to people to be interested in environmental issues, and to promote environmental culture that is translated into added value of knowledge, creative thinking and investigation skills, analysis and tackling of environmental issues through a holistic point of view [66].

Education for the environment and sustainability aims and seeks to change the relationship between humans and the environment through a vision for a better world, where human societies will function collectively and responsibly with social and ecological justice and solidarity [67]. It focuses on critical investigation and analysis of the issues, on understanding of their social, economic and political implications, on the search of alternative solutions [68] and is considered a lifelong process that begins in childhood and goes beyond the limits of formal education [69].

Education for the environment and sustainability supports all three types of education: formal, non formal and informal [70, 71]. In formal education the classroom is the physical place of learning [72]. The non formal includes every organized training process beyond the typical education system and has various goals [73]. In the informal type, the individual finds knowledge and forms attitudes and values from everyday experience and the learning acquired by his/her environment [74]. It occurs during the whole lifetime of an individual and contributes to the formation of an integrated personality [75, 76, 77]. In the framework of developing and promoting lifelong learning, research in the European Union is highly interested in the effects of the lifelong learning ideal to tutor training [78] and the introduction of modifications in the formal education systems [79]. The ultimate goal is for the educator to become a model to the pupils by dynamically supporting the value of learning, regarding it as a constant process and adopting suitable techniques in order to motivate them to lifelong learning [80].

In formal education the sustainable school follows the principle that society is vital when it is open and its members are responsible for their actions and wishes. Attention moves from "what pupils should learn" and "how pupils behave" to schools becoming points of interest where children and adults interact and learn together [23]. The application of the principles of education for sustainability leads to the prerequisite attitudes, values and commitments necessary for a sustainable society. It gives the opportunity for skill development in order to realize and tackle environmental issues. It establishes the cooperation between the school and local society without any distinction between ages or various groups [81].

The implementation of new methods opens new horizons to teachers in and out of schools, with active participation and experiential learning playing a key role. The teacher encourages cooperation in a framework

where students learn about the environment, the problems and their consequences. He/she promotes participation in such activities in order to acquire experiences and drives, supports and accompanies them through the learning process [82]. Teaching techniques and methods motivate students to search for knowledge and constantly participate in teaching processes [83].

The teacher guides them to exercise in scheduling, organizing, implementing, evaluating and identifying situations and actions [84]. He/she implements active learning and teaching techniques such as experiential learning, problem solving, educational visit, case study, role playing, research, team work, arguing, modeling, comprehending values etc. [85], while in a two-way cooperation students and teachers study, examine, discover and apply these techniques.

In this process the teacher is not the focus centre anymore and knowledge is not flowing in a one way direction from him/her to a passively receiving student [86]. Learning extends outside of the classroom at the school yard where familiarity develops and encourages social interaction [87]. Furthermore, this setting brings students in closer contact with the natural environment thus raising their interest for environmental problems and contributes to the development of their moral values [88, 89, 90, 91]. It has been sustained that the belief humans are part of nature is closely related to the adoption of positive environmental attitudes [92]. Learning that takes place at the school yard contributes to the development of collaboration [93] and socialization [90], extends the overall learning process [94], strengthens skills for research and problem solving [95], promotes self-respect and contributes to the formation of a new generation whose values impel towards the protection of nature and the society [96].

Discussion and Conclusions

Research results warn that climate change consequences are getting worse [97] and that it is very likely their complexity will increase in the future. Current situation seems to extend because “the greatest obstacles in adopting technology such as renewable power sources, are actually private interests and lack of consciousness” [98] while the International Institute for Strategic Studies underlines that if climate change continues then results may be similar to a nuclear war [99]. Considering the fact that half to two thirds of earth’s population by the year 2025 will suffer from water shortage [100], the importance of safety becomes obvious since states will notice the destruction of their natural resources and their economies, that consequently will cause instability in areas of strategic importance, national conflicts and a wider gap between the rich and the poor. It is also believed that due to shortage or pollution, water may well represent a cause for a possible war between states that share rivers, lakes and ground tables [101, 102].

