IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 15, Issue 5 Ser. II (May 2021), PP 07-11
www.iosrjournals.org

Forests Adaptation in Climate Change: Green Technologies for Environmental Management

K. Panitsidis[1], S. Georgopoulou[2], K. Spinthiropoulos[3], P. Georganakis[1]
[1]*School of Economic Sciences, Department of Management Science & Technology, University of Western Macedonia, Kozani, Greece*
[2]*School of Forestry and Natural Environment, Aristotle University of Thessaloniki, Thessaloniki, Greece*
[3]*Associate Professor, School of Economic Sciences, Department of Management Science & Technology, University of Western Macedonia, Kozani, Greece*

Abstract:
In recent years, the effects of climate change have been a major global environmental issue. Extreme climatic phenomena are on the rise and anthropogenic actions are being blamed for the changing climate. Awareness of the environmental impact has reshaped the operation and priorities of the business, investments, and public sector that is considered the pillar of each country's strategy. In the present paper, the issue of adaptation of forest ecosystems to climate change and how environmental technologies can contribute positively to it is studied and the impact on business management. Initially, a historical review is made of the emergence of the term "climate change" and how it evolved, analyzing the causes of the phenomenon of global climate change. Then, a review of the international directives and treaties that have been signed worldwide and are committed to the protection of the natural environment is made. It would be a serious omission not to mention the effects of climate change on the environment in general, and on forest ecosystems in particular. In addition, the consequences of the phenomenon in Greece with its special geomorphology and its rich biodiversity are analyzed. Finally, through the literary analysis of the effects, the need for active participation of sustainable green technologies for the protection of the environment and climate change is concluded.

Key Word*: climate change; sustainable management; forest ecosystems; adaptation; green technologies.*

Date of Submission: 06-05-2021 Date of Acceptance: 20-05-2021

I. Introduction

In recent decades, the global climate has been strongly influenced by anthropogenic activities and has caused instability in its evolution. This unstable evolution has become known as the phenomenon of climate change, which is very complex and concerns many scientific fields, something that makes it difficult to understand and deal with[1]. Climate change is the phenomenon caused by the high concentrations of greenhouse gases in the atmosphere, which is caused by anthropogenic activities[2,3]. These gases are mainly carbon dioxide as well as methane which create the entrapment of infrared solar radiation in the Earth's atmosphere, resulting in the phenomenon of global warming and the rise of the average temperature of the Earth[4,5].
This imbalance of the natural carbon cycle has affected and will continue to affect several sectors, including global health, the economy, and the balance of forest ecosystems[6–8].

According to a report of the Intergovernmental Panel on Climate Change for 2014, global gas concentrations of carbon dioxide, methane, and nitrogen dioxide have risen sharply since 1750[9,10]. The reason for the increase in greenhouse gas concentrations is human activities and more specifically intensive agriculture, the extraction of fossil fuels but also the changes in land use[3,11].

The environmental footprint is now a guide for developing strategies to reduce energy consumption by extending climate change. As Environmental Technologies have now dynamically invaded the daily lives of citizens by facilitating it, they actively participate in the protection of the environment and climate change by promoting Green Information Technology and Energy Sustainability. When used for the benefit of the natural environment and contributing to sustainable development we can then talk about environmentally sustainable environmental technologies[2,3,12].

II. The causes of climate change and their social implications

As mentioned above, the main cause of climate change is the release of larger amounts of carbon dioxide and other greenhouse gases like methane, and nitrogen dioxide, larger than what the atmosphere can accept[13,14]. An even more important cause that leads to the deterioration of climate change is deforestation and

its conversion into land for other uses[5]. Deforestation, urbanization, and shifts in vegetation patterns also affect the climate and cause changes in the balance of carbon dioxide release and absorption[15,16]. The need for man to feed led him to deforestation and the creation of arable land and the need to create urban centers reduced the undisturbed areas, which contributed to the smooth functioning of the carbon cycle[17,18]. During the last three centuries, the undisturbed areas were mainly converted into anthropogenic zones[19].

The process of deforestation releases carbon into the atmosphere, and especially carbon dioxide. In addition, reducing forest land automatically reduces the ability to absorb carbon dioxide and therefore it remains unbound in the atmosphere. Finally, deforestation caused by fires, causes oxidation in the soil and this phenomenon leads to huge consequences[20].

III. International Review and Conventions

The concept of global climate change is not new and for decades has plagued different kinds of scientists as it concerns all the biotic and abiotic factors that make up the ecosystem of our planet. The phenomenon of climate change worldwide has preoccupied all governments, leading to numerous international meetings being held with the main topic of discussion being how to deal with this phenomenon. But is climate change a phenomenon that has only preoccupied our planet in recent years? The first time the term "climate change" was officially introduced in the print media was in 1956 with a New York Times article[21], and it was then that terms such as "carbon dioxide" and "global warming" were published in the print media to be disseminated to the general public.

