VEGETATIONAL ECOSYSTEMS, FORESTS, AND TREES/SHRUBS IN THE CONTEXT OF CLIMATE CHANGE: PERSPECTIVES ON FUTURE DEVELOPMENTS AND THE POSSIBILITY OF ADAPTATION TO THESE FACTORS

Hajri HASKA
Department of Forestry, Faculty of Forestry Sciences, Agricultural University of Tirana, Albania
Eneida HASKA
Faculty of Architecture and Design, Okan University, Istanbul, Turkey
Robert DAMO
Department of Agronomy, Faculty of Agriculture, University, Fan S. Noli, Korçë, Albania
Marpol KOÇO
Cadaster Sector, Municipality of Tirana, Albania
Piro ICKA
Department of Agronomy, Faculty of Agriculture, University Fan S. Noli, Korçë, Albania

---

ABSTRACT

The world has seen a significant increase in population over recent decades. In 1880, our global population crossed the 1 billion mark, and by 1999, it had reached 6 billion. By 2019, the population had surged to 7.7 billion, and projections indicate it will reach 8.5 billion by 2030, 9.7 billion by 2050, and 10.9 billion by 2100. Concurrently, urbanization rates are on the rise. In 1980, approximately 50% of the population lived in urban areas, and it is expected that this figure will climb to around 70% by 2050. However, the Earth's natural resources are finite, with only some being renewable. These resources, including land, minerals, water, and forests, are being gradually depleted due to the growing demands of the global population. Population growth, resource consumption, and technological advancements are the primary factors driving climate change on a global scale. The world's forest area covers approximately 4.06 billion hectares, accounting for about 31% of the Earth's surface, which translates to about 0.52 hectares per person. However, these forests are not evenly distributed among different geographic regions. For instance, Albania boasts roughly 1,860,000 hectares of land dedicated to forests and pastures, constituting 65% of its territory.

Among these, forests cover 1,310,000 hectares (46%), while pastures occupy 550,000 hectares (19%). Climate change's impact on vegetation is a topic of extensive discussion in scientific circles. Environmental components of climate, such as rising temperatures, sea level elevation, changing precipitation patterns, and increased concentrations of CO2 and other greenhouse gases in the atmosphere, have profound consequences for the world's plant life, including the risk of species extinction. Global average air temperatures have raised by approximately 0.7-0.8 ºC in 2009 compared to the pre-industrial era. The Intergovernmental Panel on Climate Change (IPCC) underscores that human activities are a significant driver of global warming. Various scenarios suggest the possibility of a significant temperature increase, up to 3 degrees, within a few decades, alongside rising sea levels and reduced rainfall, even over shorter timeframes. These changes will likely lead to an extended vegetation period and the vertical migration of plants and woody species. As a Mediterranean country, Albania will be substantially affected by these changes, particularly due to increased temperatures, reduced precipitation, and rising sea levels. To mitigate the adverse effects of climate change on the environment, it is crucial to consider the interconnectedness of population growth, consumption patterns, and technology's impact on the environment. Moreover, it is imperative to devise strategies to adapt the world's vegetation, including forests and trees, to these evolving climate conditions.
Key words: Climate change, population, natural resources, forests, adaptation

1. INTRODUCTION

The phenomenon of climate change has become increasingly sensitive in recent decades. Scientific communities, governments, and national and international organizations are diligently seeking to identify the primary factors responsible for the pronounced climate changes observed worldwide. Their objective is to devise strategies and programs aimed at mitigating and reducing the negative effects of this evident climate change.

In many scientific circles, as well as in the broader public opinion, there is a growing consensus that recent climate changes are primarily attributed to human activities and interventions. Three main factors are identified as the key influencers of climate change: population growth, the utilization of natural resources, and technological advancements. To gain a deeper understanding of how these factors exert their impact, it is imperative to examine their influence across critical domains and leverage this understanding to inform policy decisions (FAO 2020). This involves informing and influencing policymakers and decision-makers at the national, regional, and global levels to curtail activities that contribute to climate change and formulate comprehensive global strategies to mitigate its impacts. While many activities and interventions impacting the environment and climate change occur at the national, regional, or country-specific levels, resolving the pressing issue of environmental changes, such as climate change, requires global cooperation and solutions.

