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CLIMATE CHANGE AND PUBLIC HEALTH

Analysis of the determinants in Latin America

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In Latin America, the challenges require collaborative efforts between governments and multiple stakeholders. Therefore, the purpose of this study is to analyze the determinants of the relationship between climate change management policies and public health in the region, to promote comprehensive regional actions, and analyze proposals that contribute to the creation of transformations that lead to a resilient economy based on sustainable development.

Abstract

Among the many aspects that COVID-19 has brought to our reality, the main one recognizes the intrinsic link between health and environmental issues. Under the “One Health” approach, this study shows an analysis of the relationship between determinants that are associated as common causes and effects of environmental and public health problems; and how these are understood or can be understood jointly for their management in Latin American countries. The study presents the key concepts for environmental and health public management. It describes some of the main determinants that environmental and public health problems in the region have in common. Subsequently, a taxonomic case study is carried out where environmental indicators are correlated with the scenarios derived from the COVID-19 pandemic in the region's countries. A summary of two talks related to the analysis of the relationship between the environment and public health is shown, which combines experts' experience and position on the issues and representatives of leading institutions in the region.

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1. Introduction

Humanity has suffered from health epidemics and pandemics for centuries, each with its characteristics, peculiarities, and social and economic contexts for our planet. The Earth is a system of interconnected elements, and any alteration of one of them affects the whole. The pandemic derived from the coronavirus has brought to our reality several essential aspects, such as the recognition of the intrinsic connection between health and the environment, that is why this study shows an analysis, under the “One Health” approach, of the relationship existing between the determinants that are associated as common causes and the effects to environmental and public health problems; and it seeks to know how these are understood jointly for their management in Latin American countries, independently, but also at the regional level.

According to the World Health Organization (WHO)¹, the “One Health” approach aims to create and implement initiatives, policies, programs, and studies in which diverse sectors work together to achieve better public health outcomes. Areas of work where the “One Health” approach is especially applicable include food safety and zoonose control², where microorganisms can be transferred from one to another by direct interaction between animals and humans or through contaminated food.

The “One Health” approach is essential because many microorganisms affect both animals and humans by sharing their developmental habitats. The problem cannot be avoided or eliminated in a single research field but in a transversal and interdisciplinary way involving environmental deterioration. The concept of environmental deterioration refers to an involution, a degradation of the planet’s state and environmental conditions, and not only of its climate. A mechanism that results in an environmental pandemic, an infectious disease that spreads throughout the world, affecting the entire system.

Climate change is not an unknown phenomenon in the Earth’s history. The planet has experienced remarkable variations and singular and extreme climatic episodes in past geological times. Climate change related to human activity and global warming that planet earth is currently experiencing is a growing global concern due to its externalities. As a process influenced by human activity, climate change has anthropogenic causes. This is mainly due to the emission of gases resulting from combustion of fossil fuel (which heat and pollute the planet) and the overexploitation of natural resources. The environment is a factor of great importance in the field of public health, as it allows to identify, characterize, monitor, control, and evaluate the effects that physical, chemical, biological, and psychosocial risks present in the environment have on human health. (Moreno, 2002). The current ailments derived from environmental degradation have occurred as secondary effects of a rapidly growing economic and social system without awareness of natural limits.

1 <https://www.who.int/news-room/q-a-detail/one-health>

2 Diseases that can spread between animals and humans.

As with many zoonoses, some viruses are spread by human pressure on a global ecosystem. The loss of a natural and safe environment weakens the animal immune system. Subsequently, pathogens easily migrate through it, providing an opportunity for a virus to mutate that can make humans and often global livelihoods. The degradation of the environment and the increase in symptoms and infections in human health are signs of an overwhelmed world that demands to regain its balance.

In 2019, the Intergovernmental Science and Policy Platform on Biodiversity and Ecosystem Services (IPBES), a partnership involving 50 countries and more than 500 scientists, concluded that human activity and the consequent loss of biodiversity had allowed the emergence of five diseases each year, which are potentially infectious for humans (IPBES, 2019). Also, the generation of knowledge and proper environmental management for a healthier world were cited, as necessary.

An environmental pandemic affects the entire planet as a system, much like an equally widespread epidemic disease. The impact of climate change, the loss of biodiversity, deforestation, inadequate water management, and intensive agricultural work are practices considered harmful to public health due to the breakdown of the environmental balance and the possible spread of pathogens and diseases. The development of a public policy requires an integrative orientation that considers initiatives based on the “One Health” approach, providing opportunities to design and manage public policies, including the sustainability criteria alongside public initiatives in health. Moreover, finally, to plan and implement actions early to mitigate possible environmental, plant, or animal origin impacts.

Latin America is home to a rich ecological diversity; it has around 60% of the planet’s terrestrial species and abundant flora and fauna. The richness of its natural capital ranges from coasts and wetlands to deserts, tropical forests, vast savanna grasslands, and high-altitude habitats. However, without proper and inclusive public policy management, large regional population concentrations will continue to have a relevant impact on biodiversity and a lack of cross-border environmental public policy agreements.

Currently, transboundary pollution has an adverse factor on human health. Hence, it is necessary to identify opportunities and challenges in managing the environment, climate change, and public health to promote recommendations and anticipate actions that public, cross-border and local policymakers should adopt to improve and accelerate environmental and social progress with a comprehensive sustainable approach. A collaborative effort is required between governments and multiple stakeholders in a region better to identify existing solutions between sustainability and human health, and better understand the implications of climate change on health and promote evidence-based policies to analyze the determining principles related to these behaviors.

This study seeks to support from various sources of information (research and a taxonomic study) the relationship between environmental management policy and public health in Latin America, and its relevance as a new field of research, to close a knowledge gap, and to identify its relevance for public management as a joint issue.

The following chapters are integrated into this study: 1. Introduction, 2. Environmental and public health management in Latin America, 3. Environmental and public health determinants, 4. Taxonomic case study, 5. Conclusions and recommendations. In the Annexes section, experts about the study can be consulted through notes collected in two webinars³ organized by the Regional Program Energy Security and Climate Change in Latin America to analyze the relationship between public health and climate change.

3 The talks can be consulted in the following links:
- First webinar. "Identification of opportunities and challenges in environmental management, climate change and public health in Latin America" held on October 9, 2020. <https://www.facebook.com/eklakas/videos/359409661791378/>
- Second webinar. "Sustainability, climate change and public health in Latin America" held on December 7, 2020. <https://www.facebook.com/eklakas/videos/1306849989662982>

2. Environmental and public health management in Latin America

Environmental management is known as the strategies or action plans with which human activities that impact the environment are administered and managed through a set of mechanisms, guidelines, and techniques whose objective is to guarantee environmental policies' practices (Acosta, 2019). In other words, it is a political process aimed at solving, mitigating, and preventing environmental problems to achieve sustainable development. Due to the existing worrisome condition of the environment, it can then be considered that environmental management is one of the most important challenges for humanity and, therefore, must be addressed (Barrientos, 2019).

Environmental management arises from the social need to conserve and increase the quality of environmental resources that satisfy human needs. It is a fundamental matter for the development and support of life on Earth. The environmental measures and actions against climate change aim to improve the quality of life and take care of natural resources to enjoy them without being compromised. In the region, the main problem has been the enforcement of current regulations for environmental management. It is vital to understand the determinants that cause environmental and public health problems realizing the importance of environmental public policy.

According to the climate threat that a particular city faces, certain public policies are formulated. Although the countries' governments usually offer solutions to environmental and health problems separately, some joint management exercises are usually known as Environmental Health Management, according to the Spanish Society for Environmental Health; this is:

'An essential area of knowledge in the field of Public Health, since it allows to identify, characterize, monitor, control and evaluate the effects on human health of physical, chemical, biological and psychosocial risks present in the environment. When we speak of "Environmental Health," we sometimes refer to the structures organized by the administration (local, national or regional) to protect and promote public health related to the environment' (Moreno, 2002).

There are different meanings of Environmental and Health Management or Environmental Health Management, and the most common ones will be developed later in the text. These refer to some of the direct consequences of climate change, such as high temperatures, water scarcity, or pollutants in the air. However, there are also other determinants whose relationship might not be as visible as are diseases transmitted directly from animals to humans, which proliferate under adverse environmental conditions, such as the SARS-Cov-2 virus, whose transmission, in 2020, caused a global pandemic. This receives a particular name of zoonoses; the World Health Organization (WHO, 2015) defines zoonotic diseases as:

‘A group of infectious diseases that are transmitted naturally from animals to humans. The most significant risk of transmission of zoonotic diseases occurs at the human-animal interface through direct or indirect exposure to animals, animal products (e.g., meat, milk, eggs), or their environment’.

The report titled Preventing The Next Pandemic: Zoonoses And How To Break The Transmission Chain (Lasso, 2020), from the United Nations Environment Program (UNEP) and the International Livestock Research Institute (ILRI, for its acronym in English), identifies ten practical steps that governments can implement to prevent future zoonotic outbreaks:

- Invest in interdisciplinary approaches, including the "One Health" approach.
- Expand scientific research on zoonoses.
- Improve cost-benefit analyses of interventions to consider the total cost count of the social impact of diseases.
- Raise awareness about zoonotic diseases.
- Strengthen monitoring and regulatory practices associated with zoonotic diseases, including within the food system.
- Encourage sustainable land management practices and develop alternatives for food security and livelihoods that do not depend on the destruction of habitats and biodiversity.
- Improve biosecurity by identifying key drivers of emerging diseases in animal husbandry and promoting proven zoonosis management and control measures.
- Support the sustainable management of landscapes and seascapes to enhance the sustainable coexistence of agriculture and wildlife.
- Strengthen the capacities of health actors linked to this issue in all countries.
- Put into practice the "One Health" approach in land use and the planning, implementation, and monitoring of sustainable development, among other fields

It is essential to ensure the protection and care of the environment to achieve sustainable development; thus, various Latin American countries have implemented different systems, programs, and public policies to meet this objective.

