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CLIMATE CHANGE AND FOOD SECURITY

A climate impact
analysis for
small-scale farmers
in Colombia

EARTHQUAKE IN TURKEY

Impacts and
Lessons Learned
from the February
2023 Earthquakes

DROUGHT

Causes, effects
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BUSINESS RESILIENCE

Keys to develop
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Climate and health

A natural
relationship

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Content

01

Climate and health. A natural relationship 06

02

Climate change and food security. A climate impact analysis for small-scale farmers in Colombia 14

03

Earthquake in Turkey. Impacts and Lessons Learned from the February 2023 Earthquakes 22

04

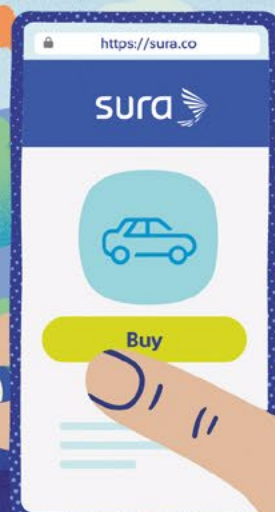
Drought. Causes, effects and mitigation 30

05

Business resilience. Keys to develop your business continuity plan 38

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Anticipation, adaptation and transformation in scenarios of uncertainty and ongoing change as the cornerstones of business competitiveness

In a world of uncertainty and constant challenges, visibility and transformation have become an invaluable asset. We are experiencing unprecedented climatic changes, with extreme temperatures, more intense and frequent phenomena, as well as natural events that bring a series of adverse impacts on the development of people and the competitiveness of companies. In light of this reality, sustainability is the key to continuing betting on the development and well-being of the next generations.

Recognizing that this task is not just the responsibility of a few actors, but of society as a whole, is a first step. From governments and businesses to local communities and individuals, we all have a role to play in building a world that is more resilient to climate change and prepared to deal with natural events. This means taking steps to promote more sustainable and healthy environments, as well as more resilient and resilient lifestyles.

Only by working together can we meet this existential challenge and protect the health and well-being of future generations. In the end, sustainability is a matter of survival under the uncertainties of today's world. It is not simply a matter of withstanding the onslaught of climate change or dealing with natural disasters, but of preparing for, transforming, and thriving in an ever-changing environment, a change that we must surely embrace as the new reality.

Nowadays, society and companies must focus on building strong and flexible systems that allow us to transform ourselves, as well as to withstand extreme events and provide adequate care to those who need it. This requires more than just investments in infrastructure and resources, but also a proactive mindset that anticipates future challenges and opportunities and seeks innovative solutions to address all types of phenomena that may put at risk the well-being of people and the sustainability of companies, regions, and communities.

Thus, in a world with more uncertainty, a proper understanding of the environment and trends undoubtedly becomes a tool to reduce uncertainty and also accompanies the challenge faced by companies in maintaining their competitiveness and sustainability as a result of a wide range of disruptive events, such as natural disasters, cyber-attacks, economic crises, political instability or public health problems.

JUANA FRANCISCA LLANO CADAVID
CEO Suramericana S. A.

01

CLIMATE AND HEALTH

A natural relationship



Climate changes have always influenced human health and well-being. Ancient civilizations related the outbreak of diseases to natural phenomena such as the seasons or environmental and physical changes.

In 400 B.C., Hippocrates, considered the father of medicine, began to relate diseases to natural phenomena and described how the seasons increase the frequency of respiratory diseases. For example, the “Perinthian cough,” an infection that occurred during the winter, affected the inhabitants of the ancient port city of Thrace in northeastern Greece. Symptoms such as fever, chills, and respiratory distress, sometimes leading to death, were associated with this disease.

Today, the relationship between climate and health is closer. Although life expectancy has increased, the prevalence of cardiovascular, chronic pulmonary, and renal diseases is driving efforts to mitigate and manage the harmful effects of climate change on human beings. Long winter seasons and greater connectivity between regions increase the rates of respiratory infections, leading to everything from school and work absenteeism to the closure of major borders with the collapse of world economies and high mortality rates.

IMPACT OF NATURAL CLIMATIC CHANGES ON PEOPLE

Although the epidemiological behavior of many infectious diseases, such as colds and influenza, depends on a rather complex combination of factors, some environmental factors partly explain high or low infection rates. For example, the efficiency of airborne flu transmission relies on viral concentration, which can be explained by the size of the droplets of saliva or nasal

secretions containing the viruses that people expel when coughing, sneezing, or talking, a characteristic that is related to some extent to the temperature and humidity of the environment. In dry environments, droplets of secretions produced by infected persons are smaller due to evaporation, which causes them to remain suspended in the air longer, with the ability to transmit the viruses they contain, even though they contain less virus than larger droplets. Meanwhile, in

humid environments, droplets containing viruses are larger because the evaporation rate is lower, which causes them to precipitate faster to the ground or other surfaces (they can travel up to 2 meters away), decreasing their transmission capacity despite having a greater viral load. However, during periods of humidity and low temperatures, people tend to shelter indoors, thus facilitating the spread of viruses under these conditions. This is one of the reasons why colds and flu spread so easily

ENVIRONMENTAL CONDITIONS ENCOURAGING PATHOGENS

Some environmental conditions such as precipitation, humidity, temperature, or ultraviolet radiation directly or indirectly support the reproduction, growth, survival, and dissemination of pathogens such as viruses, bacteria, protozoa, and helminths, which cause infections and diseases. Some examples are:

MECHANISMS OF DIRECT CONNECTION BETWEEN CLIMATE AND HEALTH

Ecological changes

Climate can alter local ecosystems and trigger epidemics. For example, Rift Valley fever is supported by rainfall that saturates and waterlogs the soil, creating an ideal breeding environment for mosquito vectors of the virus, which mainly affects animals (zoonosis) and, to a lesser extent, humans, when they come into contact with the blood or organs of infected animals.