Most theorists concur that the overall human impact on the environment results from three factors: population size, per capita consumption, and technology use (Harrison and Pearce 2000). Population represents the total number of people, consumption pertains to the quantity each individual consumes, and technology dictates the extent of resource utilization and the amount of waste or pollution generated per unit of consumption (Harrison and Pearce 2000).

Humanity has achieved remarkable success as a species throughout Earth's history. From a few thousand individuals approximately 200,000 years ago, the global population surpassed 1 billion around 1800 and reached 6 billion by 1999 (Harrison and Pearce 2000). As of the end of the 20th century, the average world population density stood at 45 people per square kilometer. Projections for global population growth in the upcoming decades and centuries vary, ranging from the lowest to the average and highest projections. According to the average long-range projection, which is based on the 1996 projection, the world's population could potentially reach 10.4 billion by 2100 and approximately 11 billion by the end of the 21st century (Harrison and Pearce 2000). As previously discussed, this population growth is undeniably a significant factor contributing to the increasing demand for resources, which will undoubtedly impact expected climate changes.

Consequently, these three elements exert a profound influence on the environmental impact they generate, with population growth being identified as the predominant factor contributing to environmental degradation (Davies 2020). This concept has been conventionally expressed through the following relationship:

I = P x A x T, or **Impact** = **Population** x **Affluence** x **Technology** (Harrison and Pearce 2000)

In this equation, environmental impact (I) is represented as the product of population (P), affluence or consumption per person (A), and technology (T) (Harrison and Pearce 2000). This equation illustrates that a larger value for a variable, such as population, even with constant per-person resource consumption, results in a greater total impact when assessing the overall issue. However, it's important to note that the impact calculated by the above formula does not represent the true environmental impact. Instead, it employs the amount of resources used or pollution generated as a proxy for environmental damage. In many situations, an additional factor must be incorporated to arrive at a more accurate assessment of the actual damage: the sensitivity of the environment. To address this, scientists have introduced the following modified relationship:

I = P x C x Tr x Tw x S (Harrison and Pearce 2000)

where:

Tr is the technology of resource use

Tw is the technology of waste management

S is the amount by which the environment changes in response to a given amount of resource extraction or pollution that in practice parameter S is hard to quantify, underline authors.

Based on the aforementioned relationship, it is crucial to comprehend the dynamic interplay that occurs when we extract, acquire, and utilize resources or when we contribute to environmental pollution, and how the environment reacts to these actions.

Environmental changes serve as feedback mechanisms that become evident when we encounter issues such as resource scarcity, adverse effects on human health, emerging hazards, or the loss of valuable assets, such as the extinction of species or the disappearance of pristine wilderness areas (Harrison and Pearce 2000). Therefore, it becomes apparent that environmental components become particularly sensitive when critical variables are impacted. For instance, the extinction of species within a specific habitat or the alteration of natural areas due to climate change can result in phenomena known in the scientific context as 'wilderness'.

By nature, humans are highly adaptable, which has been a key factor contributing to our remarkable success as a species. Throughout our history, we have undergone significant transformations in our cultures, technologies, consumption patterns, and even our family sizes. In modern times, these changes have occurred at an unprecedented pace (Harrison and Pearce 2000). As intelligent beings, humans are unquestionably among the most adaptable creatures on the planet. This adaptability has played a vital role in our species' success, as we have consistently thrived and expanded in numbers over the years and centuries. We have been able to identify areas where our practices were not sustainable and adapt to the evolving natural and social realities of our world.

2. MATERIALS AND METHODS

The study has extensively utilized a wealth of materials addressing the multifaceted issue of climate change, examining various aspects of life and the contributing factors. It combines both practical and scientific insights, culminating in recommendations for policymakers and decision-makers. These recommendations aim to guide the implementation of effective measures to mitigate the impacts of climate change. Here a deductive analysis of key factors driving climate change was made. Particular emphasis is placed on the most influential components, including the escalation of greenhouse

gases, the rise in atmospheric CO2 levels, global warming, temperature increases, rising sea levels, and changes in precipitation patterns. By delving into these aspects and identifying their underlying causes, we aim to anticipate the potential environmental catastrophes stemming from climate change. As mentioned earlier, some of these evident climate changes were briefly highlighted, and in our study, they will undergo comprehensive examination, both on a global scale and within the context of Albania.