The theory that carbon dioxide released into the atmosphere may be responsible for climate change on Earth has long been held. A theory that was abandoned as untested. But a few years later Gilbert Plass concluded through his research that, variation in carbon dioxide levels is to blame for the planet's changing climate, but many more measurements are needed to formulate this theory with certainty. Anthropogenic activities, having increased carbon dioxide emissions into the atmosphere, reinforce the theory that global warming will be a phenomenon that we will observe for many centuries to come[22].

Decades later, after the first printed claims about this theory, Gro Harlem Brundtland, Norway's first female Prime Minister, raised in the world for the first time her concerns about public health and the impact of human activity on the environment. In a report entitled "Our Common Future", Brundtland for the first time highlighted the need for climate change to be taken seriously in global strategies and proposed the design of long-term strategies for sustainable environmental management[23]. At the same time and for the first time in history, agreements were signed between states concerning the protection of the environment. The first of these was the Vienna Convention in 1986 and the Montreal Protocol in 1987, which entered into force in 1989, and accelerated the reduction of harmful chemicals that created the so-called ozone hole over Antarctica. The implementation of these agreements was fully successful as it managed to achieve the initial objectives by 95%[24].

The signing of the Kyoto Protocol in 1997 is the starting point and makes environmental protection one of the most important priorities in the world. With the signing of the Kyoto Protocol, the Contracting Parties undertake to reduce greenhouse gas emissions by 5% for the first implementation period 2008-2012, while the second implementation period concerned the years 2013-2020[25]. In 2016, the Paris Agreement which took place in December 2015 was ratified, in which a joint action plan was agreed to reduce global warming with binding instructions to publicize the progress of the participants every five years[26].

Overall, the Kyoto Protocol and the Paris Agreement have been the tools used to create and implement global strategic frameworks to protect human beings and natural ecosystems, including flora and fauna from climate change[27,28].

IV. Results & Discussion

The most important consequence of climate change is the universal degradation of the natural environment, with direct consequences the degradation of urban centers and the reduction of the quality of human life. A special mention, however, must be made of forest ecosystems, which provide a wide range of functions to the environment and humans in particular, who are also the ones that have suffered the most from the phenomenon of climate change.

The main cause of the worsening of the phenomenon of climate change is the burning of fossil fuels, but also an important factor is deforestation, which binds carbon dioxide and acts as natural balancers of the atmosphere. This imbalance of the natural carbon cycle has affected and will continue to affect several sectors, including global health, the economy, and the balance of forest ecosystems.

Deforestation, urbanization, and shifts in vegetation patterns also change the climate and cause changes in the balance of carbon dioxide release and absorption. The process of deforestation releases carbon into the atmosphere, and especially carbon dioxide. In addition, reducing the forest land automatically reduces the ability to absorb carbon dioxide and therefore it remains unbound in the atmosphere. Finally, the deforestation of

forests through their burning causes oxidation in the soil and this has huge consequences[29]. As mentioned earlier, the cause of climate change is the increase in greenhouse gases. In the case of Greece, and as a consequence of the economic crisis, about 60% of greenhouse gas emissions are generated by the electricity generation sector.

Greece's natural wealth, its great biodiversity, and its native forests are directly affected by the change of climatic conditions. The increase of temperature that is already observed in our country causes prolonged periods of drought and increases the number of fires which have catastrophic consequences for forest ecosystems affecting their survival but also for humans affecting their health, air quality, and water as well as degrade the value of the forest as a point of recreation and tourist getaways. Therefore, the consequences of climate change vary and disrupt a wide range of sectors[16,30–33]. Another important area affected by climate change is forest ecosystems. Greece is occupied of forest ecosystems by 65% in its entire land area, including forests and meadows. Forest ecosystems have a variety of roles that serve the natural environment in general but also for humans in particular. They produce an abundance of goods that can be used and traded by humans, such as biomass, fruits, herbs, intangible services that contribute to the smooth functioning of the ecosystem, such as soil protection, biodiversity and contribute to water purity while providing recreational activities for humans[34–37].

Climate change affects environmental factors which in turn affect the health and productivity of forest species. In general, the effects of climate change on the forest ecosystems of Greece do not differ compared to the rest of the world. Overall, it is expected that the degradation of forests will affect the quality of life in urban centers, which will also be degraded as functional values of the forests will be limited[38].