Changes in human activity

The climate, combined with certain human habits, encourages the spread of diseases. For example, during periods of drought, people store water for consumption in ponds or pools regardless of the necessary hygiene measures, making these places a perfect breeding ground for mosquito vectors of viruses. Another example is the permanent use of air conditioning in hot climates, which favors the spread of the bacillus responsible for Legionnaires' disease (lung infection).



during the winter, especially in extratropical regions, where the climatic seasons define the behavior of temperature and humidity. This behavior is not so marked in tropical areas, where no winter seasons exist and wet periods are characterized by rainfall, which can occur throughout the year, with some important peaks during certain months, depending on the geographical location.

Another reason why the spread of contagious diseases seems to be related to climate is that variables such as temperature and humidity have been found to increase the proliferation of pathogenic viruses, bacteria, and fungi that are transmitted by respiratory routes, such as influenza, or by vectors, such as mosquitoes spreading dengue fever.

MECHANISMS OF INDIRECT CONNECTION BETWEEN CLIMATE AND HEALTH

The reproduction rate of microbes

- The reproduction rate of infectious microorganisms is proportional to the ambient temperature. Thus, for example, the parasite that causes malaria (*Plasmodium spp.*) matures inside the mosquito that transmits it (*Anopheles*) in 26 days at 20 °C ambient temperature, but at 25 °C it does so in 13 days.
- Diseases that are spread by drinking contaminated water, such as cholera, require a minimum temperature to replicate in the environment.

Transport and reproduction of vectors and animal hosts

The geographic spread of many vectors is bounded by minimum and maximum thresholds of temperature, precipitation, and humidity. These variables also play an important role in the life cycle of vectors and, therefore, in the rate of disease transmission. For example, the dengue vector (*Aedes aegypti* mosquito) is now found in geographical areas with altitudes above 1,500 meters, when it was unusual to be found above 1,000 meters due to low temperatures.

The transport of microbes

Rain and dry winds can transport pathogens over relatively long distances, which helps their spread.

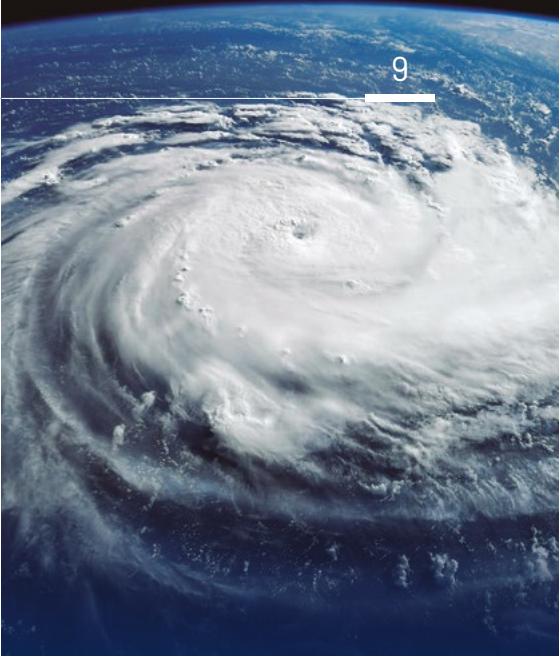
Biological evolution

Changing climate and environmental conditions play an important role in the evolution and adaptation of pathogens.

SPREAD OF DISEASE FROM EXTREME WEATHER EVENTS

Extreme weather events such as droughts, floods, hurricanes, or forest fires, in addition to causing loss of life and injury to people, can cause outbreaks of contagious diseases under certain conditions, which pose a major challenge to disaster response protocols. These conditions are:

- Displacement and congregation of affected people in shelters.
- Migration of the affected population to regions that expose them to endemic diseases for which they have no defenses.
- Damage to infrastructure and interruption of public services, affecting the provision of health services in hospitals and care centers.
- Restrictions or lack of food and drinking water can cause malnutrition or dehydration, making people more susceptible to some diseases.
- Interruption of fumigation programs, increasing the number of places for the spread of diseases and vectors of contagion.
- Post-traumatic stress disorders caused by the loss of homes or loved ones, which can eventually leave deep emotional scars.



HEALTH IMPACTS OF CLIMATE CHANGE

According to records of the current impacts of climate change, and climate projections, the world is already experiencing changes in the spatial and temporal distribution of precipitation and temperature, as well as an increase in the frequency and severity of extreme weather events. Therefore, in the face of a more severe climate, the impacts on our health will also be more significant.

1

1

EXTREME TEMPERATURES

- ☀️ Extreme temperatures are associated with heat waves that impact people's health significantly. For example, in the United States and Europe, the number of hospitalizations due to cardiovascular, renal, and respiratory problems has increased as a consequence of high temperatures. This condition can become more critical if other factors are added, such as heat islands in cities¹, population aging, and urban growth.
- ☀️ For populations less adapted to high temperatures, the risk of mortality increases by 1 to 3% for every 1°C increase in temperature.
- ☀️ Other health impacts are infections and accidents related to high temperatures.

2

WATER-ASSOCIATED DISEASES

- 💧 An increase in waterborne gastrointestinal infections (caused by *Salmonella* and *Campylobacter*²) Similarly, events such as floods, hurricanes, or droughts, related to climate change, have been shown to increase the incidence of diarrheal diseases caused by parasites such as *Giardia*³ and others.

3

FOOD SECURITY AND NUTRITION

- 🍴 Climate change can affect the quantity and quality of food production, putting global food security at stake. Food shortages and loss of nutritional value can lead the most vulnerable communities to malnutrition, making it a public health issue.