It is apparent that the confrontation of climate change cannot be separated from economic globalization, water saving, poverty mitigation, health, environmental destruction and establishment of international security and stability. To this direction governments should not continue their inflexible attitude following security strategies only for their own states but they should take into account the concerns of neighboring states for political and social stability, environmental and military safety [103]. It is evident by international events that ecological deterioration can actually threaten national security. In this framework, ecological damage constitutes a threat for people, states, natural ecosystems, socioeconomic stability and sustainable development [104].

Atmospheric pollution, temperature increase and climate change represent catastrophic effects not simply of a serious environmental crisis but of a deep values crisis of all humanity. Unity, justice and responsibility are often discussed on negotiation tables and are all values every part wishes for in order to achieve sustainable development and a prosperous society. However no progress has been made towards this goal. Strong ethical values are the only substantial argument against the modern model of consumption that pushes individuals, groups and whole states to adopt completely selfish attitude, ignoring the impact on the weakest people that have practically a small share on the climate change issue, disregarding the future generations and the fate of other living creatures on the planet. The transition from a selfish culture that promotes consumption to one of sustainability can only be built on a responsible way of living. It is necessary to reform the culture framework that governs institutions, agents of economy, information and education by means of public discussion between all society members about the moral values of the necessary system change [62].

These ethical values can be established through healthy character building, the outcome of training, culture and finally education [11]. The only secure way of achieving environmental friendly behavior in everyday life is environmental education and sustainability [105]. Education in a system like this can contribute to the formation of a new environmental culture for a new way of governing, where active citizens with good sense and creative thinking will participate in actions for securing their quality of life, problem solving, decision making and critique assessment [106]. International literature demonstrates that the new education process with this aim has encompassed the conceptual framework and methodology for sustainability that will contribute to reorientation of values and necessary adaptation of politics and practices in all levels [107].

Environmental education and education for sustainable development is not based on simple training but on culture, through which a student learns to love, respect, search and experience the value of responsibility. It uses holistic learning, recognizes the value of active participation and achieves spiritual, social, sentimental, moral, aesthetic and physical development [108]. It promotes group learning, develops environmental and moral values, attitudes, and abilities being in accordance with sustainable development [109]. It encourages students to participate in positive social transformations and develop environmental responsibility [110]. In this way, the transition from selfish materialism to the vision of unity and solidarity for all humans is achieved. Within this vision, each human being is a productive member of society. Thus, a solid base is established where upon the sense of individual responsibility for prosperity of humankind and future generations develop; this is the actual heart of sustainability [61].