2.1.National management

Some Latin American countries have shown advances in their environmental management over the years; they have shown concern and action to generate various opportunities to respond to the present challenges and prevent future risks associated with the climate.

For example, Chile has developed different instruments for environmental management. These instruments are intended to motivate the action of agents through regulations, incentives, or different mechanisms to contribute to the protection of the environment (SINIA, 2020):

- Law 19,300 Education and Research Environmental Impact Assessment System.
- Environmental Quality Standards.
- Preservation of Nature and Conservation of Environmental and Emission Heritage.
- Management, prevention, and decontamination plans.

The Environmental Performance Assessment carried out by the Organization for Economic Cooperation and Development (OECD, 2016) recognized the importance and progress that the country has had in implementing mechanisms that regulate human activities and their impact on the environment.

Another example is Peru, which has the National Environmental Management System, a set of policies, standards, principles, techniques, and instruments that organize the environmental functions and competencies of public entities so that they implement the National Environmental Policy, which considers various issues such as biological diversity, climate change and soil management (Ministry of the Environment, 2020).

In Mexico, the government has different laws to guarantee the protection of the environment, such as the General Law of Ecological Balance and Environmental Protection, the General Law of Wildlife, the General Law for the Prevention and Comprehensive Management of Waste, the General Law of Sustainable Forest Development, the National Water Law, and the Federal Law of Environmental Responsibility (SEMARNAT, 2020), among others.

However, it has some deficiencies, such as the budget assigned to the Ministry of the Environment and Natural Resources (SEMARNAT), which is currently much less than that a decade ago (SEMARNAT, 2020). Moreover, fewer resources are being allocated to tasks such as: providing the sustainable, equitable, and democratic use of water; the transition from fossil fuels to renewable energy; the reduction of air, water, and soil pollution; the fight against deforestation and illegal logging; the production of healthy food; the conservation of terrestrial and marine biodiversity; environmental education and compliance with the commitments acquired nationally and internationally to combat climate change (Excelsior, 2019).

According to SEMARNAT, it is urgent to address issues such as climate change, industrial development, the loss of forests and jungles due to human activity, pollution, and the emission of greenhouse gases, causing a global increase in temperature, a significant risk for all forms of life (SEMARNAT, 2016).

Countries are responsible for implementing policies that seek sustainable development through tools to apply to all citizens to achieve an actual change in homes, companies, and governments. Everyone considers the environment a priority and acts in its defense and care. These sectors' economic decisions play a fundamental role in environmental management, the use of natural resources, and the fight against climate change.

2.2. Cross-border management of the environment and public health

It is important to bear in mind that climate change and other environmental issues have causes and effects that go beyond political borders; that is, any action that leads to climate change in one place will affect another, so it requires not only the approach of any one nation but also cross-border environmental health management policy.

For a long time, Latin America faced different challenges related to development and environmental degradation. In the Earth Summit held in Rio de Janeiro in 1992, more than 170 governments and 108 Heads of State and governments approved agreements focused on sustainable development and care for the environment (Gencat, 2009). Among other commitments, the following are cited:

- Agenda 21: a global action plan to promote sustainable development.
- Rio Declaration on Environment and Development: a set of principles defining States' civil rights and obligations.
- Declaration of principles relating to forests: guidelines for the most sustainable management of the world's forests.

On the other hand, additional coverage agreements were obtained that provided for the will of development through different protocols (Alternativas y Capacidades, 2019):

- The United Nations Framework Convention against Climate Change - Ratified by the 33 countries of Latin America, it entered into force in March 1994. The objective was to stabilize the concentrations of greenhouse gases in the atmosphere at a level that would prevent dangerous anthropogenic interference in the climate system. Also, it establishes a general framework for intergovernmental efforts to face the challenges caused by climate change (U.N., 2020).
- The Biodiversity Convention is a legally binding international treaty with three main objectives: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits derived from genetic resources. Its objective has been to promote measures that lead to a sustainable future (UNDB, 2020).

Additionally, in 2011, the Latin American Sustainable Leadership Platform was created, which was a regional coalition of companies, governments, academicians, international organizations, and civil society organizations that seek to incorporate sustainability in all their activities, with emphasis on reinforcing efforts and urgency that climate action demands today, increasing the ambition and adaptation capacity of Latin America. Its mission is to educate, inspire and mobilize leaders from the private sector, governments, academicians, and civil society to build an innovative ecosystem for sustainability and position Latin America by 2030 as a leader in the sustainable use of its natural resources, adapting to the climate change. This aligned with the United Nations Sustainable Development goals and the goals of the Paris Agreement.

To raise awareness on the issue of environment and promote the sustainable practice, in 2013, the Green Latin America Awards were launched, which recognize those who have made contributions to meeting the sustainable development goals of the United Nations (U.N.) in terms of water quality, caring for wildlife, forests, and oceans, human development, energy, sustainable finance, solid waste management, production and responsible consumption (Vogue, 2020).

In August 2020, the Latin American and Caribbean Platform for Climatic Justice launch was presented in El Salvador, Guatemala, Mexico, Colombia, Argentina, and Uruguay, among other regional countries, the Latin American and Caribbean Platform for Climatic Justice. Latin American movements, organizations, and social networks have converged to face the climate crisis in an articulated way (The World News, 2020).

These are a few joint efforts between countries in the region, where it is observed that they are working both on their objectives and meeting the Sustainable Development Goals (SDGs). On the one hand, in countries with more implemented technologies and more resources, the environment is a priority. On the other hand, countries with low resources have many objectives in which they must continue working. As external catalysts, several international organizations intervene in Latin America's objectives to meet the environmental goals of various platforms, organizations, governments, and companies who have been working for some time to promote sustainable development.

3. Environmental and public health determinants

The planet is an integrated system that works through microsystems that work in perfect harmony and synchrony, so it is evident that there are relationships between the subsystems and simultaneously create causes and effects between them, operating in constant action and consequence model. Environmental impacts transversally affect various aspects of human life; therefore, their effects can be considered multifactorial since they are directly related to the environment. This is one of the aspects with which there is a direct and close relationship with human health.

The WHO (2016) declared, through the Department of Public Health, Environment and Social Determinants of Health, that 23% of the global burden of mortality is due to environmental factors and attributes 24% of morbidity. Hence, it is of utmost importance and of urgent quality to ensure the care of the environment and reduce negative impacts as much as possible. In this regard, the Intergovernmental Panel on Climate Change highlighted that:

“The health effects will be mainly additional burdens in diarrheal diseases, malnutrition, cardiorespiratory and infectious diseases; morbidity and mortality because of heatwaves, floods and droughts will increase; there will be changes in the behavior of vector-borne diseases. Those are repercussions that will disproportionately affect vulnerable populations (children, the elderly, the sick, the poor and isolated populations” (Cofepris, 2020).

It should be noted that the crises or problems that we face and will face in the future affect the entire population in general, since neither people with a higher social position can buy another air, nor can those in lesser populated regions isolate themselves from the effects of climate change. These impacts affect everyone equally, and those sectors that are now the most vulnerable in socio-economic terms will be the most affected.

Also, it must be considered that, according to the problem, the level of susceptibility of populations may change; for example, those who live in regions with mountains or slopes are less susceptible to floods or hurricanes than those who live near the coast. Likewise, for example, the Economic Commission for Latin America and the Caribbean (ECLAC) established that the region would be one of the most vulnerable despite being one of the ones contributing the least to the climate change phenomenon. Brazil, Mexico, Venezuela, and Argentina contribute 80% of the region's total greenhouse gas emissions, and yet, it represents only 9% of the world total. On the other hand, according to King (2004), an estimated 75% of emerging infectious diseases in humans are zoonotic. Some have been derived from climate change, such as bird flu and Zika. Other zoonotic diseases such as HIV and salmonellosis have spread from animals to humans. They have had a negative impact on public health, the economy, and society (Lori Cuthbert, 2020). Ebola occurred due to the high deforestation in Africa to build settlements. So populated

areas and nature led to the spread of the disease transmitted by wild animals. The U.N. (2015) mentions five factors that caused a rise in these infectious diseases: Deforestation and changes in land use, illegal or weakly regulated trade in wildlife, intensive agriculture and livestock, antimicrobial resistance, and climate change. Other figures regarding the impact of zoonosis are:

“Every year, around two million people die from neglected zoonotic diseases, mainly in low- and middle-income countries. These can cause serious diseases, deaths, and productivity loss among livestock populations in the developing world. This problem keeps hundreds of millions of small farmers in extreme poverty. In the last two decades alone, zoonotic diseases have generated economic losses of more than 100 billion dollars, not including the cost of the COVID-19 pandemic, which is expected to reach 9 billion dollars in the next few years” (Lasso, 2020).

Today, global public health is under threat due to the recent zoonotic disease known as COVID-19, which was said to have been transmitted to humans at a wild animal market in Wuhan, China, in late 2019. Because humans do not have immunity to the virus, the disease has been transmitted to hundreds of thousands of people, causing deaths worldwide.

The physical, chemical, and biological factors of the environment are determinants in human health. Next, information is presented where climate change, air pollution, greenhouse gases, loss of biodiversity, deforestation, and intensive agriculture and livestock are described as common determinants in the relationship between the environment and public health.