4

MENTAL HEALTH

- 🧠 From a physiological point of view, high temperatures affect the proper functioning of neurotransmitters such as serotonin and dopamine in the brain, which play a key role in mood, cognitive function, and performance of complex tasks. In addition, prolonged exposure to high temperatures over days or weeks can increase irritability and risky behaviors, such as substance and alcohol abuse, violence, and suicide.
- 🧠 The impact on cognitive function may explain the increase in hospitalizations for dementia during heat waves.
- 🧠 Studies suggest that a single attack of hyperthermia (increased body temperature) can cause prolonged effects on attention or memory, reducing the ability to perform protective actions, such as dressing appropriately or drinking sufficient fluids.
- 🧠 Similarly, studies report heat-induced sleep disturbances in people with mental illness and the elderly. Sleep loss is associated with increased irritability, frustration, and negative emotions.



WHO IS MOST VULNERABLE?

Climate-related health risks have historically had a heterogeneous impact on society. Generally, low-income communities are the most vulnerable to adverse health effects related to climate variables such as precipitation and temperature. These communities face precarious environmental conditions, often exacerbated by poor sanitation systems and limited access to safe drinking water. Additionally, they have little access to information, resources, institutions, or other factors that could help them prepare for and mitigate the risk of disease.

On the other hand, the risks associated with extreme weather events represent a higher degree of vulnerability for children, pregnant women, people with disabilities, those with pre-existing and chronic diseases, the elderly, immigrants, and workers who work in open fields.

SURA RESEARCH

In 2016, SURA entered into a cooperation agreement with the Institute for Occupational Safety and Health of the German Social Accident Insurance to investigate the level of UV radiation exposure experienced by outdoor workers in the construction and agricultural sectors in selected regions of Colombia.

The research was conducted over 9 months, and its results showed that the population analyzed was exposed to UV radiation levels well above the recommendations for occupational environments. These findings highlight the urgency of implementing measures such as the use of personal protection and the adequacy of the work environment to mitigate the carcinogenic risk associated with UV radiation.

🔍 If you want to know more about SURA's research, [click here](#)

2



1. The term heat islands refers to the localized increase in temperature in urban environments, compared to natural or undeveloped areas, due to factors related to the growth and concentration of structures, such as buildings, roads, or sidewalks; the lack of green areas, such as parks or corridors; pollution from traffic and industry; or the use of electrical appliances, such as computers or refrigerators, which release heat.
2. The most common bacterial cause of gastroenteritis worldwide, and one of the four leading causes of diarrheal disease.
3. Intestinal parasite that produces cysts, primarily inhabiting contaminated surface waters.

GLOBAL ACTION AND MITIGATION OF HEALTH IMPACTS OF CLIMATE CHANGE

The different global actions to address the impacts that climate, and specifically climate change, have on people's health focus on the two main climate change management mechanisms implemented at the global level: climate change mitigation, understood as measures adopted to avoid or reduce greenhouse gas emissions; and climate change adaptation, understood as actions that help reduce vulnerability to the impacts of climate change.

MITIGATION

Climate change mitigation consists of reducing and avoiding greenhouse gas (GHG) emissions, which cause global warming. The mitigation measures established by governments within the framework of Nationally Determined Contributions⁴ (NDCs) also provide a framework for action to address the impacts of climate change on people's health. These impacts generate significant social and economic costs, such as medical and care costs, loss of productivity, and also more subjective costs that are difficult to quantify, such as pain, suffering, and reduced enjoyment of leisure time.

In this context, several studies have shown the social and economic benefits of adopting climate change mitigation measures on health. An example of this is the research conducted by the World Health Organization in 2023, in which they evaluate the impacts of Colombia's NDCs, showing that the implementation of the most ambitious mitigation measures could contribute to avoiding more than 3,800 premature deaths per year by 2030, thanks to the improvement of air quality.

4. Nationally Determined Contributions (NDCs) are the national climate commitments established under the Paris Agreement to limit the average global temperature increase to 1.5°C, adapt to climate impacts, and secure financing to achieve these goals.

ADAPTATION

Adaptation to climate change refers to all measures aimed at minimizing the impacts related to more extreme and frequent weather; in particular, those aimed at reducing the effects on people's health, which can be implemented at the national, local, and personal levels. National or statewide measures include: assessing the level of preparedness on a regional scale to respond to high-impact weather events such as heat waves, floods and hurricanes; planning for infectious disease outbreaks; and assessing the level of vulnerability and resilience of hospital infrastructure to manage emergencies.

At the local level, possible adaptation measures include the modification of urban designs through the implementation of elements such as cool roofs, tree shading, or green paths, and the construction of cold shelters for those areas where increases in the frequency and severity of heat waves are projected. Other actions include preserving green zones in urban areas and generating early warnings of heat waves.

Finally, adaptation to the health impacts of climate change will also require multi-scale adaptation measures, ranging from individual actions, such as adaptation of housing, to policies and strategies at the community and national levels.



CLIMATE RESILIENT HEALTH SYSTEMS

Achieving climate-resilient health systems is part of the global actions to mitigate the impacts of climate change. To this end, the World Health Organization has developed the Operational Framework for Climate-Resilient Health Systems Development, a guiding document addressing the multiple evidence of the effects of climate change on people's health and, therefore, the need to create more resilient health systems in the face of projected climate conditions.

The objective is for health programs to improve their capacities in a changing and unstable climate, to ensure their efficiency and responsiveness to improving health, reducing inequalities and vulnerability, and providing adequate social and financial protection in the context of the challenges posed. Monitoring, prevention, management, and effective adaptation are key to achieving these objectives.

Importantly, WHO recommendations are also relevant to decision-making in other sectors, such as nutrition, water, sanitation, and emergency management. These recommendations can guide the targeting of investments and support to countries by international organizations. They are also critical for integrating health aspects into countries' National Climate Change Adaptation Plans. These plans have normative support from resolutions of the World Health Assembly and WHO regional committees on protecting health from climate change, as well as other relevant regulations.