3. RESULTS AND DISCUSSION

Europe is naturally a continent with vast woodlands, yet only fragments of its original wild forests remain, often tucked away in remote mountain valleys and estuaries (Davies 2020). This condition can be attributed to several factors that contribute positively to the lush vegetation found across the European continent. Notably, the correlation between the Mediterranean climate in many of its regions and the cooler continental climate in its interior, coupled with abundant rainfall and springs, is evident in the valleys of mountain streams and rivers even today.

National and local policies and plans wield significant influence over the potential expansion or contraction of public access, stewardship, and the appreciation of natural resources in cities, towns, and villages. These policies have direct impacts on public health, safety, and the overall enjoyment of urban environments (FAO 2020). Consequently, policymakers and decision-makers should increasingly factor in long-term regional development programs and strategies when considering future aspects related to environmental components that ultimately affect the public's health and the quality of life of local communities. As a Mediterranean country, Albania is poised to be significantly impacted by these changes, particularly by rising temperatures. By 2025, temperatures are expected to increase by 0.8-1.1 ºC, rising to approximately 1.7-2.3 ºC by 2050 and 2.9-5.5 ºC by 2100. Furthermore, precipitation levels (%) are projected to decline, ranging from -3.4 to -2.6 in 2025, -6.9 to -5.3 in 2050, and approximately -16.2 to -8.8 in 2100 (MEFWA 2009). These changes will also result in an elevation of sea levels in the country, posing challenges, especially for riparian forests, but also for vegetation as a whole in the foreseeable future.

The forecasted rise in temperature and decrease in precipitation will lead to milder winters, warmer springs, hotter and drier summers, and drier autumns (MEFWA 2009). This seemingly contradictory combination of increased heat and reduced precipitation undeniably poses one of the most challenging sets of circumstances for the biology and ecology of plants and trees.

The global climate is undergoing a warming trend, with average temperatures now half a degree centigrade higher than they were a century

ago. The nine warmest years of this century have all occurred since 1980, and the 1990s are likely the warmest decade of the second millennium1. Pollution from greenhouse gases such as carbon dioxide (CO2) and methane is at least partially responsible for this phenomenon. In 1995, the Intergovernmental Panel on Climate Change (IPCC) concluded that the preponderance of evidence suggests a noticeable human influence on global climate (MEFWA 2009). These anomalies resulting from climate change will undoubtedly impact specific components of the environment, including the air, water, soil, and more. Consequently, through a cascade effect, we can anticipate negative repercussions on plant life and plant ecosystems, including forests.

Emission rates for the most significant anthropogenic greenhouse gas, carbon dioxide (CO2), have surged 120-fold over the past 150 years (MEFWA 2009). Although Albania is a relatively small country, it also contributes to the increase in greenhouse gas emissions due to various human activities across different sectors of its economy and society. In 2000, Albania's total greenhouse gas emissions amounted to 7,619.90 gigagrams (Gg). The primary contributing sector was energy, accounting for 44.00% of emissions, followed by agriculture at 27.12%, and land use change and forestry at 21.60%. On a per capita basis, greenhouse gas emissions in Albania were measured at 2.47 metric tons of CO2 equivalent per capita. This figure stands notably lower, approximately 4-5 times less, than the average in industrialized countries (MEFWA 2009).

Unless the governments worldwide take decisive action to curb the ongoing increase in CO2 emissions, atmospheric concentrations of carbon dioxide are projected to double from pre-industrial levels by 2080. This doubling of CO2 levels may result in a global temperature increase of around 3ºC. Climate models offer insights into the expected consequences, indicating that land areas will warm at twice the rate of the oceans. High latitudes will experience faster warming during winter, and significant alterations in precipitation patterns are anticipated, particularly in tropical regions (Harrison and Pearce 2000). From the above observations, it becomes clear that the global community will face a heightened urgency in dealing with expected climatic changes in the coming decades. These changes will exert negative effects on all ecosystems, encompassing terrestrial ecosystems, oceans, and more. Rising temperatures, in particular, will have direct and indirect impacts on the biology and ecology of vegetation as a whole, with forests being a focal point of concern. Notable differences are expected in terms of plant distributions, with certain species favored and others disfavored by these climate changes.