3.1. Climate change

This phenomenon is an essential determinant of public health. According to Checkley (2000), climate change increases disease transmission risks, mainly through air and water pollution. For example, it increases storms' strength and duration, such as hurricanes, cyclones, and other weather-related incidents.

Climate change has many various causes, a major one being rapid urbanization. It is estimated that almost two-thirds of the region's population lives in urban centers. While urbanization creates more job and business opportunities, the challenge comes when there is inadequate urban planning, which has been linked to health care complications, inadequate drainage systems, and overcrowding, among others. In the event of a disease outbreak, there is an increased risk of the disease spreading rapidly and affecting masses due to population concentration.

Unplanned urban development has been attributed to ineffective environmental health management policies (Jaitman, 2015 and Marx, 2013). However, other scholars believe that unplanned urbanization is due to the lack of implementation of existing environmental laws and the pressure to meet housing demand in urban centers (UN-Habitat, 2012). According to

Salcedo (2011), urbanization and public health are interdependent. A sustainable city should handle a certain population based on existing resources such as water, the transport network, housing, and other social amenities (UN-Habitat, 2012).

Another relevant determinant of climate change is environmental degradation due to wood burning, which generates fine particulate matter PM2.5, also known as black carbon, in the environment. This phenomenon has seen an upward trend in many countries. According to WHO (2018), recommended air quality standards should not have an annual mean PM2.5 concentration of 10 micrograms per cubic meter. Unfortunately, due to the burning of wood in many cities, the concentration of PM2.5 is too high (Alves, 2020).

According to the U.N. (2020), the greatest global challenge is climate change. Among its manifestations are mentioned the rise in temperature, the high sea level, and lost ecosystems. Different political instruments such as the Kyoto Protocol in 1995 and the Paris Agreement were used in 2015 to consolidate different countries' responses to combat climate change. Another great current tools to solve this great challenge are the U.N. Sustainable Development Goals (SDGs). The following are goals focused on environmental protection

- Goal 7. Affordable and clean energy: Goals are set to ensure affordable, modern, renewable, and reliable energy, as well as to improve energy efficiency and improving technologies.
- Objective 13. Climate action: Incorporate measures related to climate change.
- Objective 14. Underwater life: Reduce marine pollution, as well as the preservation of ecosystems.
- Objective 15. Life of terrestrial ecosystems: Considers the well-being of forests, biodiversity, and desertification

Each nation must identify its population's critical objectives: those that need more action to be achieved. The following table (refer to table 1) shows the main Latin American countries' location in the ranking or index of compliance with the SDGs. The table also allows us to observe that underwater life (Objective 14) is one of the problems that require more attention in Latin American countries.

Climate change and public health policies are closely linked because of extreme weather conditions, population displacement, physical damage, water availability, and vector-borne diseases that become common (Câmara, 2016); malaria outbreaks are due to favorable environments for mosquitoes to breed. More than 100 million people in the region, especially in the Amazon area, live in areas prone to this disease; Brazil, Colombia, Peru, and Venezuela are among the most affected. Diarrheal diseases are caused by food and water contamination, especially during floods (Checkley, 2000).

TABLE 1. Ranking of compliance with the SDGs in Latin America. Country its critic SDGs

	PAÍS	ODS MÁS CRÍTICOS
1	Costa Rica	2, 9, 10, 16
2	Chile	13, 15
3	Cuba	9, 10, 14, 15, 16
4	Ecuador	2, 3, 6, 9, 10, 16
5	Uruguay	3, 10, 12, 14, 15, 16
6	Argentina	6, 8, 10, 14, 16
7	Brazil	3, 8, 10, 14, 16
8	Peru	6, 9, 10, 16
9	Bolivia	2, 3, 9, 10, 14, 16
10	Paraguay	3, 9, 10, 12, 14, 16
11	Colombia	6, 10, 16
12	Dominican Republic	2, 3, 10, 14, 15, 16, 17
13	Nicaragua	2, 3, 9, 10, 16
14	Jamaica	2, 3, 8, 9, 10, 14
15	Mexico	2, 4, 6, 7, 8, 9, 10, 15, 16, 17
16	Panama	2, 3, 9, 10, 16
17	El Salvador	3, 9, 10, 14, 16
18	Venezuela	1, 2, 3, 9, 10, 13, 14, 16
19	Honduras	1, 2, 3, 8, 9, 10, 14, 15, 16
20	Belice	3, 8, 9, 10, 12, 14, 15, 16
21	Guatemala	2, 3, 5, 9, 10, 14, 15, 16
22	Haiti	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14, 15, 16

Source: L.A. Network (2018).

Climate change could endanger half of the plant and animal species in the world's most biodiverse areas. Even if the temperature rises by 2°C, about 25% of the species would be lost (WWF, 2020). Finally, the WHO (2018) estimates that climate change will cause an additional 250,000 deaths annually due to malnutrition, malaria, diarrhea, and heat stress concerning health risks.

3.2. Air pollution

Air pollution levels are dangerously high in many parts of the world. According to new data from the WHO (2018), nine out of ten people breathe air with high pollutant levels. Updated estimates show that seven million people die each year from ambient (outdoor) and domestic air pollution, which is quite an alarming figure. Therefore, air pollution is recognized as a critical risk factor for non-communicable diseases, as it is estimated to cause a quarter (24%) of all adult deaths from heart disease, 25 % of deaths from stroke, 43% of deaths from chronic obstructive lung disease, and 29% of deaths from lung cancer. More than 90% of air pollution-related deaths occur in low- and middle-income countries (WHO, 2018).

It is estimated that about seven million people die each year from exposure to fine particles contained in polluted air, which penetrate deep into the lungs and cardiovascular system, causing diseases such as stroke, heart disease, lung cancer, obstructive lung disease, and chronic and respiratory infections such as pneumonia.

The main sources of air pollution caused by the fine particulate matter are inefficient energy used in households and the industrial, agricultural, transportation, and coal-fired power plants sectors. In some regions, sand, dust, burning waste, and deforestation are additional air pollution sources.

Air quality can also be influenced by natural elements, such as geographical, meteorological, and seasonal factors. Such pollution knows no borders, so improving air quality requires uninterrupted and coordinated government measures at all levels to collaborate and find solutions that enable sustainable transportation, production and use of more efficient and renewable energies, and waste management. This aspect shows that these factors' sanitary control can only be carried out from an intersectoral policy since both industry and transport play a crucial role.

Metropolises are estimated to be the largest emitters of greenhouse gases (GHG). Industrialization and increased vehicles in urban centers enhance greenhouse gases emitted into the air (Vella-Brodrick 2011). Also, the elimination of natural vegetation prevents the sequestration of carbon dioxide, generating worse climatic conditions in urban areas and the presence of misty skies that are already perceptible in several cities in the region. Air quality impacts a multitude of people to respiratory diseases (Riojas-Rodríguez, 2016).

In Argentina, according to the National GHG Inventory of the Ministry of Environment and Sustainable Development, in the period 2018-2019, emission of GHGs was 53% by the energy sector; 37% by the agricultural, livestock, forestry, and other land-use sectors; 6% by industrial processes; and 4% by residues. It was recorded that the deforested area was 156 thousand hectares only for the agricultural sector and livestock in that same period. The trend in the amount of emissions from agriculture has been increasing since 2012 due to increased emissions from crop residues and synthetic fertilizers.

In Mexico, according to the National Institute of Public Health (INSP), 20 thousand deaths are caused annually due to air pollution, and 9,600 of them correspond to the Metropolitan Area of the Valley of Mexico (Excélsior, 2016). On the other hand, according to Ortiz (2020), the consequences of pollution on health are:

- The desertification in the north of Mexico. Regions are becoming barren lands due to rivers' drying up, animal and plant species' deaths, and aquifers' impact.
- Extreme temperature rises of 4°C in Mexico City.
- Unusual rainfall in some areas.
- Advancement in hot seasons.
- Forests and vegetation loss related to human activities; forest fires related to temperature increases.
- Disappearance of glaciers in the mountains Pico de Orizaba, Popocatepetl and Iztaccíhuatl.
- Disease's emergence such as dengue, in places where there were none before

3.3. Loss of Biodiversity

Loss of biodiversity is one of the consequences of climate change. Biodiversity evolves and adapts to various stages of our planet. However, the sudden current climate change and natural disasters have forced many flora and fauna species to abandon their habitats or ecosystems. As temperatures rise, animal and plant populations cannot respond to those conditions or are threatened by phenomena such as wildfires or natural disasters.

The loss of biodiversity is also seriously affected by other problems such as overpopulation, overexploitation of resources, and pollution (Riojas-Rodríguez, 2016). As the population explosion increases in urban centers, there is a great demand for water and land; the destruction of natural habitats to create housing and agriculture is why there is a great biodiversity loss. While urbanization and creating more living space is a good idea, it requires proper planning and should ideally focus on environmental and health effects.

Among the consequences of the environmental problems that can be summed up on the loss of biodiversity is that marine areas are among the most affected ecosystems since they are among the most fragile. Six marine regions of exceptional biodiversity inhabited by 1,729 species of fish, 124 species of marine mammals, and 330 species of birds, called hotspots of marine biodiversity, coincide with areas very seriously affected by global warming (Nuevatribuna, 2019). Mexico is one of the countries with the greatest biodiversity on the planet. It is fortunate to have most climates in the world, endemic species, and rich flora and minerals. However, the demographic expansion has caused the loss of endemic species. On the other hand, Argentina has 18 ecoregions, placing it among the most privileged countries in this regard. The Ministry of Environment and Sustainable Development (2019) of Argentina has identified a land-use change, deforestation, inappropriate practices in the livestock sector, introduction of invasive alien species, trafficking of animal species, and climate change as the main causes of biodiversity loss and 25% of its species are at risk.