References

1. J. Diamond, Collapse. How societies choose to fail or succeed [in greek], Katoptro, Athens, 2006.
2. C. Larrère, Respect or responsibility? What ethics for the environment? [in greek] In: E. Theodoropoulou, M. Kaila, M. Bonnet & C. Larrère (eds.), Environmental Ethics: from research and theory to application, Atrapos, Athens, 2009, pp. 41-67.
3. A. Dahl, Ethical Challenges of Climate Change, Paper presented at the 11th Annual Conference of the International Environmental Forum. Accessed from [Http://www.bcca.org/ief/ddahl07b.htm](http://www.bcca.org/ief/ddahl07b.htm). 2007.
4. R. E. Green, S. J. Cornell, J. P. W. Scharlemann and A. Balmford, Farming and the Fate of Wild Nature, Science, 307 (2005) 550-555.
5. J. A. Thomas, M. G. Telfer, D. B. Roy, C. D. Preston, J. J. D. Greenwood, J. Asher, R. Fox, R. T. Clarke and J. H. Lawton, Comparative Losses of British Butterflies, Birds, and Plants and the Global Extinction Crisis, Science, 303 (2004) 1879-1881.
6. R. Dunn, Modern Insect Extinctions, the Neglected Majority, Conservation Biology, 19 (2005) 1030-1036.
7. J. R. Miller, Biodiversity Conservation and the Extinction of Experience, Trends in Ecology & Evolution, 20 (8) (2005) 430-434.
8. O. D. Cheesman and R. S. Key, The Extinction of Experience: A Threat to Insect Conservation? In: A. J. A. Stewart, Tim R. New, Owen T. Lewis (eds), Insect Conservation Biology: Proceedings of the Royal Entomological Society's 23rd Symposium, CABI, Wallingford, UK, 2007.
9. J. L. Snaddon, E. C. Turner and W. Foster, Children's Perceptions of Rainforest Biodiversity: Which Animals Have the Lion's Share of Environmental Awareness? Cambridge, UK, 2008.
10. D. Suzuki, The legacy. An elder's vision for our sustainable future, Greystone Books, 2010.
11. A. Georgopoulos, Earth. A small and fragile planet. [in greek], Gutenberg, Athens, 2006.
12. J. Huckle and A. Martin, Environments in a Changing World, Prentice Hall, New Jersey, 2001.
13. K. Webster and C. Johnson, Sense & Sustainability: Educating for a Low Carbon World, TerraPreta, UK, 2008.
14. B. Jickling, H. Lotz-Sisitka, R. O'Donoghue and A. Ogbuigwe, Environmental Education, Ethics, and Action: A Workbook to Get Started, UNEP, Nairobi, 2006.
15. B. McKibben, A deeper Shade of Green. National Geographic, Voices, August, 2006.
16. R. Stevenson, Schooling and environmental/sustainability education: From discourses of policy and practice to discourses of professional learning, Environmental Education Research, 13 (2) (2007) 265-285.
17. L. Sauvé, Environmental Education: Possibilities and Constraints, Connect, Vol. XXV11, no 1/2 (2002) 1-4.
18. J. Huckle, ESD and the Current Crisis of Capitalism: Teaching beyond Green New Deals, Journal of Education for Sustainable Development, 4 (2010) 135-142.

19. D. Tilbury, Rising to the Challenge: Education for Sustainability in Australia, *Australian Journal of Environmental Education*, 20 (2) (2004) 103-114.
20. S. Breiting, M. Michela and F. Morgensen, *Quality Criteria for ESD-schools*, ENSI, Vienna, 2005.
21. A. Gough, *Sustainable Schools: Renovating Educational Processes*, *Applied Environmental Education and Communication*, 4 (2005) 339-351.
22. J. A. Ferreira, L. Ryan and D. Tilbury, *Whole-School Approaches to Sustainability: A Review of Models for Professional Development in Pre-service Teacher Education*, Canberra: Australian Government Department of the Environment and Heritage and the Australian Research Institute in Education for Sustainability (ARIES), 2006.