THE SPECIFIC OBJECTIVES OF THIS OPERATIONAL FRAMEWORK ARE:



Contribute to the structural design of governance, clearly establishing roles and responsibilities associated with plan implementation.



To guide and prepare professionals working in the health sector, as well as in other determinants such as public services, food systems, energy, and urban planning, to address health risks associated with climate change through a resilience approach.



Identify the vulnerabilities of the health sector to climate change and design comprehensive plans based on this information.



SOURCES

Marisol Tamayo Vélez: Physician from Universidad de Antioquia and Master in Epidemiology from Universidad CES, with experience in Patient Safety, specifically in the epidemiological surveillance of infections related to health care and in the design and follow-up of health risk management models. Currently responsible for the technical scientific component of the Health Management of voluntary insurance SURA Colombia.

Juan Pablo Restrepo: Civil Engineer and specialist in Water Resources from the Universidad Nacional de Colombia. During the last few years, his work has focused on issues related to the connection between climate variability and physical risks of climate change, with productive sectors such as agriculture, energy, mining, construction, and insurance. He currently serves as Corporate Director of Trends and Hydrometeorological Risks of Suramericana S.A.



CLICK HERE
For references to this article.

02

CLIMATE CHANGE AND FOOD SECURITY

A climate impact analysis for small-scale farmers in Colombia

Climate change, while challenging, presents an opportunity to innovate and strengthen global food security by improving both food production and quality. In Latin America and the Caribbean, the agricultural sector has the potential to lead this change, facing global warming with resilient strategies. This region, rich in resources and diversity, can transform its economies toward more sustainable and robust models, thereby reducing hunger and poverty. For smallholder farmers, these challenges can become drivers of innovation and adaptation, providing access to new resources and technologies, and strengthening their capacities in the face of climate change. A prosperous and sustainable future for all can be secured thanks to proper management and adaptation.

Food security is understood as the situation in which all people have physical, economic, and permanent access, in quality and quantity, to sufficient, safe, and nutritious food that satisfies their dietary needs for an active and healthy life. Thus, changes in temperature, rainfall patterns, and the increase in the frequency of extreme weather events caused by global warming can pose a risk to food security, as they negatively affect agricultural production, decreasing the nutritional quality and quantity of food produced. Additionally, humans, plants, and animals will be exposed to new pests and diseases that manifest only under certain temperature and humidity conditions. This situation will entail new risks for food security, food safety, and human health.

Globally, the agricultural sector is responsible for approximately 30% of greenhouse gas (GHG) emissions. Of these emissions, 56% are due to deforestation, while 44% come from crop and livestock production. In Latin America and the Caribbean, the agricultural sector accounts for 47% of the region's total emissions (about 3.8% of global emissions). This region is particularly vulnerable to the negative effects of climate change due to its low adaptive capacity, the geographical location of some of its countries, and the susceptibility of the agricultural sector, which contributes approximately 5% of the region's GDP. This makes GHG mitigation fundamental to ensuring food security, as it not only preserves the natural resources and ecosystems on which food production is based but also promotes community resilience and adaptation.

Agriculture can contribute to climate change mitigation and reduce its environmental impact with a structural transformation in its production, marketing, and consumption system. Applying a sustainable approach that integrates ecosystem services with an agroecological vision is essential. This includes reducing deforestation due to changes in land use, implementing efficient crops, improving livestock nutrition, applying pasture regeneration techniques with integrated crop-grazing and no-tillage livestock systems, and applying circular economy principles in agricultural chains to reduce waste generation and improve its efficient management, such as the use of biogas obtained from animal waste as fuel, thus reducing the consumption of fossil fuels.