3.4. Deforestation

According to Luchetti (2016), deforestation is defined as a process generally caused by human action, in which the forest area is destroyed. It is directly caused by man's action, mainly burning carried out by the timber industry, as well as the practice of obtaining soil for agriculture and livestock.

According to Lora (2010), deforestation is worrying because CO₂ retention is reduced, promoting global warming, and creating favorable conditions for diseases to spread. Also, deforestation is associated with the total loss of ecosystems, soil and nutrients, and inadequate water filtration for aquifers' recharge, leading to water scarcity. Forests are natural filters to breathe pure and clean air; without them, chronic respiratory diseases and lung cancer would skyrocket, causing millions of deaths.

Additionally, deforestation induces a rebound in mosquitoes due to greater exposure to the sun and humidity in recently deforested areas, which favors dengue, malaria, etc. The extinction of organisms within an environment changes that balance and prevents the transmission of pathogens. The transmission of infectious diseases involves the contact of several species. On many occasions, the pathogen and its host are involved; however, many host species will harbor this pathogen, and on many occasions, there is a requirement for an intermediate animal such as flies, ticks, or fleas. This is considered a vector that transmits the contagious disease to its final host. According to the WHO (2020), vector-borne infections represent almost 17% of infectious diseases that affect more than one billion people worldwide.

In another study (De Sy, 2017), Latin America was found to account for almost 54% of deforestation. The main drivers of deforestation were agriculture, urban sprawl and infrastructure, and illegal mining.

According to an article by D.W. (Thomas M, 2019), the Brazilian government considers deforestation a key factor for Brazil's economic growth. Agricultural land use represents 70% of the country's emissions. Globally, it is the seventh-largest producer of greenhouse gases; most of them produced through deforestation, indicating that from August 2018 to July 2019, 9,762 square kilometers were deforested. Brazil is the leading country in Latin America in deforestation, and large areas are used for livestock. Brazil attracts many investors in the beef market; it is a major exporter of beef worldwide due to the low land cost, particularly in rural areas. For its part, Peru is also currently grappling with deforestation from illegal gold mining.

Mexico occupied one of the top places in the rate of deforestation, nearing 75 thousand hectares per year. The nominal practice of the federal norms and the negligible awareness in our society will exacerbate this situation. According to SEMARNAT (2016), 1,500 thousand hectares of forest were lost from 2005 to 2010.

3.5. Intensive agriculture and livestock

It is considered that intensive agriculture began as a change in agricultural production in the mid-twentieth century, with the introduction of chemical fertilizers, which, although managed to increase production considerably, brought innumerable undesired effects on the environment (Cocco, 2016). The high demand for food products and other materials worldwide makes intensive agriculture necessary because it guarantees employment opportunities directly or indirectly to millions of people and contributes to the growth and development of economies. Nevertheless, while it plays a vital role in economic growth, it has had negative implications such as cutting down more forest cover and applying agrochemicals linked to food contamination and health risks. Exposure to pesticides has been linked to depression, skin conditions, miscarriage, cancer, respiratory problems, memory disorders, congenital disabilities, and neurological conditions such as Parkinson's disease (Valcke, 2017).

According to the Food and Agriculture Organization of the United Nations (FAO) (2020), the region has a quarter of the world's arable land and a third of its freshwater resources; its agricultural exports correspond to 15% of the global total. Despite this significant role that Latin America plays in agriculture, in the last decade, the region and the United States have led the world's consumption of pesticides, especially in transgenic crops such as soybeans or cotton. According to the Pan American Health Organization (PAHO), in 12 Latin American countries, poisoning by chemical products, especially pesticides and lead, has caused 15% of registered diseases (Es Global, 2018).

Intensive agriculture is related to a lack of adequate policy management over agribusiness and a lack of effective mechanisms to control land's overexploitation. There is the challenge of implementing existing laws, particularly in governments where their representatives are the primary beneficiaries of similar practices; the objective should be to balance food production and environmental conservation. With planned agribusiness, Latin America would benefit from sustainable development and, at the same time, minimize the spread of diseases derived from inadequate agricultural practices.

The cultivation of soy and its high demand has also contributed to deforestation in many countries of our continent. In Bolivia, where deforestation is driven by the massive desire for more agricultural land, huge fires have destroyed vegetation to create more space for agriculture (De Sy, 2015). In Brazil, according to data from the Brazilian Association of Collective Health, it is the country that uses the most pesticides in its agriculture, with 70% of food being contaminated by pesticides, which means that each Brazilian consumes an average of 7.3 liters of pesticides annually (Bioeco, 2018).

In Latin America, as throughout the world, economic necessity has motivated intensive agriculture and ranching, leading to deforestation, loss of diversity, and climate change intensification.

4. Case Study: Towards a Taxonomy of Environmental Management vs. COVID-19 in Latin America

This section presents a taxonomic study that relates environmental and carbon management indicators in Latin America with the behavior of the COVID-19 pandemic in countries of the region to support decision-making and public policy formulation during this health emergency. The case study uses the latest public information available as of December 31, 2020. This taxonomic study's thesis is that local environmental and carbon management are important factors that influence the behavior and impact of COVID-19 at the country level.

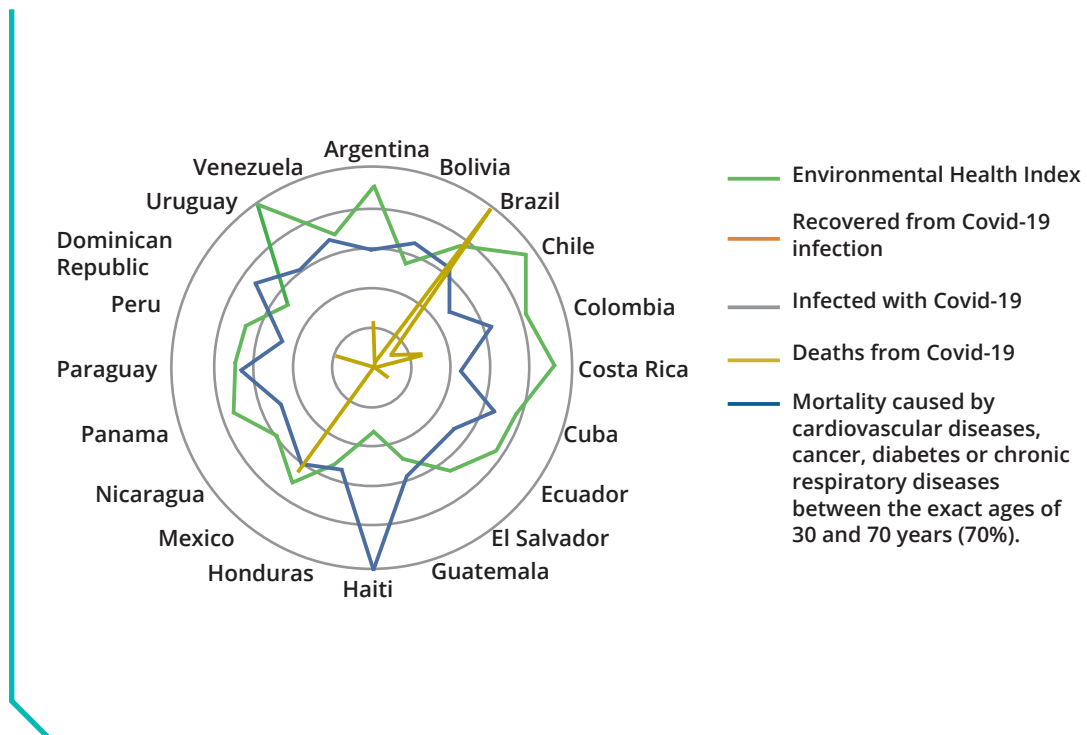
This taxonomic study gathers, normalizes, measures, and analyzes strategic data that scientifically support the management of interrelated indicators at the national level; can be helpful during and after the contingency caused by COVID-19, which should be used as a resource to increase regional resilience in a crisis like this or other airborne infection cycles.

4.1. Results of the case study

The following graph (See graph 1) shows four of the main incidence indicators of the SARS-CoV-2 virus in different Latin American countries, with data collected as of December 31, 2020. Among the main findings that can be observed are:

- In the Environmental Health Index indicator, countries with the highest values are Uruguay, Chile, Costa Rica, and Argentina.
- Brazil, Colombia, Argentina, and Mexico are Latin American countries that show the highest number of people who have recovered from COVID-19 and the countries with the highest number of COVID-19 cases in the same order.
- Regarding the number of deaths from COVID-19, the countries mentioned with the highest number of deaths are Brazil, Mexico, Colombia, Argentina, and Peru.
- Regarding the percentage of people between the ages of 30 and 70 who could die from cardiovascular diseases, cancer, diabetes, or chronic respiratory diseases, the countries with the highest risk are Haiti, the Dominican Republic, Venezuela, Paraguay, and Bolivia.