23. K. Henderson and D. Tilbury, *Whole-School Approaches to Sustainability: An International Review of Sustainable School Programs*, Australian Research Institute in Education for Sustainability (ARIES), 2004.
24. J. T. Crowley, Causes of Climate Change Over the Past 1000 Years, *Science*, 289 (2000) 270-277.
25. IPCC-Intergovernmental Panel on Climate Change, *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK, 2007.
26. IPCC-Intergovernmental Panel on Climate Change, *Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change*, IPCC Secretariat, Geneva, 2008.
27. R. Mukundan, M. S. Pradhanang, M. E. Schneiderman, D. C. Pierson, A. Anandhi, S. M. Zion, H. A. Matonse, G. D. Lounsbury, S. T. Steenhuis, Suspended sediment source areas and future climate impact on soil erosion and sediment yield in a New York City water supply watershed, USA, *Geomorphology*, 183 (2013) 110–119.
28. Y. Zhou and R. S. J. Tol, Evaluating the costs of desalination and water transport, *Water Resources Research*, 41 (3) (2004).
29. IPCC- Intergovernmental Panel on Climate Change. *Climate Change 2007: Synthesis Report, Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Geneva, Switzerland, 2007.
30. T. P. Barnett, D. W. Pierce, A. M. Krishna, P. J. Gleckler, B. D. Santer and J. M. Gregory et al., Penetration of Human-Induced Warming into the World's Oceans, *Science*, 309 (2005) 284-287.
31. D. Tilman, J. Fargione, B. Wolf, C. D'Antonio, A. Dodson, R. Howarth et al., Forecasting Agriculturally Driven Global Environmental Change, *Science*, 292 (2001) 281-284.
32. C. S. Reynolds, *Ecology of Phytoplankton*, Cambridge University Press, Cambridge, 2006.
33. J.M. Kwon, A. Haraguchi and H. Kang, Long-term water regime differentiates changes in decomposition and microbial properties in tropical peat soils exposed to the short-term drought, *Soil Biology & Biochemistry*, 60 (2013) 33-44.
34. E. Stefanou, Shortage, contamination, pollution and commercialization of water. The treated waste water could be a source of water [in greek], Symposium "Water in an Era of Climate Change", Athens, 2009.
35. L. Celliers, S. Rosendo, I. Coetzee, G. Daniels, Pathways of integrated coastal management from national policy to local implementation: Enabling climate change adaptation, *Marine Policy*, 39 (2013) 72-86.
36. R.M. Oswald, S. McNeil, Methodology for Integrating Adaptation to Climate Change Into the Transportation Planning Process, *Public Works Management Policy*, 18 (2013) 145-167.
37. T. Garnett, Food sustainability: problems, perspectives and solutions, *Proceedings of the Nutrition Society*, 72 (1) (2013) 29–39.
38. P. Smith and J. P. Gregory, Climate change and sustainable food production, *Proceedings of the Nutrition Society*, 72 (2013) 21–28.
39. P. Quillfeldt and F. J. Masello, Impacts of climate variation and potential effects of climate change on South American seabirds - a review. *Marine Biology Research*, 9 (4) (2013) 337-357.
40. E. Drakou, Spatial heterogeneity and species diversity in protected areas of Greece [in greek], PhD thesis, Aristotle University of Thessaloniki, Faculty of Science, Department of Biology, 2009.
41. R. D. Easterling, A. G. Meehl, C. Parmesan, A. S. Chagnon, R. T. Karl, O. L. Mearns, Climate Extremes: Observations, Modeling, and Impacts. *Science*, 289 (2000) 2068-2074.
42. P. Wicker and S. Becken, Conscientious vs. ambivalent consumers: Do concerns about energy availability and climate change influence consumer behaviour? *Ecological Economics*, 88 (2013) 41-48.