PROJECTED PRECIPITATION AND TEMPERATURE DUE TO CLIMATE CHANGE IN COLOMBIA

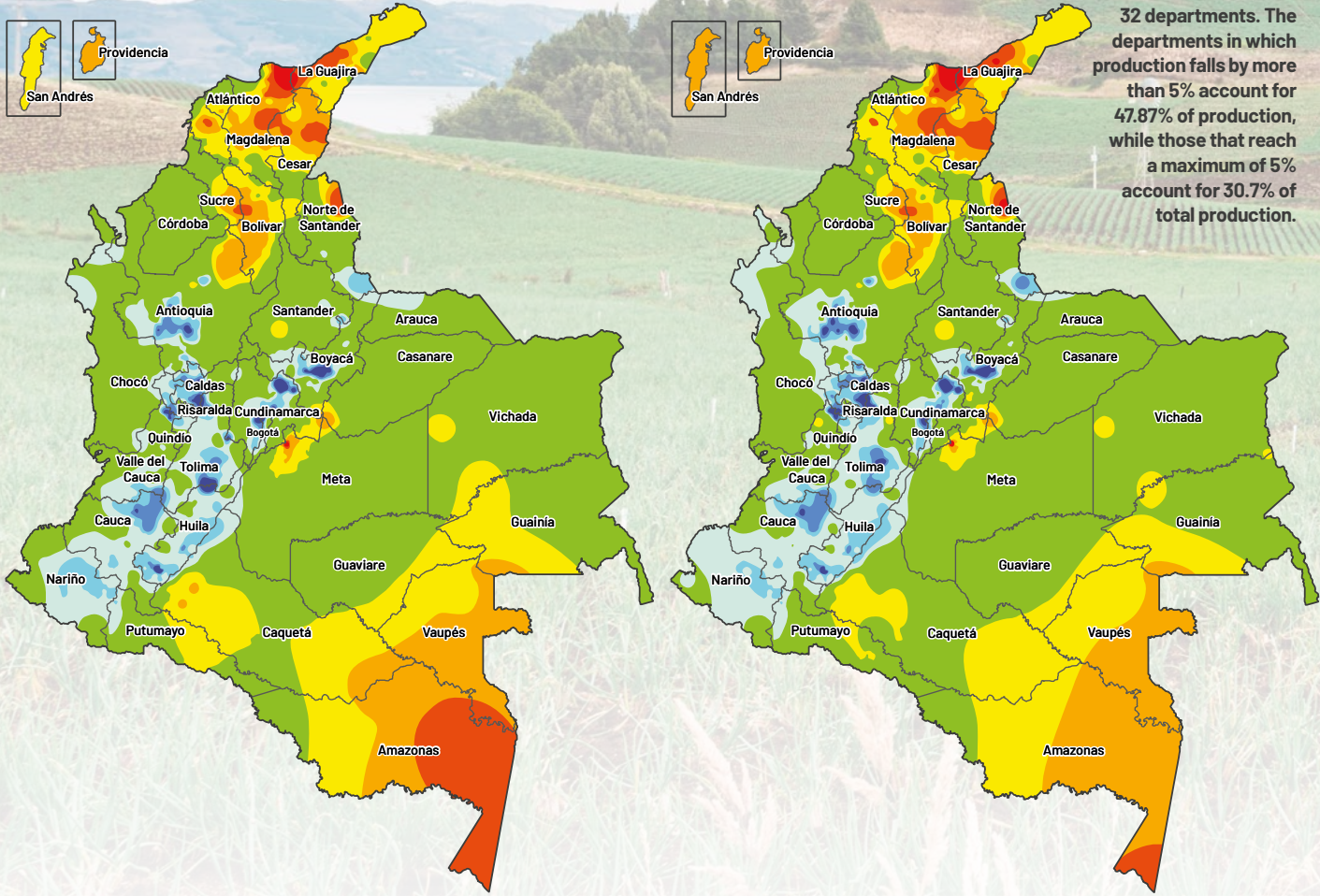
With the projected changes in the magnitude of temperature and spatial-temporal patterns of precipitation due to climate change, the availability of water required by crops to develop adequately is affected. Therefore, areas with limited water resources or those susceptible to floods and severe storms are vulnerable to losses in their

agricultural production, as well as to greater exposure of crops to pests and diseases, as they are weakened by water stress or excess humidity. This necessitates an analysis of precipitation and temperature factors, projecting different scenarios of change to provide greater clarity on their impacts on agricultural production. The following are the analyses of the scenarios studied that reflect the future dynamics of these factors in the Colombian territory. The scenarios were constructed

by the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM) with the RCP (representative concentration pathways) base¹, and the fluctuations are compared regarding the period. This is the standard scenario when making climatologies for temperature.

1. For more information on climate change scenarios, see article 2 in issue 10 of Geociencias magazine.

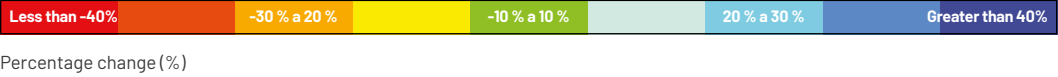
SCENARIOS OF REDUCTION IN AVERAGE PRECIPITATION



A pattern of decreasing production is also observed in 23 of the 32 departments. The departments in which production falls by more than 5% account for 47.87% of production, while those that reach a maximum of 5% account for 30.7% of total production.

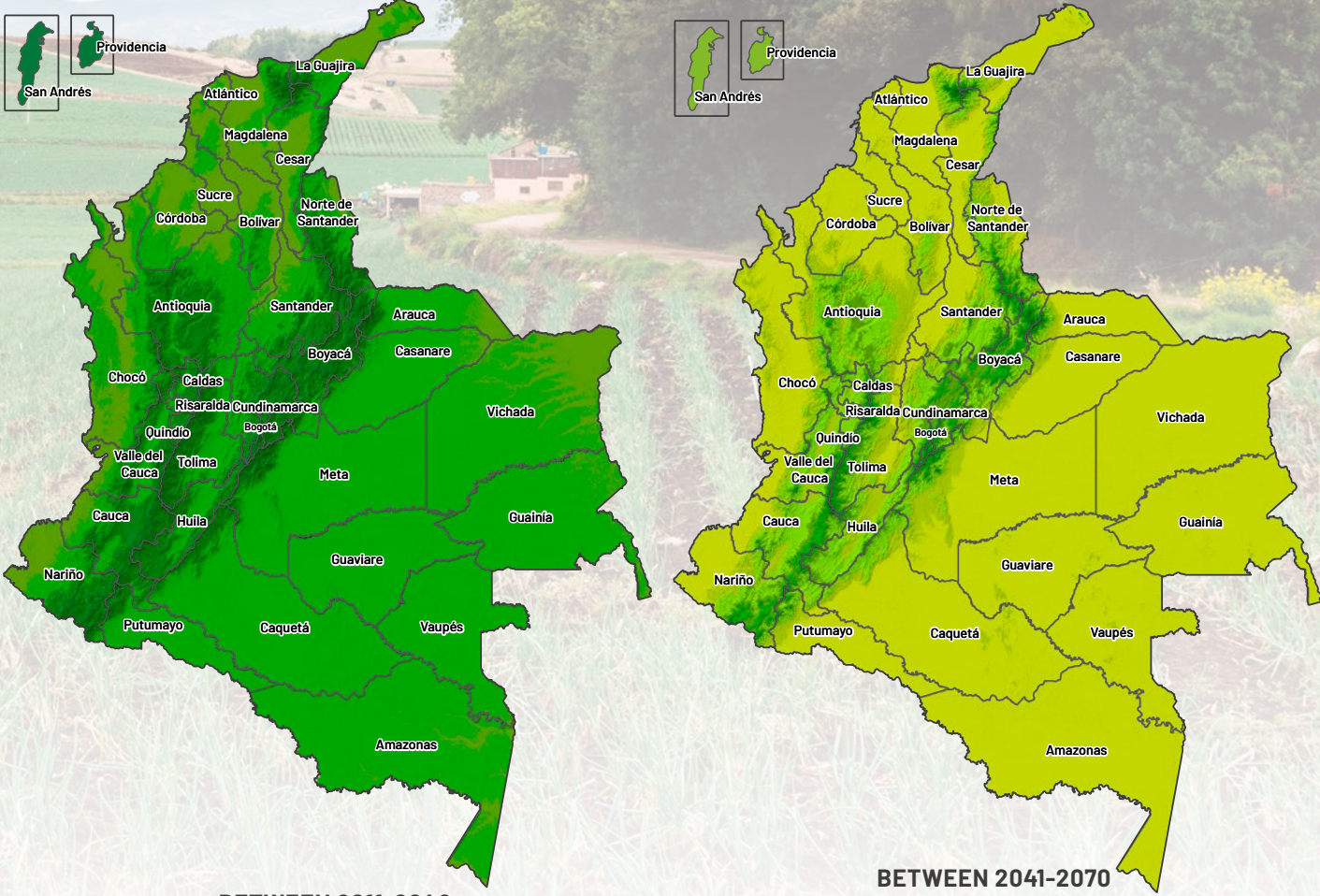
BETWEEN 2011-2040 Precipitation decreases by 10-40% in approximately 32% of the country.