The rise in sea levels due to the melting of glaciers and ice sheets, along with the thermal expansion of the oceans, poses a significant threat to heavily populated coastal regions. Sea levels are already on a trajectory for substantial

increase, likely reaching 1 to 2 meters over the next 500 years as a consequence of past warming. This increase will slowly penetrate into the ocean depths, leading to thermal expansion as it propagates (Harrison and Pearce 2000). Albania, due to its unique geographical position and diverse climatic conditions, stands as a testament to the exceptional natural diversity found within its borders. It is often rightly described as *the great museum of nature* (Sala *et al.*, 2017). According to the national forest and pasture inventory in Albania for 2021, forests cover approximately 46% of the country's total land area, amounting to 1,179,000 hectares. These forests contain a substantial volume of wood, totaling about 57.7 million cubic meters, with an average of 0.65 hectares per person (AKP 2022). In terms of land area per inhabitant, Albania ranks among the top countries in Europe. However, when assessing the quality of these forests, it's important to consider various indicators, such as annual growth per hectare and standing volume per hectare. These indicators reveal that the quality of Albania's forests is relatively low. It's worth noting that a significant portion of the forested land is classified as shrubs, which impacts the overall quality assessment. Forests dominated by beech, oak, and fir, for example, exhibit considerably different quality indicators compared to shrub-covered areas.

Albania boasts a rich and diverse flora thanks to a combination of significant factors, including its geographic position, geological characteristics, soil types, hydrographic features, relief, and climate. The country is home to an impressive array of approximately 3,250 vascular plant species, which accounts for about 30% of Europe's flora, totaling around 11,000 species. In recent years, several plant species in Albania have faced threats and have become rare. Consequently, various institutions and researchers have conducted studies and applied IUCN criteria to classify these species based on their current status. Furthermore, efforts have been made to establish monitoring processes for the most endangered species and provide recommendations for their conservation and habitat protection. Albania hosts approximately 30 endemic plant species and 160 sub-endemic species. Among the notable endemic species are *Acanthalimon albanicum, Aster albanicus subsp. paparistoi, Arenaria serpentini, Centaurea candelabrum, Hypericum haplophylloides subsp., Leucojum valentinum subsp. Vlorense, Ligusticum albanicum, Lunaria telekiana, Moltkia doerfleri, Sanguisorba albanica, Viola dukadjinica, Viola raunensis, and Wulfenia baldaccii* (Haska *et al.*, 2010).

Trees offer a multitude of valuable benefits to the communities in which they are situated, contributing to improved living and working environments. These benefits encompass a wide range of advantages, including air and water purification, provision of habitat for various organisms, enhancement of mental and physical health, delivery of economic and ecosystem services, flood reduction, and mitigation of climate change through carbon storage and

sequestration. Trees also play a role in reducing the urban heat island effect (MA 2021). The positive impact of vegetation, especially trees and forests, on urban centers has long been acknowledged. They contribute significantly to improving specific environmental components, particularly air quality. Trees absorb carbon dioxide and release oxygen while also filtering out dust particles and other gases. Additionally, they play a pivotal role in modifying precipitation patterns, exerting a notable influence on both surface and groundwater regimes. Moreover, trees and plants within urban environments provide a wide array of ecosystem services and help mitigate the urban heat island effect, fostering suitable habitats for wildlife and enhancing biodiversity.