43. B. D. Lobel, B. M. Burke, C. Tebaldi, D. M. Mastrandrea, P. W. Falcon, L. R. Naylor, Prioritizing Climate Change Adaptation Needs for Food Security in 2030, *Science*, 319 (2008) 607-610.
44. M. L. Parry, C. Rosenzweig, A. Iglesias, M. Livermore, G. Fischer, Effects of climate change on global food production under SRES emissions and socio-economic scenarios, *Global Environmental Change*, 14 (2004) 53–67.
45. N. Stern, *Stern Review on the Economics of Climate Change* (pre-publication edition). Executive Summary, London, HM Treasury, 2006.
46. K. A. Mandal and J. Zhang, Climate change and the future of freshwater resources of the island: a case study on the Rishiri Island, Japan. *Environmental Earth Science*, 66 (2012) 1309-1319.
47. A. G. Meehl and C. Tebaldi, More Intense, More Frequent, and Longer Lasting Heat Waves in the 21st Century, *Science*, 305 (2004) 994-998.
48. R. Garnaut, *The Garnaut Review, Australia in the Global Response to Climate Change*, Cambridge University Press, 2011.
49. C. B. Chessman, Identifying species at risk from climate change: Traits predict the drought vulnerability of freshwater fishes, *Biological Conservation*, 160 (2013) 40–49.
50. W. A. Tudhope, P. C. Chilcott, T. M. McCulloch, R. E. Cook, J. Chappell, M. R. Ellam, W. D. Lea, M. J. Lough and B. G. Shimmield, Variability in the El Nino-Southern Oscillation Through a Glacial-Interglacial Cycle. *Science*, 291 (2001) 1511-1517.
51. P. Quillfeldt and F. J. Masello, Impacts of climate variation and potential effects of climate change on South American seabirds - a review. *Marine Biology Research*, 9 (4) (2013) 337-357.
52. H. J. Jungclaus, N. Keenlyside, M. Botzet, H. Haak, J. J. Luo, M. Latif, J. Marotzke, U. Mikolajewicz and E. Roeckner, Ocean Circulation and Tropical Variability in the Coupled Model ECHAM5/MPI-OM, *Journal of Climate*, 19 (2006) 3952-3972.
53. P. F. Chavez, G. P. Strutton, E. G. Friedrich, A. R. Feely, C. G. Feldman, G. D. Foley and J. M. McPhaden, Biological and Chemical Response of the Equatorial Pacific Ocean to the 1997-98 El Nino. *Science*, 286 (1999) 2126-2131.
54. J. P. Webster, J. G. Holland, A. J. Curry and H.-R. Chang, Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment. *Science*, 309 (2005) 1844-1846.
55. IPCC-Intergovernmental Panel on Climate Change, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, Cambridge University Press, Cambridge, England, 2012.
56. S. M. Gardiner and L. Hartzell-Nichols, Ethics and global climate change, *Nature Education Knowledge*, 3(10):5 (2012).
57. A. Dahl, Ethical challenges of climate change. Paper at the 11th Conference of the International Environmental Forum, Ottawa, 12-14 October 2007. <http://www.bcca.org/ief/ddahl07b.htm>, 2007. Accessed 25/6/11.
58. M. Grasso, An ethical approach to climate adaptation finance, *Global Environmental Change*, 20 (2010) (2009) 74-81.
59. F. Lecocq and J. C. Hourcade, Unspoken ethical issues in the climate affair: Insights from a theoretical analysis of negotiation mandates, *Economic Theory*, 49 (2012) 445–471.
60. S. M. Gardiner, Ethics and global climate change, *Ethics*, 114 (2004) 555–600.
61. A. Dahl, Alternatives to the consumer society. PERL 2nd International Conference, Berlin, 19-20 March 2012. <http://iefworld.org/ddahl12a>, 2012. Accessed 20/5/2013.
62. BIC-Bahá'í International Community, *Rethinking Prosperity: Forging Alternatives to a Culture of Consumerism*, 18th Session of the United Nations Commission on Sustainable Development, New York, 3 May 2010. <http://bic.org/statements-and-reports/bic-statements/10-0503.htm>, 2010. Accessed at 15/3/2012
63. A. Katsikis, Utilization of recycled materials and environmental education. Or how the ingenuity of art meets the wisdom of Nature [in greek], 1st Panhellenic Conference interdisciplinary art and environmental education "Art as a tool for environmental education. Teacher / Educational approaches for Forest / Tree & Recycling", Athens, 29-31 May 2009, pp. 66-76.
64. G. Xanthakou, *Designing a imaginative family* [in greek], Atrapos, Athens, 2007.
65. M. Kaila, E. Theodoropoulos, M. Demetriou, G. Xanthakou & N. Anastasatos, *Environmental Education Research data and instructional design* [in greek], Atrapos, Athens, 2005.