GRAPH 1. Incidence indicators of the SARS-CoV-2 virus in Latin America

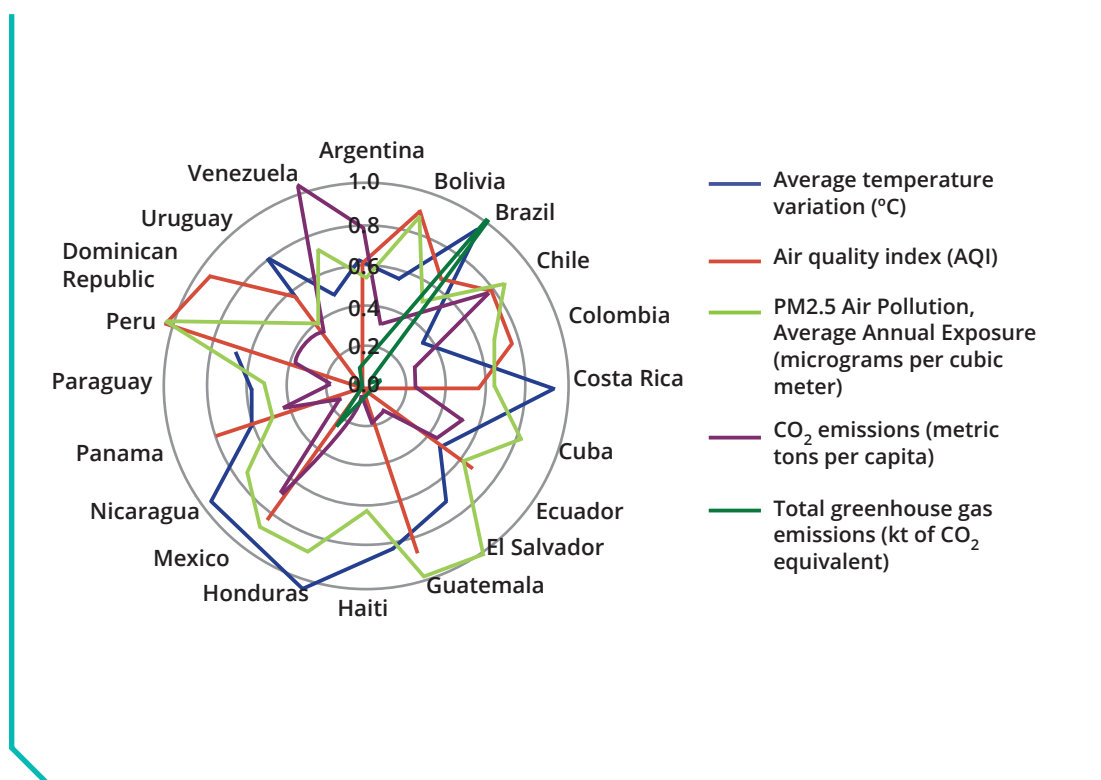


Source: Own elaboration with data obtained from the Center for Systems Science and Engineering at Johns Hopkins University. Retrieved on December 31, 2020.

The following graph (see graph 2) shows five environmental indicators whose effects are related to the incidence of airborne diseases. It is observed that:

- The average temperature variation in some Latin American countries has been registered above 1°C; Honduras (1.2), Mexico (1.13), Brazil (1.10), Nicaragua, and Costa Rica (1.1) are the countries with the most significant variation.
- Peru, the Dominican Republic, Bolivia, Guatemala, and Mexico are the countries with the worst air quality.
- Regarding air pollution by PM2.5, Peru, El Salvador, and Guatemala occupy the region's first places.
- Venezuela, Argentina, Chile, and Mexico are the countries with the highest amount of CO₂ metric tons per inhabitant, while Brazil, Mexico, and Bolivia are the largest emitters of GHG emissions.

GRAPH 2. Environmental indicators that contribute to the proliferation of airborne diseases for Latin America

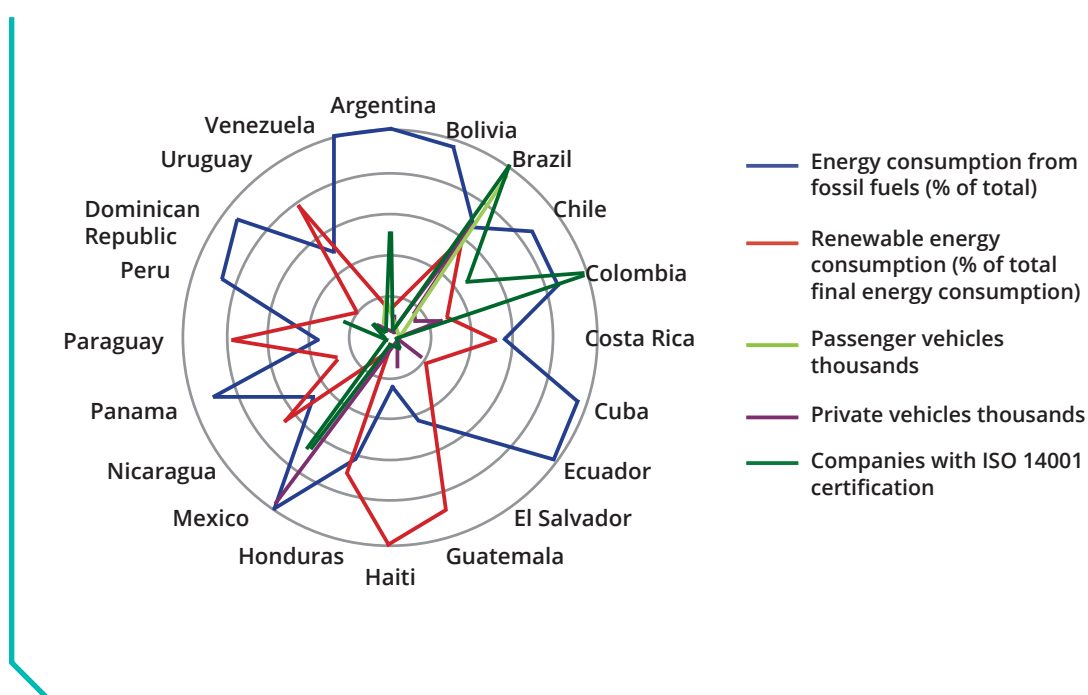


Source: Own elaboration with data obtained from NUMBEO, the World Bank, and the Economic Commission for Latin America. Retrieved on December 31, 2020.

Below are the indicators on the consumption and practices of various energy sources in Latin American countries (see graph 3), where it is observed, among other things, that:

- Mexico, Venezuela, and Argentina are the countries with the highest consumption of fossil fuels. In contrast, renewable energy consumption is led by Haiti, Guatemala, and Paraguay.
- Brazil, Mexico, and Argentina present the highest number of passenger vehicles and private vehicles regarding the vehicle fleet.
- Colombia, Brazil, and Mexico have the largest number of companies with ISO 14001 certification; this certification focuses on protecting the environment.

GRAPH 3. Renewable energy consumption and practices indicators in Latin America



Source: Own elaboration with data obtained from the World Bank, the International Organization of Automobile Manufacturers, and the Economic Commission for Latin America. Retrieved on December 31, 2020.

Policies that focus on urban improvement and care for the environment with a sustainable approach are important for growth and development. Most Latin American countries have a policy focused on public transport, either at the national or at the state level; the same happens with those focused on mobility on bicycle lanes. The following table (see table 2) shows a list of the countries that have (✓) national policies for public transport, hiking, and cycling, and with multilateral environmental agreements and environmental agreements; those that do not have these policies () and those from whom no information has been obtained in this regard (□).

TABLE 2. Latin American countries that have mobility policies and environmental agreements or conventions

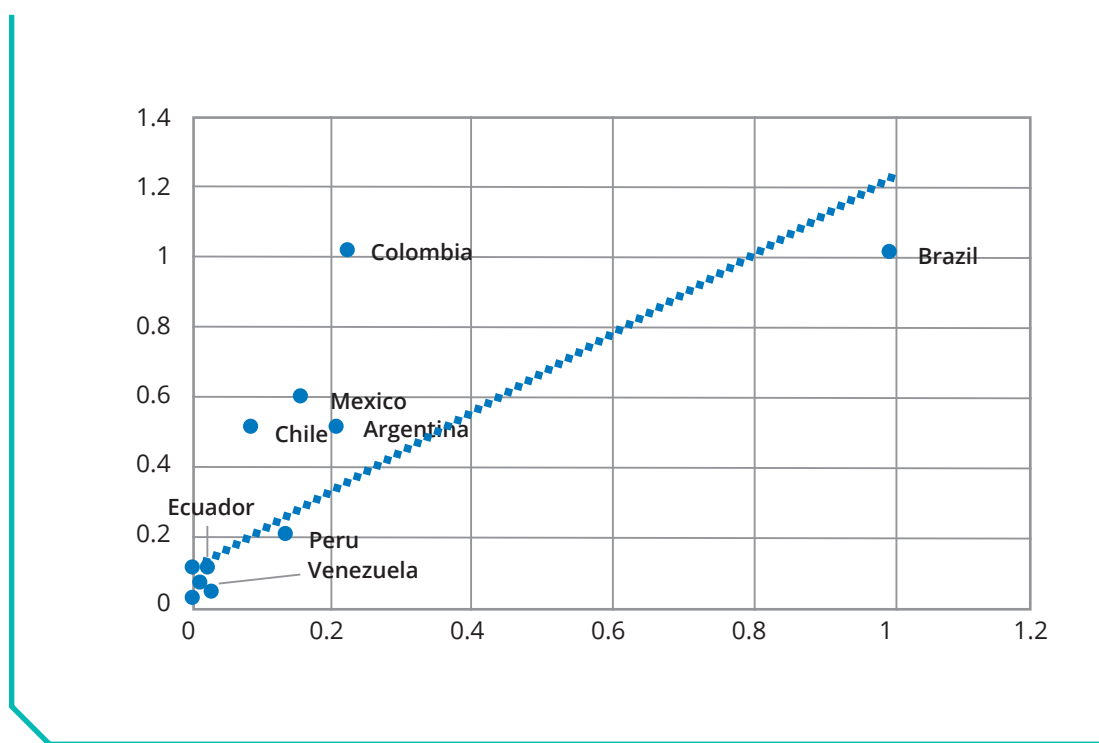
COUNTRY	NATIONAL TRANSPORT POLICY	NATIONAL POLICY ON HIKING AND CYCLING	MULTILATERAL ENVIRONMENTAL AGREEMENTS AND ENVIRONMENTAL CONVENTIONS
Argentina	✓	□	✓
Bolivia	✓	✓	✓
Brazil	✓	✓	✓
Chile	✓	✓	✓
Colombia	✓		✓
Costa Rica		□	✓
Cuba	✓		✓
Ecuador	□	✓	✓
El Salvador	□		✓
Guatemala	□	□	✓
Haiti			✓
Honduras	□		✓
Mexico	□	□	✓
Nicaragua	✓	□	✓
Panama	✓		✓
Paraguay			✓
Peru	□	✓	✓
Dominican Republic			✓
Uruguay	□	□	✓
Venezuela			✓

Source: Own elaboration with data obtained from the World Health Organization and the Economic Commission for Latin America. Retrieved on December 31, 2020.