In response to climate change, evergreen species such as oak forests are expected to expand, while the area covered by beech forests may decrease (MEFWA 2009). Rising sea levels pose challenges to forest ecosystems in areas like Kune-Vain, Velipojë, and Divjakë-Karavasta, leading to changes in lagoon size and shifts in the aquatic flora and fauna. This transformation in habitats impacts the local ecosystems. The plant kingdom itself displays adaptation to climate change as plants evolve to survive in changing conditions. For instance, in arid regions, plants have evolved features like spikes and thorns to minimize water loss through transpiration, as seen in cacti. In dry environments, you find plants like broom *(Spartium)* with long, thread-like structures that reduce water loss compared to leaves. Adaptation is also observed in plants like *Tamarix* (photo 3), which thrive in dry and saline terrains (CChP 2023).

Fig. 1: View from the Kune-Vain lagoon, Lezhe. The water-ground level is very small. (Photo H. Haska, 2021)

The photos provided clearly illustrate the minimal difference in elevation between the sea's surface and the land, highlighting the vulnerability of coastal areas to future sea level rise. According to projections, sea levels are expected to increase by up to 24 cm by 2050 and up to 61 cm by 2100 (CChP 2023). This anticipated rise poses a significant challenge to the continued existence and development of riparian forests. For an extended period, the roots of trees and shrubs would remain submerged in water, particularly during tidal fluctuations. This prolonged inundation can have detrimental effects on these ecosystems.

A similar concern is applicable to the Divjake-Karavasta National Park, where rising sea levels in the future could threaten the local vegetation and have additional impacts. Of particular concern is the potential destruction of Pelican Island, which serves as the nesting and breeding ground for the Dalmatian pelican *(Pelicanus crispus).* These pelicans are indigenous to the Divjake-Karavasta lagoon and are classified as endangered (CR) according to IUCN criteria. They have been nesting and breeding on the island known as *Ishulli i Pelikaneve,* as depicted in figure no. 2. The minimal difference in elevation between the island and the sea's surface makes it vulnerable to the effects of rising sea levels (Pano *et al.,* 2017).

Fig. 2: View from the lagoon of Divjake-Karavasta, where you can see that the difference between the water level and the land is very small, including Pelikane Island. (Photo Haska and Haska 2016).

Urban green spaces and the trees planted within them have a lasting impact that extends far beyond their initial establishment. The mature canopy we see today reflects the conditions and decisions made many years prior (Roman *et al.,* 2018). Consequently, Urban Forestry remains a vital consideration today, as it profoundly affects urban life, environmental quality, and the well-being of communities in residential areas, all of which are undeniably influenced by climate change. Biophysical legacy effects encompass the outcomes of past disturbances, including extreme weather events and pest and disease outbreaks (Haska *et al.,* 2010). Therefore, both at the global and local levels, future climate change predictions are incorporated into the creation and management of urban forests.

An important issue to address is the emissions released by certain tree species, particularly Biogenic Volatile Organic Compounds (BVOC), which can be especially problematic at high temperatures. These emissions can contribute to environmental and air pollution and consist of compounds like terpenes and monoterpenes. Therefore, the selection of tree species for afforestation, whether in traditional forestry or urban forestry, should consider contemporary criteria that avoid trees and shrubs emitting air-polluting compounds. While it's well-known that trees and shrubs absorb carbon dioxide (CO2) and various atmospheric pollutants, recent research has revealed that they emit BVOCs, or volatile organic compounds, also. It's crucial to recognize that climatic conditions and the specific composition of urban forests influence the absorption and emission of gases, impacting the atmosphere's composition and air quality in urban areas (Calfapietra *et al.*, 2022).

The quantity of pollutants absorbed, or Biogenic Volatile Organic Compounds (BVOCs) emitted by trees is indeed dependent on the species and environmental conditions. Tree emissions of volatile organic compounds can contribute to the formation of ozone and carbon monoxide (Novak 2000). As a recommended species for urban greening and afforestation, the linden tree (Tilia) meets several criteria, including the non-emission of BVOCs (Haska 2020). This makes it a suitable choice for urban environments where air quality is a concern.