66. T. Lekkas, G. Kolokythas, The evolution of school environmental education programs [in greek], 1st Panhellenic Conference interdisciplinary art and environmental education "Art as a tool for environmental education. Teacher / Educational approaches for Forest / Tree & Recycling", Athens, 29-31 May 2009, pp. 25-41.
67. E. Flogaiti, Exploring a fruitful relationship: Environmental Education and Art [in greek], 1st Panhellenic Conference interdisciplinary art and environmental education "Art as a tool for environmental education. Teacher / Educational approaches for Forest / Tree & Recycling", Athens, 29-31 May 2009, pp. 131-134.
68. J. Huckle, A. Martin, *Environments in a changing world*, Prentice Hall, New Jersey 2001.
69. European Commission, *A renewed EU strategy for sustainable development* [in greek], 2006.
70. T. Belle, Formal, non formal and informal education: a holistic perspective on lifelong learning, *International Review of Education*, vol. 28 (2004) 159-175.
71. A. Sipitanou and G. Zarifis, A lifelong learning in Greece, In: N. Terzis (Ed), *Lifelong learning in the Balkans. Education and pedagogy in Balkan countries*, Kyriakides brothers, Thessaloniki, 2006.
72. A. Rogers, *Informal learning and literacy*. Encyclopedia of language and education, Springer, US, 2008.
73. K. Illeris, *The three dimensions of learning*, Niace, Leicester, 2002.
74. B. Findsen and L. Carvalho, Older adults' learning patterns: trajectories and changing identities? In: M. Osborne, M. Houston and N. Toman (eds), *The pedagogy of lifelong learning*, Routledge, Oxon, 2007.
75. R. Johnston, Community education and lifelong learning: local space of global fare? In: J. Field and M. Leicester (eds), *Lifelong learning. Education across the lifespan*, Routledge Falmer, New York, 2003.
76. M. Saisana, 2007 Composite learning index: robustness issues and critical assessment. GRC. Scientific and Technical Report, Luxembourg, European Commission, 2008.
77. H. Van Dar Zee, Learning society, In: P. Jarvis (ed), *From adult education to the learning society. 21 years from the international journal of Lifelong Education*, Routledge, Oxon, 2006.
78. J. Chapman, R. Toomey, J. Gaff, J. McGilp et al., *Lifelong Learning and Teacher Education*, Centre for Lifelong Learning, Faculty of Education, Australian Catholic University, 2004.
79. Eurydice, *Lifelong Learning: the contribution of education systems in the Member States of the European Union. Results of the Eurydice Survey*, EU, Brussels, 2000.
80. C. Day, *The development of teachers: the challenges of lifelong learning*, Typothito, Athens, 2003.
81. G. Koussoulas, Basic principles and characteristics of Environmental Education [in greek], In: Proceedings of the 8th National Conference of the Union of Greek Physicists "Environment and Life", March 26-29, Heraklion, 2009.
82. W. B. Stapp, and D. A. Cox, Environmental education model, In: G. Thomson (ed), *What is good in environmental education?* Canadian Parks and Wilderness Society, 2002.
83. P. Xochellis, The teacher in the modern world [in greek], Typothito, Athens, 2005.
84. P. Higgins and R. Nicol, Outdoor education: authentic learning in the context of landscapes. An international collaboration project, Comenius Action 2.1, European In-Service Training Courses V (2), 2002.
85. A. Mogias, Historical flashback in Science and Environmental Education: Is it a matter of competitive or cooperative relationship? The example of Marine Education [in greek], In: 7th Pan-Hellenic Conference of Science and New Technologies Education entitled "Educational Research and Practice Interactions in Natural Sciences", Alexandroupoli, 15-17 April, 2011.
86. Herrington and J. Herrington (eds), *Authentic learning environments in higher education*, Information Science Publishing, Hershey, PA, 2006.
87. Morrill and D. A. Snow, The study of personal relationships in public places, In: C. Morrill, D. A. Snow & C. H. White (Eds), *Together alone: personal relationships in public places*, 2005, pp. 1-22.
88. R. D. Bixler, M. E. Floyd and W. E. Hammitt, Environmental socialization: qualitative tests of the childhood play hypothesis, *Environment and Behavior*, 34(6) (2002) 795-818.
89. E. Kals and H. Ittner, Children's environmental identity, indicators and behavioral impacts, in identity and the natural environment, In: S. Clayton and S. Opatow (eds), *The psychological significance of nature*, The MIT Press, Cambridge, Massachusetts, 2003.
90. L. Phenice and R. Griffore, Young children and natural world. *Contemporary issues in early childhood*, vol 4 (2) (2003) 167-178.
91. D. Sobel, *Place-based education, connecting classrooms & communities*, The Orion Society, Great Barrington, MA, 2004.