BETWEEN 2041-2070 Precipitation decreases between 10 and 40% in approximately 29.6% of the country.



“Knowledge is fundamental for the development of the agricultural sector, that is why at SURA we have the GeoSURA platform, which allows our clients to access historical weather information as well as forecasts of different climate variables, which is a fundamental input in management and timely decision making.” Juan Pablo Loureiro De Rada, Vice President of Seguros de Suramericana S.A.

AVERAGE TEMPERATURE INCREASE SCENARIOS



BETWEEN 2011-2040 The average annual temperature of the continental portion of the territory gradually increases by 0.9 °C by 2040 and the average sea surface temperature increases by 0.5 °C in the Caribbean and 0.7 °C in the Pacific.

BETWEEN 2041-2070 The average annual temperature of the continental portion of the territory gradually increases by 1.6 °C by 2070 and the country's sea surface temperature increases by an average of 0.85 °C in the Caribbean and 1.2 °C in the Pacific.



OVERVIEW OF THE AGRICULTURAL SECTOR

The agricultural sector is one of the country's main economic sectors, contributing approximately 6% to 8% of Colombia's GDP and providing 15% of the country's jobs. Currently, one of the main drivers of the sector's growth is crop diversification. Among the crops that stand out for their

growing production are coffee, bananas, flowers, cocoa, fruits and vegetables.

A tool developed by the National Administrative Department of Statistics (DANE) to understand the productive conditions of the sector is the National Agricultural Census (CNA), a statistical operation that incorporates georeferencing elements and is carried out every 10 years, being 2014 its last version. The last CNA

covered 98.9% of operational coverage, including 1,101 municipalities distributed in 32 departments and the archipelago of San Andrés, Providencia and Santa Catalina.

The variables measured by the CNA make it possible to identify the levels of vulnerability of the sector to climate change through a characterization of the sector.

CNA RESULTS BY ANALYSIS VARIABLES



Pest control: 57.8% of producers carry out chemical pest, weed and disease control.



Technical assistance: 24.2% of the producers residing in the rural areas surveyed used technical assistance or advisory services to support the sustainability of their productive activities. This assistance is provided by official or private agencies.



Credit: 16.3% of the farmers residing in the census rural area requested credit for the development of their activities, especially for the purchase of inputs. Of these requests, 88.9% were approved.



Labor market: 72.8% of the producers are heads of household, and 23.4% of them are women. Approximately 58% have a primary school education and 21% have no education. A total of 4.5 million permanent workers have been identified, of which 22.6% are women. Additionally, 6.5 million additional day laborers have been hired.



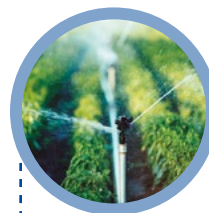
Management of production equipment: 29% of producers residing in the rural area have machinery and equipment. This machinery is largely used for crop management in the agricultural and livestock sectors, allowing for greater efficiency for the producer.



Livestock: The national species inventory puts poultry in first place (more than 720 million), followed by cattle (21.5 million), pigs (5 million), horses (1.2 million), sheep, goats and, to a lesser extent, buffalo.



Energy sources: 32.8% of the farmers use energy to carry out their agricultural activities. The sources used are the electrical grid (83.4%), fossil fuels (10.8%), and power plants (7.1%).



Water management: 87.4% of agricultural production units reported having access to water. However, 54.7% experienced difficulties using it due to issues such as droughts, deficient infrastructure, or suboptimal water quality for crops. In 77.1% of production units, efforts were made to protect water sources by conserving vegetation and, to a lesser extent, by planting trees.



Soil protection: 75.2% of producers employ soil protection practices. The most commonly used methods are: 1) stubble mulching (covering the soil with stubble to prevent direct exposure), 2) minimum tillage, and 3) manual planting or planting without soil removal. Regarding fertilizer use, approximately 70% use chemical fertilizers, while organic fertilizers are the second most common choice.



Crop management: 60.2% of the harvested area is dedicated to permanent monocultures (with long harvest cycles such as trees, shrubs, and flowers). Twenty-eight percent consists of transitory monocultures (harvest cycles of less than one year that are replanted), and 11.8% are associated crops (polycultures that include permanent, transitory, fodder, etc., or agroforestry systems). Agro-industrial crops, tubers and bananas, and cereals account for 79.2% of the total harvested area, representing 68.7% of the country's agricultural production. Among agro-industrial crops, the largest share is held by coffee, followed by African palm and sugarcane.