All Latin American countries have environmental agreements and conventions. Bolivia, Brazil, and Chile are the only ones that have national policies and international agreements for these three issues.

Considering the previous indicators and following the hypothesis of this taxonomic study that tells us that local environmental and carbon management influence the behavior and impact of COVID-19 in the countries, a correlation was made (see graph 4) between the recovered cases of COVID-19 and the number of companies that have ISO 14001 certification. As a result, a positive correlation was obtained: the greater the number of companies with ISO 14001, the greater the number of people recovered.

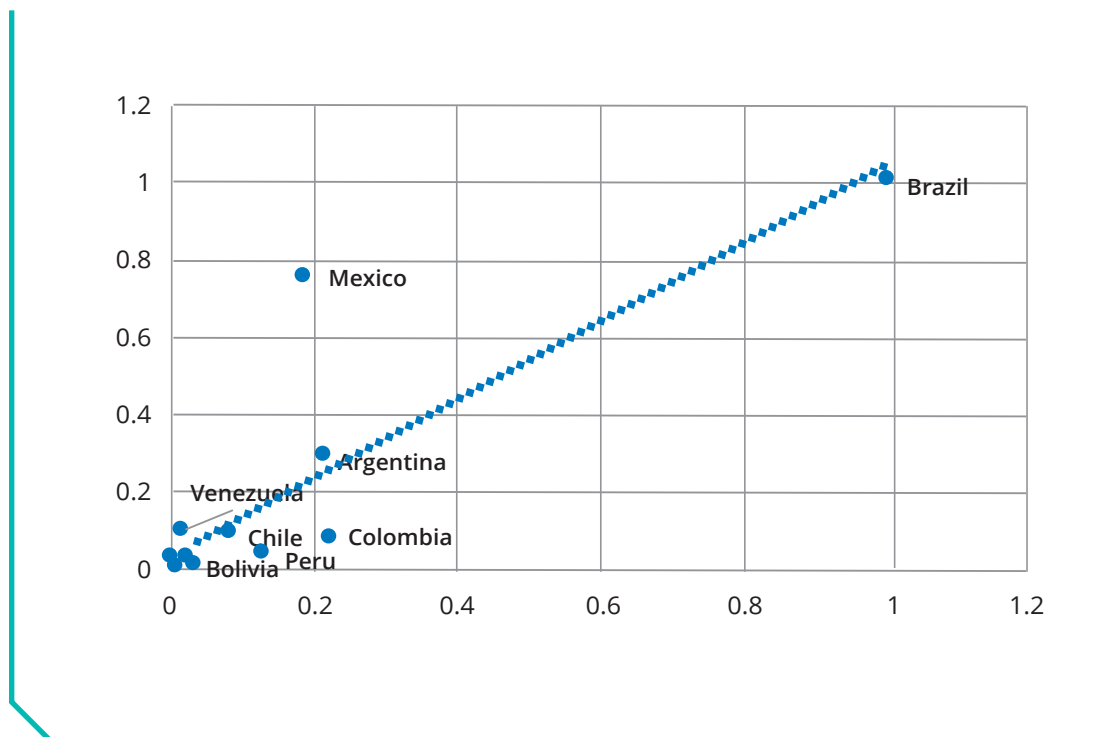
GRAPH 4. Recovered from COVID-19 vs. companies with ISO 14001 certification



Source: Own elaboration.

Following the same logic, a correlation was made between the number of people infected by the COVID-19 virus and passenger vehicles in Latin American countries (see graph 5). A positive correlation was identified; in countries with a larger number of vehicles, there is a greater number of confirmed cases.

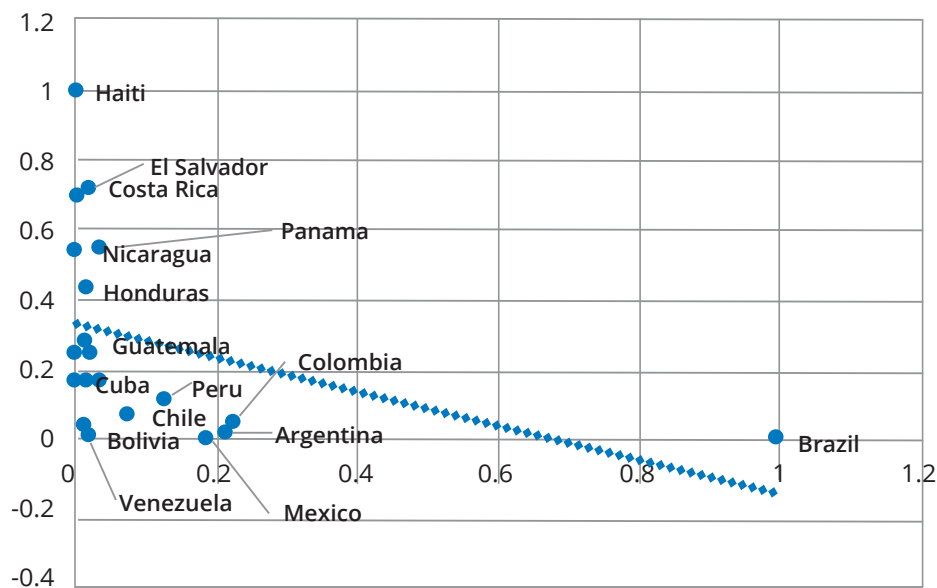
GRAPH 5. Infected with COVID-19 vs. passenger vehicles



Source: Own elaboration.

Next, the indicators for GHG emissions and people infected by COVID-19 in Latin American countries were correlated (see graph 6). Its result showed a negative correlation; in this case, they all seem to attend to a different order.

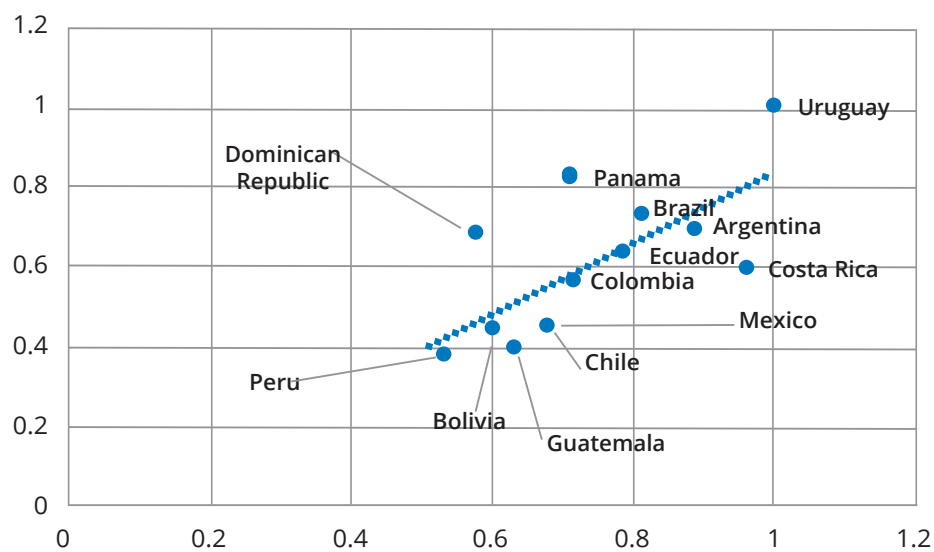
GRAPH 6. Infected with COVID-19 vs. greenhouse gas emissions



Source: Own elaboration.

Additionally, a correlation was made between the Air Quality Index indicators and particle pollution 2.5 (see graph 7). What yielded a positive result meant that they were closely related; when there is a greater quantity of PM2.5 particles, the air quality index also increases. It should be noted that the lower the ICA value, the better the air quality.

GRAPH 7. Air quality index (AQI) vs. air pollution by PM2.5



Source: Own elaboration.

Subsequently, an analysis of the data was carried out. The information was processed to determine an index that would reflect Latin American countries' conditions based on the selected environmental and health indicators (see table 3). The index showed that Uruguay had the best environmental conditions, followed by Haiti, Nicaragua, Costa Rica, and Panama. The worst performers were in the last place to Bolivia, preceded by Honduras, El Salvador, Guatemala, and Mexico. These entities, which are among the last positions in the region, could implement many improvement opportunities.