The biodiversity of Greek forest ecosystems is another sector that is affected and will be affected more in the future with the intensification of the phenomenon of climate change. The increase of the dry season and the extremely high temperatures of the summer months have as a consequence the necrosis of the spruce individuals mainly in the Peloponnese but also the rest of Greece. The invasion of conifers in broadleaved clusters, and finally, the drying and necrosis of the forest pine mainly take place in the Pieria Mountains. In conclusion, with the loss of biodiversity and the redistribution of species, we have a simultaneous reduction of the services provided by forest ecosystems[16,39–42].

Forest ecosystems and nature in general, have their mechanisms to adapt to the changes caused by climate change and this has been proven by all the climate change that our planet has undergone. However, the ever-increasing pressure on forest ecosystems due to changing conditions and the intensification of the phenomenon does not allow them to adapt smoothly to all the consequences mentioned in previous chapters. Therefore, man must positively influence this adjustment and make socio-economic and environmental disturbances less undesirable. And this is now an imperative[25,43].

The concept of adaptation includes all those actions that need to be implemented in natural and man-made ecosystems to deal with the effects of a changing climate. The immediate adoption and implementation of a national adaptation plan are considered necessary to mitigate the effects of climate change. The key value of creating an anti-climate change strategy should be the sustainable management of natural resources, while in the long run new varieties should be created that are resilient to future climate change[25,44–46]. Society has great demands on forest ecosystems. They must serve their functional role, produce goods and intangible services, and this, in combination with the intensification of land-use changes, the degradation of air quality, and increasing deposition nitrogen has the effect of taking measures to increase the resilience of forests to this complex of factors[7].

Measures to prevent climate change and implement sound management measures, such as crop interventions to reduce competitiveness, erosion, and floods, will address the adverse effects on forest ecosystems but also limit the economic benefits man is reaping from the forest-meadow ecosystems[37]. Adaptation to global climate change is an important example of a responsible society that has sufficiently understood the dangers and effects of climate change. The purpose of social adaptability is to create an adequate framework and to develop actions to increase the knowledge, skills, and motivation of the groups involved[1].

The initial objective of the adaptation is to raise awareness and adopt environmental habits, to formulate flexible strategies through a holistic approach to the phenomenon of climate change, and the implementation of these strategies by the parties involved, including governments, NGOs, the private sector, and NGOs[8,47,48].

Given that the effects of climate change are already evident, the adaptation and measures taken in this direction should also be observed in modern society. The implementation of these strategies is an important step towards the sustainable management of the planet and gives optimistic messages for the sustainability of forest ecosystems[28,40,49]. According to Spittlehouse & Stewart, tackling and adapting to forest disturbances while maintaining their genetic diversity and resilience has been set as a high-priority goal worldwide. Through proper management, the duration and direction of forest adaptation can be affected, but at the same time, society must be adapted[50]. It is also worth mentioning the concept of "barriers", which is introduced by Moser & Ekstrom.

Barriers are obstacles that can be overcome with the coordinated efforts of all affected parties, with more creative management and a universal change of mindset. Obstacles to the process of adapting to climate change make adaptation less effective and may require costly changes that lead to missed opportunities but also higher costs. Such barriers may be laws that have been enacted and make it difficult to implement the adaptation plan as well as conflicting interests between the parties involved[51].

V. Conclusion

In conclusion, if climate change has been caused by anthropogenic activities, then man must establish the tools and define the framework and policies that will help reduce the phenomenon. The European Strategic Energy Technology Plan is a pillar of research and innovation in EU energy and climate policy, contributing to the structure of European and national research programs and generating significant investment in low carbon technologies. The European Union is targeting Eco-innovation and green technologies as clean technologies are the future of the European economy.

To adapt to climate change and deal with its effects, the aim is to improve information, increase the ability to monitor the relevant parameters, strengthen the resilience of infrastructure, and more effective protection of the population and ecosystems. The above will be achieved mainly through the modernization of monitoring institutions, the strengthening of skills, the more effective elaboration of risk management plans and studies, and the strengthening of protection infrastructures.

The immediate adoption and implementation of a national adaptation plan are considered necessary to mitigate the effects of climate change. Sustainable management of natural resources should be a key value in creating an anti-climate change strategy. Society has a great demand on forest ecosystems, they must serve their functional role, produce goods and intangible services in combination with the intensification of land-use change, degradation of air quality, and increasing nitrogen deposition has the effect of taking measures to increase the resilience of forests to this set of factors. Protecting the environment, reducing carbon dioxide, and protecting against climate change are now entrenched in global priorities. Sustainable management is the core idea of Agenda 2030 promoting the balanced development of the economy, society, and the environment. An important tool in this direction is the technology which, with its evolution and progress can lead to new goods that promote the goals of the 2030 agenda.