In the past, Albania was endowed with abundant forest resources, a fact noted by foreigners in their works and publications. For instance, Mantegazza, in his book titled, *L'Albania*, published in 1912, highlighted the richness of Albania's forests. He mentioned the Sangiacato of Durazzo and its substantial forested territory, which could have been a significant source of wealth for the region. Unfortunately, the proper management of these forests was lacking, and in many cases, they were harvested beyond sustainable limits. Additionally, illegal logging and fires have further exacerbated the problems facing the country's forests in recent decades. These human interventions, in conjunction with the impacts of climate change, necessitate interventions and conservation efforts to stabilize damaged forest areas (Vico 1912).

Fig.3: *Tamarix tamarix* on the coast, in riparian forests, and in sand without water**.**

Fig. 4. *Spartum*, it grows well in very dry soils (Photo Haska, 2023)

In summary, climate change has several significant effects on vegetation and forests, including: i) increase in temperature which leads to an extension of the vegetation period, affecting the growth and behavior of plants, ii) global warming which contributes to the greenhouse effect, altering temperature patterns and impacting plant ecosystems, iii) increase in sea level which results in the inundation of riparian forests, potentially threatening these ecosystems, iv) decrease in Rainfall: Leads to more days with drought conditions, affecting plant health and survival, v) seasonality of rains: Variability in rainfall patterns can cause stress in plant growth due to water scarcity during different vegetation stages vi) increase in atmospheric CO2 which contributes to atmospheric pollution and affects plant physiology, and vii) greenhouse gas emissions which can lead to changes in the ozone layer, further influencing environmental conditions.

4. CONCLUSIONS

The following conclusions could be drawn:

Climate change indeed has wide-ranging and increasingly noticeable impacts, affecting various aspects of the economy and society in Albania. These impacts are not limited to specific sectors or regions but are likely to affect all sectors and areas to varying degrees. Some of these effects may become irreversible if not addressed adequately (Topalli and Monnin 2023). It's crucial to recognize that while the initial impacts of climate change may not be very pronounced, they tend to become more pronounced and require greater efforts and resources to mitigate as time goes on. Therefore, proactive measures and strategies are essential to minimize the long-term impacts on both the economy and society.

In terms of forest management, it's crucial to adopt approaches that are tailored to the expected climatic changes. This includes adapting cultural services provided to forest ecosystems and utilizing appropriate interventions and technologies for forestry practices and timber harvesting. Such adaptive measures are necessary to ensure the sustainability and resilience of forest ecosystems in the face of changing climatic conditions.

Protecting riparian forests, especially those along riverbanks and near coastal areas, is of utmost importance. These ecosystems are particularly vulnerable to the impacts of climate change, such as rising sea levels and changing precipitation patterns. Stricter protective measures and careful management are essential to ensure their preservation. Engineering constructions and contemporary methods, experiences, and technologies should be employed to mitigate the impact of rising sea levels on these forest ecosystems, especially in regions like Kune-Vain, Divjake Karavasta, Velipoje, and others.

Additionally, it's crucial to address the human intervention that has damaged forest areas in various parts of the country. Efforts should be made to stabilize and rehabilitate these areas through appropriate interventions and restoration work. This is essential for the overall health and resilience of forest ecosystems in Albania, especially in the face of climate change and its associated challenges.

Urban Forestry plays a crucial role in improving the quality of urban life and the environment, including residential areas. These urban green spaces and tree canopies have a positive impact on air quality, temperature regulation, mental and physical health, and overall well-being of communities. As urban areas are not immune to the effects of climate change, it's essential that urban forestry takes into consideration the predictions of climate changes in its creation and management. By doing so, cities and towns can better adapt to the challenges posed by climate change and enhance the resilience of urban ecosystems.

In the broader context, addressing climate change requires a comprehensive approach that considers the interactions between population growth, consumption patterns, technology, and their impact on the environment. It's essential to study and understand these relationships to formulate effective strategies for minimizing the negative impacts of climate change. Additionally, adapting the vegetative world, including forests and trees, to the changing climate is crucial for preserving biodiversity, ecosystem services, and the overall health of the planet. This approach recognizes the interconnectedness of environmental, social, and economic factors in the face of global climate challenges.

REFERENCES

Agjencia Kombëtare e Pyjeve (AKP). 2022. Inventari Kombëtar i Pyjeve dhe Kullotave në Shqipëri, Tiranë, 2022.