92. P. W. Schultz, C. Shriver, J. J. Tabanico and A. M. Khazian, Implicit connections with nature, *Journal of Environmental Psychology*, 24 (1) (2004) 31-42.
93. M. Rickinson, D. Sanders, P. Benefield, J. Dillon and K. Tearney, Improving the understanding of food, farming and land management amongst school-age children: A literature review, Department of Education and Skills, 2003.
94. K. Skamp and I. Bergman, Facilitating learnscape development, maintenance and use: Teacher's perceptions and self-reported practice, *Environmental Education Research*, v.7 (4) (2001) 333-358.
95. F. Rauch, The potential of education for sustainable development for reform in school, *Environmental Education Research*, v8 (1) (2002) 43-51.
96. K. Malone and P. J. Tranter, School grounds as sites for learning: making the most of environmental opportunities, *Environmental Education Research*, v.9 (3) (2003) 283-303.
97. IPCC-Intergovernmental Panel on Climate Change, *Climate Change 2007, the Fourth Assessment Report (AR4)*, United Nations, 2007.
98. MET Office, *Avoiding dangerous climate change*, Department of Energy and Climate Change, 2005.
99. IISS-International Institute for Strategic Studies, *Strategic Survey. The annual review of world affairs*, 2007.
100. J. A. A. Jones, *Water sustainability. A global perspective*, Hodder education, London, 2010.
101. M. A. Mimikou, Water resources in Greece. Suggestions for a rational water management [in greek], Symposium "Water in an Era of Climate Change", Athens, 2009.
102. J. E. Miller and L. R. Evans, *Forward osmosis: A new approach to water purification and desalination*, Sandia report, Sandia National Laboratories, 2006.
103. J. Baylis and St. Smith (eds.), *Globalization of World Politics*, Oxford University Press, Oxford, 2005.
104. J. Ganoulis, *Water Resources Management and Environmental Security in Mediterranean Transboundary River Basins*, In: *Environmental Security and environmental management: The risk assessment*, Springer, Netherlands, 2006, pp. 49-58.
105. D. Kalaitzidis, The need for environmental education [in greek], *Eleftherotypia* (2007). http://www.enet.gr/online/online_fpage_text/id=2038920 Accessed 10/2/2008.
106. K. Wheeler and A. P. Blijur (eds), *Education for sustainable future: a paradigm of hope for the 21st Century*, Kluwer Academic, New York, 2001.
107. N. Tzaberis and V. Papavassileiou, Exploring environmental knowledge of secondary school teachers of Rhodes [in greek], In: S. Kanellakis, K. Maridaki-Kassotaki and V. Papavassileiou (eds.), *Processes of thought in the school and the environment*, Pedio, Athens, 2010, pp. 459-490.
108. V. Green, *An exploration of school gardening and its relationship to holistic education*, MS thesis, University of Guelph, 2004.
109. A. Zachariou and L. Symeou, The local community as a means for promoting education for sustainable development, *Applied Environmental Education & Communication*, 7 (4) (2008) 129-143.
110. R. Miller, A brief introduction to holistic education, In: *The encyclopedia of informal education*. [Http://infed.org/mobi/a-brief-introduction-to-holistic-education/](http://infed.org/mobi/a-brief-introduction-to-holistic-education/) (2000). Accessed 20/11/2013.



International Conference
ADAPTtoCLIMATE

27 – 28
March, 2014

Filoxenia Conference Centre
Nicosia, Cyprus

CERTIFICATE OF PRESENTATION

awarded to

A. Mogias

for presenting the paper with title

THE CONTRIBUTION OF EDUCATION FOR SUSTAINABLE
DEVELOPMENT IN ADDRESSING ETHICAL ISSUES OF CLIMATE CHANGE

at

ADAPTtoCLIMATE
International Conference **2014**

held in

Nicosia, Cyprus

Prof. Maria Louzidou

The conference is organized in the framework
of the LIFE+ co-financed project "Development
of a national strategy for adaptation
to climate change adverse impacts in Cyprus",
CYPADAPT (LIFE10 ENV/CY/000723)

Visit the Conference website:
<http://adapttoclimate.uest.gr/>



MINISTRY OF
**AGRICULTURE,
NATURAL RESOURCES
AND ENVIRONMENT OF CYPRUS**



National Technical
University of Athens



National Observatory
of Athens



The EU's Funding Instrument
for the Environment