References

[1]. Stasinos, G. Climate Change and Forest Ecosystems in Europe. (University of Thessaly, 2013).
[2]. Andreopoulou, Z. Green Informatics: ICT for Green and Sustainability. J. Agric. Informatics 3, 8 (2013).
[3]. Panitsidis, K., Andreopoulou, Z., Kokkinakis, A. & Gitas, I. Information System Development using Open-Source tools for the spread of fresh water fish fauna in inland water ecosystem of Greece. J. Environ. Prot. Ecol. 19, (2018).
[4]. Matthopoulos, D. P. & Tsekos, C. A. Principles of environmental sciences. (University Studio Press, 2011).
[5]. Tsekos, C. A. & Matthopoulos, D. P. Ethics, science and environment: The need for a new environmental worldview. Int. J. Environ. Stud. (2009).
[6]. Andreopoulou, Z. Internet of Things and food circular economy: A new tool for Sustainable Development Goals. Riv. di Stud. sulla Sostenibilita (2017).
[7]. Hani, N. et al. Adaptive forest landscape restoration as a contribution to more resilient ecosystems in the Shouf Biosphere Reserve (Lebanon). in Plant Sociology (2017).
[8]. Panitsidis, K., Georgopoulou, S. & Spinthiropoulos, K. Spatial Environmental Impact of Climate Change and Carbon in MBA Programs. IOSR J. Bus. Manag. 23, 23–32 (2021).
[9]. Bakhtiari, F. International cooperative initiatives and the United Nations Framework Convention on Climate Change. Clim. Policy (2018).
[10]. Tsanaktsidis, C. G. et al. Relation between quality and production cost for pure biodiesel bases on the mixes of raw materials. in IOP Conference Series: Earth and Environmental Science vol. 40 (2016).
[11]. Andreopoulou, Z. Adoption of information and communication technologies (ICTs) in public forest service in Greece. J. Environ. Prot. Ecol. 10, 1194–1204 (2009).
[12]. Shaikh, Z. Towards Sustainable Development: A Review of Green Technologies. Trends Renew. Energy 4, (2018).
[13]. Giuliani, G. et al. Sharing Environmental Data through GEOSS. Int. J. Appl. Geospatial Res. 2, 1–17 (2011).
[14]. Stocker, T. F. et al. 2013: Technical summary AR5. in Climate change 2013: The physical science basis. contribution of working group I to the fifth assessment report of the Intergovernmental Panel on Climate Change (2013).
[15]. Bank of Greece. Environmental and social impact of climate change in Greece. (2011).
[16]. Papageorgiou, A., Karetsos, G. & Katsadorakis, G. . Forest An Integrated Approach. WWF Greece (2012).
[17]. Spinthiropoulos, K., Garefalakis, A., Stiakakis, E. & Chatzivasileiadou, S. Financial Development and Economic Growth: An Empirical Research about Greece-Cointegration Test. SSRN Electron. J. (2012).
[18]. Tsanaktsidis, C. G. et al. Creation of environmentally friendly fuel high in energy by mixing marine fuel oil and biodiesel. J. Mar. Environ. Eng. 10, (2018).
[19]. Ellis, E. C., Goldewijk, K. K., Siebert, S., Lightman, D. & Ramankutty, N. Anthropogenic transformation of the biomes, 1700 to 2000. Glob. Ecol. Biogeogr. (2010).
[20]. Soares-Filho, B. et al. Role of Brazilian Amazon protected areas in climate change mitigation. Proc. Natl. Acad. Sci. U. S. A. (2010).
[21]. Kaempffert, W. Warmer Climate on Earth May Be Due to More Carbon Dioxide in the Air. The New York Times (1956).
[22]. Plass, G. N. The Carbon Dioxide Theory of Climatic Change. Tellus (1956).
[23]. Brundtland, G. H., Khalid, M., Agnelli, S., Al-Athel, S. & Chidzero, B. J. N. Y. Our Common Future? Pathways to 2050. World