TABLE 3. Taxonomic Index of Environmental and Carbon Management vs. COVID-19

COUNTRY	INDEX
Uruguay	64.4
Haiti	54.1
Nicaragua	48.8
Costa Rica	45.3
Panama	45.3
Paraguay	42.7
Chile	42.0
Brazil	41.2
Colombia	39.6
Peru	39.1
Ecuador	38.7
Venezuela	38.7
Cuba	38.5
Argentina	38.3
Dominican Republic	37.0
Mexico	36.9
Guatemala	35.6
El Salvador	35.5
Honduras	34.6
Bolivia	26.9

Source: Own elaboration.

Next, a table is presented (see table 4) that contains the indicators that made up the index and the position of the 20 countries concerning each of them.

TABLE 4. Comparative table of the ranking of indicators

RANKING	Fewer deaths from COVID-19 per 100,000 inhabitants.	Lower mortality from cardiovascular disease, cancer, diabetes, or chronic respiratory disease (%)	Lower air pollution from PM2.5 means annual exposure (in micrograms per cubic meter)	Lower CO ₂ emissions (metric tons per capita)	Higher consumption of renewable energy (% total final energy consumption)	Higher number of public transport vehicles per capita	Higher number of companies with ISO 14001 certification per capita
1	Cuba	Argentina	Venezuela	Peru	El Salvador	Uruguay	Chile
2	Haiti	Brazil	Honduras	Brazil	Cuba	Argentina	Uruguay
3	Nicaragua	Guatemala	Costa Rica	Bolivia	Peru	México	Colombia
4	Venezuela	Haiti	Peru	Venezuela	Mexico	Brazil	Argentina
5	Uruguay	Honduras	Ecuador	Costa Rica	Brazil	Costa Rica	Costa Rica
6	El Salvador	Venezuela	Guatemala	Chile	Venezuela	Chile	Peru
7	Dominican Republic	Dominican Republic	El Salvador	Argentina	Argentina	Panama	Brazil
8	Guatemala	Bolivia	Chile	Cuba	Dominican Republic	Venezuela	México
9	Honduras	Paraguay	Bolivia	Mexico	Ecuador	Dominican Republic	Ecuador
10	Paraguay	Panama	Brazil	El Salvador	Uruguay	Colombia	Panama
11	Costa Rica	Costa Rica	Uruguay	Haiti	Haiti	Ecuador	Bolivia
12	Bolivia	Cuba	Cuba	Panama	Panama	Paraguay	Paraguay
13	Ecuador	Mexico	Colombia	Uruguay	Chile	Peru	Honduras
14	Chile	Uruguay	Mexico	Ecuador	Bolivia	Guatemala	El Salvador
15	Colombia	Ecuador	Argentina	Honduras	Honduras	Bolivia	Dominican Republic
16	Brazil	Colombia	Nicaragua	Dominican Republic	Colombia	Cuba	Nicaragua
17	Argentina	Peru	Paraguay	Paraguay	Paraguay	Nicaragua	Venezuela
18	Mexico	El Salvador	Dominican Republic	Guatemala	Nicaragua	El Salvador	Guatemala
19	Panama	Chile	Panama	Nicaragua	Guatemala	Honduras	Cuba
20	Peru	Nicaragua	Haiti	Colombia	Costa Rica	Haiti	Haiti

Source: Own elaboration.

The following table presents the indicators name considered and the source from which the data were obtained (see table 5).

TABLE 5. Indicators. Recovered as of December 31, 2020

INDICATOR	SOURCE
<input type="checkbox"/> Environmental Health Index (Environmental Performance Index).	Wendling, Z.A., Emerson, J.W., de Sherbinin, A., Esty, D.C., et al. (2020). 2020 Environmental Performance Index. New Haven, CT: Yale Center for Environmental Law & Policy. epi.yale.edu
<input type="checkbox"/> Deaths from COVID-19.	CSSE: Center for Systems Science and Engineering at Johns Hopkins University.
<input type="checkbox"/> Recovered from COVID-19.	
<input type="checkbox"/> Confirmed cases of COVID-19.	
<input type="checkbox"/> Mortality caused by cardiovascular diseases, cancer, diabetes, or chronic respiratory diseases between the exact ages of 30 and 70 years (%).	World Bank.
<input type="checkbox"/> CO2 emissions (metric tons per capita).	
<input type="checkbox"/> Total GHG emissions (Kt of CO2 equivalent).	
<input type="checkbox"/> Consumption of energy from fossil fuels (% of the total).	
<input type="checkbox"/> Renewable energy consumption (% of total final energy consumption).	
<input type="checkbox"/> Air pollution by PM2.5 means annual exposure (micrograms per cubic meter).	
<input type="checkbox"/> Public transport vehicles.	
<input type="checkbox"/> Private vehicles.	
<input type="checkbox"/> National public transport policy	WHO: World Health Organization.
<input type="checkbox"/> National policy on hiking and cycling.	
<input type="checkbox"/> Companies with ISO 14001 certification.	CEPAL: Comisión Económica para América Latina y el Caribe.
<input type="checkbox"/> Participation in multilateral environmental agreements -MEAs and environmental agreements.	
<input type="checkbox"/> Average temperature variation (°C).	
<input type="checkbox"/> Air quality index (AQI).	NUMBEO.

Source: Own elaboration.

The Taxonomic Index of Carbon and Environmental Management vs. COVID-19 allows us to observe that the most polluted countries are among the lowest index positions. Likewise, in the correlations made between indicators, it is interesting to observe how different order or origin elements have similar behavior and affect each other, supporting this research hypothesis. For this reason, correct environmental and carbon management should be considered a core part of public policy regarding climate change and future public health crises.

5. Conclusions and recommendations

The impact of climate change, loss of biodiversity, deforestation, inadequate water management, and intensive agricultural practices are some of the practices considered potential risks to public health due to the breakdown of the environmental balance and the possible spread of pathogens and diseases. That is why the formulation of public policy must adopt an integrative orientation considering initiatives of the “One Health” approach; providing opportunities to design and manage public policies integrating sustainability criteria with public policy on public health; as well as plan and implement early interventions to mitigate possible impacts of environmental, plant or animal origin.

A region that is home to a rich ecological diversity, such as Latin America, with more than half of the planet’s terrestrial species and complex and abundant flora and fauna, needs adequate and integrated public policies for the management of impacts; and risks associated with climate and biodiversity. Otherwise, climate change is expected to continue, with potential externalities and consequences for human health.

An important aspect that the COVID-19 pandemic has brought to our time is recognizing the intrinsic link between health and the environment. Therefore, this study examined the relationship between the determinants associated with environmental and public health problems as common causes and consequences under the “One Health” approach and how they are collectively understood in Latin American countries for their management.

Environmental health is an important element in public health since it allows to identify, characterize, monitor, regulate and evaluate physical, chemical, biological, and psychosocial threats to human health present in the environment.

The “One Health” approach aims to collaborate in different sectors to obtain better public health results. The study’s findings are intended to apply to a wide range of stakeholders, including government officials, policymakers, academicians, and stakeholders from all sectors, to foster multisectoral responses to health risks and threats to the public, to integrate common approaches at local, national, international, and global levels.

Based on the analysis carried out by this study, the following recommendations could be suggested:

Public education

- Cultural practices influence environmental degradation, and people’s ignorance produces some. Environmental public education is needed to educate citizens to empower them to make informed decisions and avoid harmful environmental practices.

Living space

- Building homes with insulation will be vital to keeping them warm and minimizing excessive wood burning. Collaterally, ecological housing is needed in urban centers to improve the conservation of the environment.

Political will

- For decades, governments have placed their focus on economic and political development. However, attention now needs to be integrated into preserving the environment, which will play an essential role in improving public health. Governments must realize that unplanned urbanization has caused many social problems that threaten public health.

Collaboration

- Stakeholders must work together to build sustainable cities. Initiatives to improve living standards, access to better services, employment opportunities, and other related factors are needed in rural areas to prevent population explosion in urban centers.

Public participation

- Society plays a vital role in conserving the environment, particularly communities that live closer to the forests. Public opinion is crucial to avoid resistance to change. People need to take responsibility for the conservation of the environment.

Public policies

- Policy formulation will require time, resources, and educational processes to align efforts towards a “One Health” policy without economic decisions mitigating environmental initiatives.
- All human beings are inhabitants of the same planet; we must satisfy our present needs without compromising future generations. Nature-based solutions to improve our public health will depend solely on the society and a collaborative system.

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Annex I. Summary of the first webinar

Conversation titled "Identification of opportunities and challenges in environmental management, climate change and public health in Latin America."

Held on October 9, 2020.

Available at: <https://www.facebook.com/eklakas/videos/359409661791378/>

The first discussion was a part of project analysis of the determinants concerning the policy and management of sustainability, climate change, and public health in Latin America, organized by the Regional Program for Energy Security and Climate Change in Latin America, of the Foundation Konrad Adenauer, on October 9, 2020. The objective of the discussion was to analyze the determinants in the relationship of sustainability management policy, climate change, and public health in Latin America, and promote comprehensive actions in the region, and analyze proposals that contribute to the creation of transformations that lead to a resilient, sustainable, and socially responsible economy.

The participants were: Enrique Román (Officer in Charge of the Representation of Peru, of the Food and Agriculture Organization of the United Nations (FAO)), Santiago Gowland (Vice President of Global Innovation and General Director for the Latin American Region, The Nature Conservancy (TNC), Argentina, and Pablo Necochea, Senior Sustainability Manager of Grupo Televisa, Mexico as moderator.