Complementary agricultural activities: The most common complementary agricultural activities include, in first place, residential use, followed by service activities, in which education and agricultural support activities stand out. In second place, agrochemical product processing and commerce, in which handicrafts and the sale of food and alcoholic beverages stand out; and, finally, industry, with mining.

Based on the diversity of crops in Colombia, a categorization is made to allow a better analysis of the data:



CASH CROPS

They are planted with the purpose of obtaining economic benefits through their sale and commercialization. They are grown in large quantities for local, national or international markets, such as coffee, wheat, corn and soybeans.



FOOD CROPS

These crops are grown to produce food for human consumption, which is crucial for ensuring the country's food security, as many farmers in Colombia use them for self-consumption. Due to their significance in the food system, these crops are subdivided into two categories.

- ② Food crops with high nutritional content: characterized by high energy and nutrient content, such as beans, cabbage and fruits.
- ② Food crops with low nutritional content: characterized by low energy or nutrient content, such as tomatoes, onions and lettuce.

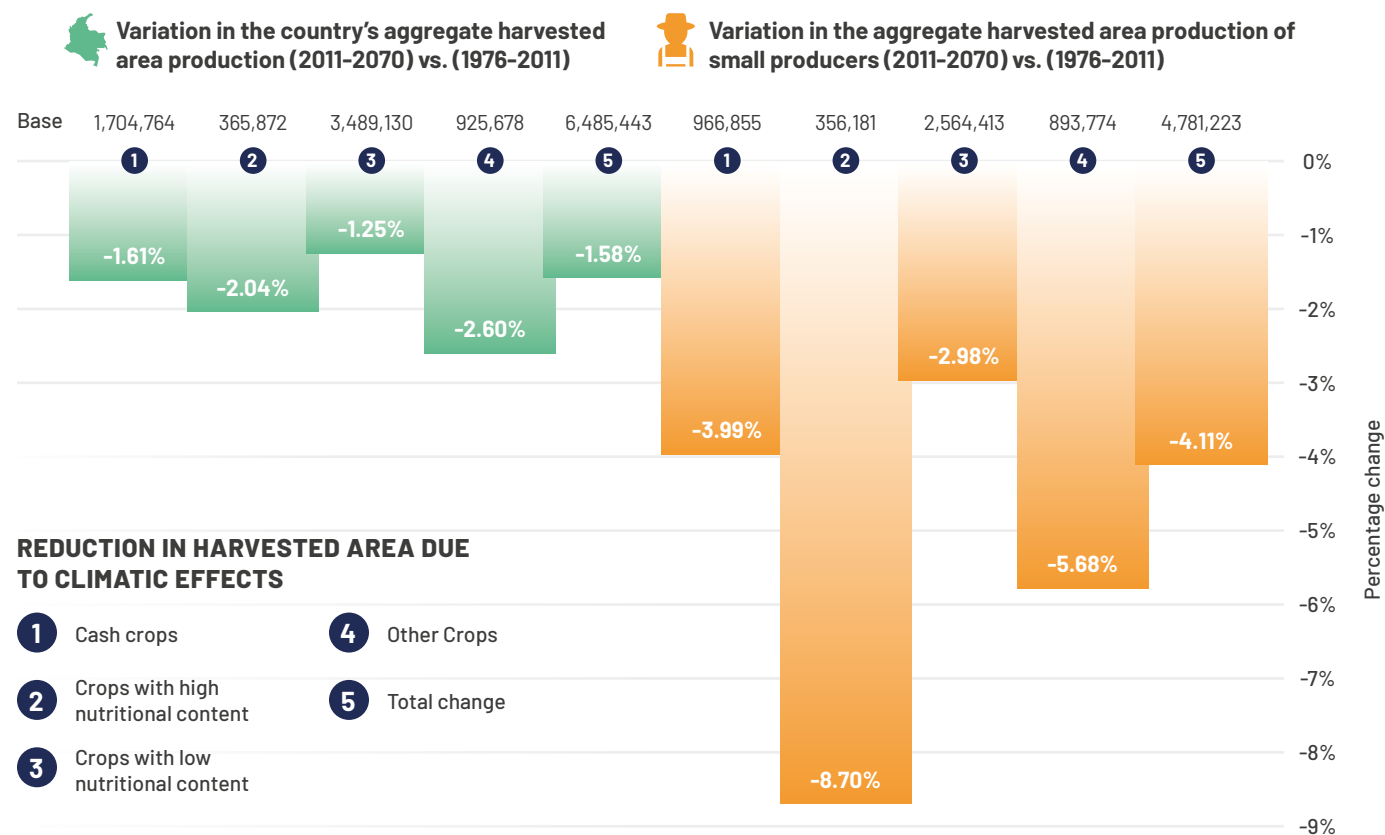


OTHER CROPS

This category encompasses all agricultural crops not classified as either cash or food crops. It includes a wide variety of crops such as industrial crops (used for the production of textile fibers or biofuels), medicinal crops (for the production of essential oils), ornamental plants, and forage crops for livestock, among others. Examples of crops in this category include pine, fodder corn, roses, and other floral species.

POSSIBLE EFFECTS OF CLIMATE CHANGE ON AGRICULTURAL PRODUCTION

To understand the effects of climate change on agricultural production at both the national level and for small producers, the information from the CNA is analyzed alongside the IDEAM temperature and precipitation scenarios presented above.



Effects for the country

Combining the data from the CNA with the climate scenarios, it is notable that for the period between 2011 and 2070, aggregate production in Colombia is projected to decrease by an average of 1.58% compared to the average production from 1976 to 2011.