Bus. Counc. Sustain. Dev. (1987).
[24]. Dervitsiotis, K. N. An innovation-based approach for coping with increasing complexity in the global economy. Total Qual. Manag. Bus. Excell. (2012).
[25]. Gerden, T. The adoption of the kyoto protocol of t he united nations framework convention on climate change. Prisp. za Novejso Zgodovino (2018).
[26]. Fawzy, S., Osman, A. I., Doran, J. & Rooney, D. W. Strategies for mitigation of climate change: a review. Environmental Chemistry Letters vol. 18 (2020).
[27]. Manolas, E. Climate change: Challenges for the 21st century. (2017).
[28]. Scott, W. & Vare, P. Global warming and climate change. in The World We'll Leave Behind (2020).
[29]. Philip E, H. Adapting to climate change: is there scope for ecological management in the face of a global threat? J. Appl. Ecol. (2005).
[30]. Yu, X. W., Liu, H. Y., Yang, Y. C., Zhang, X. & Li, Y. W. GeoServer Based Forestry Spatial Data Sharing and Integration. Appl. Mech. Mater. 295–298, 2394–2398 (2013).
[31]. Kambezidis, H. D. Climate change and thermal comfort in Greece. Climate (2021).
[32]. Liotiris, C. Enhancement of the forest road network accessibility using Information Systems. J. Agric. Informatics 9, 1–7 (2018).
[33]. Du, D. & Ng, P. The impact of climate change on tourism economies of Greece, Spain, and Turkey. Environ. Econ. Policy Stud. (2018).
[34]. Mansourian, S. & Regato, P. Case study: The European Union's afforestation policies and their real impact on forest restoration. Forest Restoration in Landscapes: Beyond Planting Trees (2005).
[35]. Regato, P. & Berrahmouni, N. Using nontimber forest products for restoring environmental, social, and economic functions. in Forest Restoration in Landscapes: Beyond Planting Trees (2005).
[36]. Rey, A., Petsikos, C., Jarvis, P. G. & Grace, J. Effect of temperature and moisture on rates of carbon mineralization in a Mediterranean oak forest soil under controlled and field conditions. Eur. J. Soil Sci. (2005).
[37]. Ruiz-Benito, P. et al. Available and missing data to model impact of climate change on European forests. Ecol. Modell. (2020).
[38]. Nord-Larsen, T. & Johannsen, V. K. National Forest Inventories. (Springer International Publishing, 2016).
[39]. Dimopoulos, P., Bergmeier, E. & Fischer, P. Natura 2000 habitat types of greece evaluated in the light of distribution, threat and responsibility. Biol. Environ. 106, 175–187 (2006).
[40]. Giannakopoulos, C., Kostopoulou, E., Varotsos, K. V., Tziotziou, K. & Plitharas, A. An integrated assessment of climate change impacts for Greece in the near future. Reg. Environ. Chang. (2011).
[41]. Tsitsoni, T. K. Greece. in National Forest Inventories: Assessment of Wood Availability and Use (eds. Vidal, C., Alberdi, I. A., Hernández Mateo, L. & Redmond, J. J.) 423–437 (Springer International Publishing, 2016).
[42]. Panitsidis, K., Andreopoulou, Z. & Misso, R. GeoHAB, a Data Sharing, Spatial Web 2.0 Application for Habitat Types and Land Cover. Int. J. Appl. Geospatial Res. 10, (2019).
[43]. Smyris, P. Introduction: The forest ecosystem. WWF Greece (2012).
[44]. Giorgi, F. Climate change hot-spots. Geophys. Res. Lett. (2006).
[45]. IPCC. IPCC Special Report 2018. Glob. Warm. 1.5°C. An IPCC Spec. Rep. impacts Glob. Warm. 1.5°C above pre-industrial levels Relat. Glob. Greenh. gas Emiss. pathways, Context Strength. Glob. response to eradicate poverty (2018).
[46]. Solomon, S. et al. IPCC,2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovermental Panel on Climate Change (2007).
[47]. Amran, A., Ooi, S. K., Wong, C. Y. & Hashim, F. Business Strategy for Climate Change: An ASEAN Perspective. Corp. Soc. Responsib. Environ. Manag. 23, (2016).
[48]. Misso, R. & Foundation, S. C. Sustainable development and green tourism : new practices for excellence in the digital era Zacharoula Andreopoulou * Gian Paolo Cesaretti Safwat Shakir Hanna Ioakeim Tzoulis. J. Int. Bus. Entrep. Dev. 11, (2018).
[49]. Dale, V. H. et al. Climate change and forest disturbances. BioScience (2001).
[50]. Spittlehouse, D. L. & Stewart, R. B. Adaptation to climate change in forest management Spittlehouse and Stewart Adaptation to climate change in forest management. BC J. Ecosyst. Manag. (2003).
[51]. Moser, S. C. & Ekstrom, J. A. A framework to diagnose barriers to climate change adaptation. Proc. Natl. Acad. Sci. U. S. A. (2010).

K. Panitsidis, et. al. "Forests Adaptation in Climate Change: Green Technologies for Environmental Management." *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*, 14(5), (2021): pp 07-11.