It began by presenting the discussion, the objectives, and the main points to be discussed, which revolved around the relationship between environmental and public health determinants associated with the main problems facing Latin America today and the elements to consider for its public management.

The first intervention was made by Santiago Gowland, who highlighted the relevance and pertinence of treating and understanding the relationship between environmental and public health events. His presentation was titled "Green Recovery: Latin America." Among the most critical data that Santiago presented were:

- The region has six out of ten of the world's most biodiverse countries, with 10% of the planet's land cover but 40% of its biodiversity.
- There are significant gaps in this convergence: the public policy gap, which has to do with aligning subsidies and incentives towards a low-carbon economy, and also the control of illegality that is required in this decade; there is a gap in the markets where we must first ensure compliance with legality, traceability, and transparency in everything - that is, the supply chain and, emergence of biodiversity economies were to be able to start working with nature. Another gap is financial. The current biodiversity financing gap is \$ 598-824 billion per year.
- The COVID-19 pandemic has brought a significant increase in public debt in Latin American

countries, and a recession in the regional economy of up to 9% of GDP is estimated.

- There is no solution for climate change except natural solutions such as reforestation; forests contribute 37% to climate change mediation.
- To conclude, he made an invitation to promote investments based on nature as a proven mechanism to promote environmental and health changes, as well as the investments in the ten biomes that cannot be lost, providing the vision of the project, and focusing on joining forces for the biomes

Enrique Román's second intervention began by highlighting the importance for FAO, the organization he represents, to talk about environmental problems about health in the context of the pandemic caused worldwide by the coronavirus. Regarding the same, several institutions have traced their origin in environmental problems. His presentation was titled 'Challenges for food and nutritional security: Plant Health.' A summary of the most relevant points mentioned by the speaker are:

- World hunger continues to increase; an increase of 10 million people is estimated in one year and up to 60 million in 5 years. More than 2 billion people do not have regular access to sufficient and nutritious food. If this trend continues, the number of hungry people could exceed 840 million by 2030.
- The COVID-19 pandemic may add up to 132 million people to the number who suffered from hunger earlier this year.
- FAO estimates that agricultural production should increase by approximately 60% by 2050.
- Plants produce 80% of the food we eat and 98% of the oxygen we breathe.
- Plant pests are responsible for losing up to 40% of food crops globally and it incurs commercial losses in agricultural products.
- Due to climate change, pests on plants are emerging earlier, and in greater numbers and places where they have not been seen before.
- The year 2020 is the International Year of Plant Health for the U.N. (2020).
- Plant health contributes to SDG 1, 2, 8, 12, 13, 15, and 17.
- The International Plant Protection Convention (IPPC) was formed with 183 countries, which seek three main objectives:
 1. Protect sustainable agriculture and improve world food security.
 2. Protect the environment, forests, and biodiversity.
 3. Facilitate economic and commercial development.

In the search to reduce the impact of climate change, food insecurity, the impact on plant health, and the loss of biodiversity, it is necessary to rethink the public policies of each region, as well as prioritize, increase, and search for technologies that are sustainable, profitable and natural; as well as innovate green economic mechanisms that support the channeling of resources such as carbon credits, green investments, financing and subsidies for ecological practices.

It must be remembered that Latin America and other parts of the world are in a vulnerable situation; they are large food producers, and even so, they are exposed to the food crisis that increases day after day. There must be a responsibility on each region's governments to change the production, distribution, and consumption processes urgently. Likewise, it is essential to raise the processes jointly rather than individually because as the conditions of climate change and other environmental problems continue to increase, it becomes increasingly imperative to focus efforts on priority regions that are crucial for the preservation of environmental conditions instead of continuing to act on individual small-scale projects.

Conclusion of the first webinar

As a priority action, it is suggested to achieve the investment above, externally, and internally, where financial companies can be integrated by private, public, philanthropic, or developmental interests. Banks, both private and commercial, would have to find or formulate conditions for financing and incentives for low-carbon economies. Within its territory, Latin America, six of the ten most biodiverse countries globally, would almost necessarily have to have a mature market for carbon credits, where payments for ecosystem services and mobilization for carbon transactions are considered.

Similarly, climate change knows no borders, and health clearly shows us, with the COVID-19 pandemic, that it does not have them either; therefore, the responsibility must come from all sectors: agriculture, production, development, social inclusion, and citizenship in general. From a collaborative work perspective, it is possible that policies that align incentives, subsidies, and reinforcements of natural solutions to the climate could emerge from working together, accelerating the processes that are of great importance for the action plans against the problems mentioned in this document and by the webinar speakers.

Annex II. Summary of the second webinar

Conversation titled: *"Sustainability, climate change and public health in Latin America."*

Held on December 7, 2020.

Available at: <https://www.facebook.com/eklakas/videos/1306849989662982>

The second discussion was within the project analysis of the determinants concerning the policy and management of sustainability, climate change, and public health in Latin America, organized by the Regional Program for Energy Security and Climate Change in Latin America, of the Foundation Konrad Adenauer, on December 7, 2020; whose objective was to analyze, under the "One Health" approach, the determinants in the relationship between the environment and public health in Latin America, seeking to contribute valuable discussions and promote comprehensive actions in the region, analyzing proposals that contribute to achieving the assurance of a sustainable region.

The participants were Ismael Couto (tutor of the Colegio de la Frontera Norte and member of The Climate Reality Project, Mexico), Lucas Ribeiro (CDP Latin America Involvement Manager), and Pablo Necochea, Senior Sustainability Manager of Grupo Televisa, Mexico as moderator. The conversation began by recalling what happened in the first discussion of the series, mentioning the most important points in the previous section of this document. The first speaker, Ismael Couto, presented information on climate change from the organization's position - The Climate Reality Project, of which he is a part. The speaker began by making an invitation to care for the environment from the presentation of the first photo we have of planet Earth taken from the moon, remembering that this small world (in perspective) is the only one that we have habitable and that we must take care of it. He also reminded us that any action we take locally has repercussions on a global level. Among the most relevant points that he mentioned are the following:

- Every 24 hours, we emit 110 million tons of human-made global warming pollution into the atmosphere's thin layer.
- The most significant source of global warming pollution is the burning of fossil fuels generated in almost all productive sectors on which the capitalist economic system depends.
- The energy trapped by global warming pollution today 'is equivalent to the explosion of 400,000 atomic bombs like the one in Hiroshima, every day, 365 days a year' according to James Hansen, former director of NASA's Goddard Institute for Space Studies.
- Mexico is the eleventh emitter of global warming pollutants.
- There are three global systems vulnerable to the climate that are the most susceptible to causing political or social instability: the first is the food supply that is affected by determinants such as fire, heat, droughts, floods, pests, diseases, toxins, shortage of water, among others; the second is health threatened by determinants such as food,

extreme climates, infectious diseases, contaminated water, heat fatigue, air pollution, among others; and the water.

- For every 1°C increase in global warming, crop yields are projected to decline for corn by 7.4%, wheat by 6%, rice by 3.2%, and soybean by 3.1%. These crops comprise two-thirds of the calorie intake of humans.
- A study on carbon dioxide CO₂ and soy by The Union of Concerned Scientists at the University of Illinois found that amphibians and Japanese beetles were more attracted to plants raised in high CO₂ conditions; beetles that fed on high CO₂ leaves lived longer and laid more eggs; and the high levels of CO₂ also reduced the natural defenses of the plants, leaving them almost defenseless against pests.
- Mortality from air pollution in Mexico costs the country more than 2% of the GDP.
- A study of 324 cities in China found a 15-22% increase in COVID-19 cases in areas with high levels of NO₂ and PM2.5 pollution.
- As the climate changes and human settlements spread into the Earth's remaining wilderness, an average of five new infectious diseases emerges each year.

The speaker concluded that today there are various proposals to produce renewable energy as an alternative to the practices described above that affect the environment and public health. In this regard, he recalled that Mexico had been a part of the Paris Agreement to reduce GHG generation to zero, and actions are expected to go on the right track.

Lucas Riberio continued the discussion with a presentation titled 'Corporations and supply chains.' He began by describing the main concepts related to climate change as they are; greenhouse effect, GHG, changes in temperature patterns and time scale; mentioning that the greatest challenge lies in reducing the speed with which the Earth's temperature has risen in the last 100 years. In this sense, the work carried out in favor of the environment would have led to a reduction in temperature. Among the main data shared by the speaker are:

- The International Energy Agency projects a 30% increase in the water needed for energy production by 2035.
- The World Bank predicts that water security, intensified by climate change, could cost up to 6% of GDP by 2020 in some world regions.
- Growth in deforestation in the Amazon in 2019 was over 30%.

The speaker noted that there are still solutions to climate change problems facing the region and humanity today. From the institution's vision for which it collaborates (CDP América Latina), there are four fundamental pillars for the formulation of a new environment-friendly economy: transparency, energy efficiency and use of resources, innovation in the business model, and alliances, and use of renewable energy and resources.

Conclusion of the second webinar

With this discussion, a broader panorama is obtained to manage environmental health from the perspective of other sectors. Various components are presented that must not be lost sight of, such as environmental policies, where technical standards are established like environmental legislation that establishes standards for human behavior. There are also environmental institutions that execute environmental policies and monitor compliance with them, as well as administrative instruments such as permits to carry out certain actions with a negative impact on the environment. On the other hand, it highlights the difference learned between the different environmental phenomena that we are facing, which, although seem to deal with the same thing, have different meanings, such as global warming and GHGs, where the former contributes to generating the latter and both, in turn, affect climate change.

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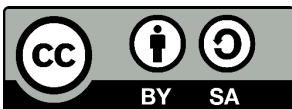
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