Calfapietra C, Fares S, Manes F, Morani A, Sgrigna G, Loreto F. 2022. Role of Biogenic Volatile Organic Compounds (BVO) emitted by urban trees on ozone

concentration in cities: A review. Environmental Pollution 183(2013)71-80. Accessed September 29, 2022

Climate Chance Post (CChP).2023. Climate Chance Post, Albania, Coastal erosion, Coastal flood risk Albania. Vulnerabilities - Coastal flood risk in Albania. Assessed 19 My 2023.

Davies C. 2020. The evolution of urban forestry in Europe over the last 25 years; 5 February 2020; https://zenodo.org/record/3909788#.Y4muyr3MKpo Accessed August 23, 2022.

FAO. 2016. Guidelines on urban and peri-urban forestry, by F. Salbitano, S. Borelli, M. Conigliaro and Y.Chen. FAO Forestry Paper No.178. Rome, FAO of the Nations Union.

FAO. 2020. Global Forest Resources Assessment 2020, Main report, Food and Agriculture Organization of the United Nations, Rome 2020.

Harrison P, Pearce F. 2000. AAAS Atlas of Population and Environment. American Association for the Advancement of Science, University of California Press, Victoria Dompka Markham, editor.215 p, Californa.

Haska H, Merko F, Salla M, Male J. 2010. Some important correlations between forest ecosystems and water resources in Albania. BALWOIS-Ohrid, R.Macedonia 25-29May2010. https://balwois.com/?s=Hajri+Haska&post_type=k9proceeding

Haska H. 2020. An overview of urban greenery in inhabited centers in Albania - the past, current situation, and challenges for the future. Scientific Conference organized by Academy of Sciences of Albania, collaboration with universities A. Xhuvani, Elbasan and E.Çabej-Gjirokastër, 17 December 2021, Elbasan, Proceedings Book ISBN: 978-928-339-91-1, page-132-155, Tirane 2023, Albania. http://akad.gov.al/ash/images/2023/pdf/Libri_kumtesave.pdf

Invernizzi – EDITORI, ROMA 1912.

MA. 2021. Morton Arboretum, 2020 Chicago Region Tree Census Report , 4100 Illinois Route 53, Lisle, IL 60532, Chicago, Illinois, 2021.

MEFWA. 2009. Ministry of Environment, Forestry and Water Administration, Albania's Second National Communication to the Conference of Parties, page 168, Tirana, November 2009

Novak JD. 2000. Tree species selection, design, and management to improve air quality"; Construction Technology, ASLA Annual Meeting PROCEEDINGS.

Pano N, Frasheri A, Bushati S, Kongjika E, Abdyli B, Haska H, Pano E, Muca G. 2017. Akademia e Shkencave e Shqipërisë. Hapesira Bregdetare Divjakë-Karavasta në Adriatik, ASHSH Monografi, Tiranë 2017.

Roman LA, Pearsall H, Eisenman ThS, Conway TM, Fahey RT, Landry Sh, Vogt JM, van Doorn NS, Grove JM, Locke DH, Bardekjian AC, Battles JJ, Cadenasso ML, Konijnendijk van den Bosch CC, Avolio M, Berland A, Jenerette GD, Mincey SK, Pataki DE, Christina Staudhammer Ch. 2018. Human and biophysical legacies shape contemporary urban forests: A literature synthesis. *Urban Forestry & Urban Greening*, **31**: 157-168.https://doi.org/10.1016/j.ufug.2018.03.004. Accessed 14.12.2022.

Sala S, Qiriazi P,Nikolli P. 2021. Trashëgimia natyrore dhe peizazhet tërheqëse të bashkisë së Tiranës, Tirane 2021.

to the Central Bank, SUERF Policy Brief, No 541, 2023. Accessed 9.05.2023 https://www.suerf.org/docx/f_cae2be3a60e8d453ec372274f39ad13c_63117_suerf.pdf.

Topalli M, Monnin P. 2023. Climate Risks in Albania and their Relevance.

Vico Mantegazza. 1912. L'ALBANIA, Copright by Bontempelli e Invernizzi, 1912 - Albania - 277 pages.