This decrease in productivity results from the scenarios of reduced precipitation and increased temperature defined by IDEAM, given that the other variables remain constant in the prediction algorithm.

Effects on small producers

For the time periods analyzed, the production of small farmers is reduced almost three times more than the case of agricultural production at the national level (4.11%). This is a great finding, since the result discriminates the effect of climate variables for a segment that has greater restrictions for access to resources and adaptation measures.

Analyzing the results in more detail, 78.6% of small farmers show a reduction in production for the period 2011-2070, and 72% of the country's departments also experience a pattern of decreasing production. Another relevant finding is that, except in the central-eastern region and the departments of San Andrés and Córdoba, small producers in the rest of the country are affected by changes in temperature and precipitation.

Conclusions of the Analysis

Changes in temperature and precipitation are expected to impact both national agricultural production and small farmers. While the effects vary by region and crop type, the fact that the decrease in production for small agricultural units is nearly three times greater than the national average underscores the heightened vulnerability of this group of producers. This situation is further exacerbated by the lower profit margins of small producers compared to other actors in the supply chain, such as suppliers and marketers, as their products do not reach end consumers directly. Additionally, high levels of labor informality and difficulties in accessing better infrastructure and technology contribute to the negative impact on small farmers' production projections.

ADAPTATION CHALLENGES

The results obtained show the need to implement adaptation measures aimed at small farmers. This goes hand in hand with the development of local public policies and knowledge of the risk that climate change implies for the sector. According to the FAO (Food and Agriculture Organization of the United Nations), adaptation measures for the sector include:

Optimizing crop irrigation based on the specific species and climatic conditions of the region.

Use of crop and fodder varieties for livestock, adapted to variable climatic conditions.

Knowledge and use of climate data and weather forecasts combined with early warning systems.

The process of formalizing small producers through public policies will be key to reducing the adverse impacts of climate change.

Improving soil quality and health strengthens crops, making them more resilient to climate variability, diseases, and pests. Recommended practices include reducing agrochemical use, employing organic soil conditioners, and utilizing biopreparations for sustainable pest and disease management.

Enhancing irrigation systems to be more adaptable to fluctuations in rainwater availability, including the integration of catchment and storage systems.

Promoting agricultural biodiversity to improve crop resilience to climatic events such as droughts and floods, and to foster ecosystems that self-regulate and adapt to changing climates.

Protecting watersheds and forests through the application of Nature-based Solutions (NBS) with a focus on Ecosystem-based Adaptation (AbE)².

² For more information, see article 2 of issue 9 of *Geociencias* magazine.

To ensure that the implementation of adaptation options effectively reduces vulnerability and enhances the resilience of the agricultural sector in Latin America, it is crucial to consider the following actions: Prioritizing research and the dissemination of knowledge, strengthening institutional capacities and coordinating climate policies with development policies.

SOURCES

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development, impact assessment in the rural sector and technological transformation in the rural sector of developing countries, among others.

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For references to this article.

03

EARTHQUAKE IN TURKEY

Impacts and Lessons Learned from
the February 2023 Earthquakes

Understanding the impacts of earthquakes requires a detailed assessment of the risks cities face and strengthening their preparedness and resilience. While predicting earthquakes is not possible, mitigating their consequences is feasible. In this context, the analysis of recent earthquakes in Turkey and the response actions taken provide valuable lessons for businesses, individuals, and society at large. These lessons can serve as important tools for preparedness in the event of similar occurrences.

Turkey, located in a seismically active region, experienced two strong earthquakes on February 6, 2023, near the Syrian border. The first, of magnitude 7.8 Mw and at a depth of 10 km, occurred at 4:17 a.m. local time, according to information provided by the USGS. Nine hours later, a second quake of magnitude 7.5 Mw occurred at a depth of 7.4 km, followed by several aftershocks.

These earthquakes impacted 10 provinces in Turkey and 5 in Syria. According to an analysis by the World Bank, direct losses were estimated at USD 34.2 billion, which is equivalent to 4% of Turkey's GDP in 2021. These figures underscore the country's vulnerability to natural disasters and highlight the urgent need for implementing prevention and preparedness measures for future seismic events.

Natural disaster preparedness and crisis management strategies emphasize the importance of planning and adaptive capacity in enhancing business resilience. These measures are crucial for mitigating the devastating effects of earthquakes and facilitating a faster recovery after such events.

Analyzing seismic events from various regions and time periods has led to the development of strategies at governmental, economic, social, and environmental levels. These strategies aim to mitigate the impacts of such catastrophic events on people, businesses, and the state. The primary objective is to establish measures that ensure business continuity and maintain the habitability of affected areas.



THE SEISMIC CONTEXT IN TURKEY AND THE EVENTS OF 2023

To understand the events of February 2023, it is essential to take into account the seismic context of Turkey. Turkey is located in a zone of high seismic activity and has experienced at least six earthquakes of magnitude greater than 7 in the last 50 years.

Turkey is located in a region where four tectonic plates converge: Anatolian, Arabian, Eurasian, and African. This geological configuration results in numerous faults across the country, with the northern region being particularly earthquake-prone due to the convergence of the Anatolian and Eurasian plates. Furthermore, the southern part of the country is intersected by the East Anatolian fault system. These geological features contribute to Turkey's high seismic activity, as evidenced by more than fifty recorded seismic events from the 20th century to the present.

After the 1999 Izmit earthquake of magnitude 7.6, Turkey realized the need to improve its building standards to ensure the safety of its citizens. This event highlighted the need to update and enforce a more rigorous and safer building code.

THE EARTHQUAKE IN FIGURES

 February 6, 2023

First earthquake

7,8 Mw

with a depth of 10 km at
4:17 a.m. local time

Second earthquake

7,5 Mw

with a depth of 7.4 km at
13:24 p.m. local time



More than 1,000 aftershocks



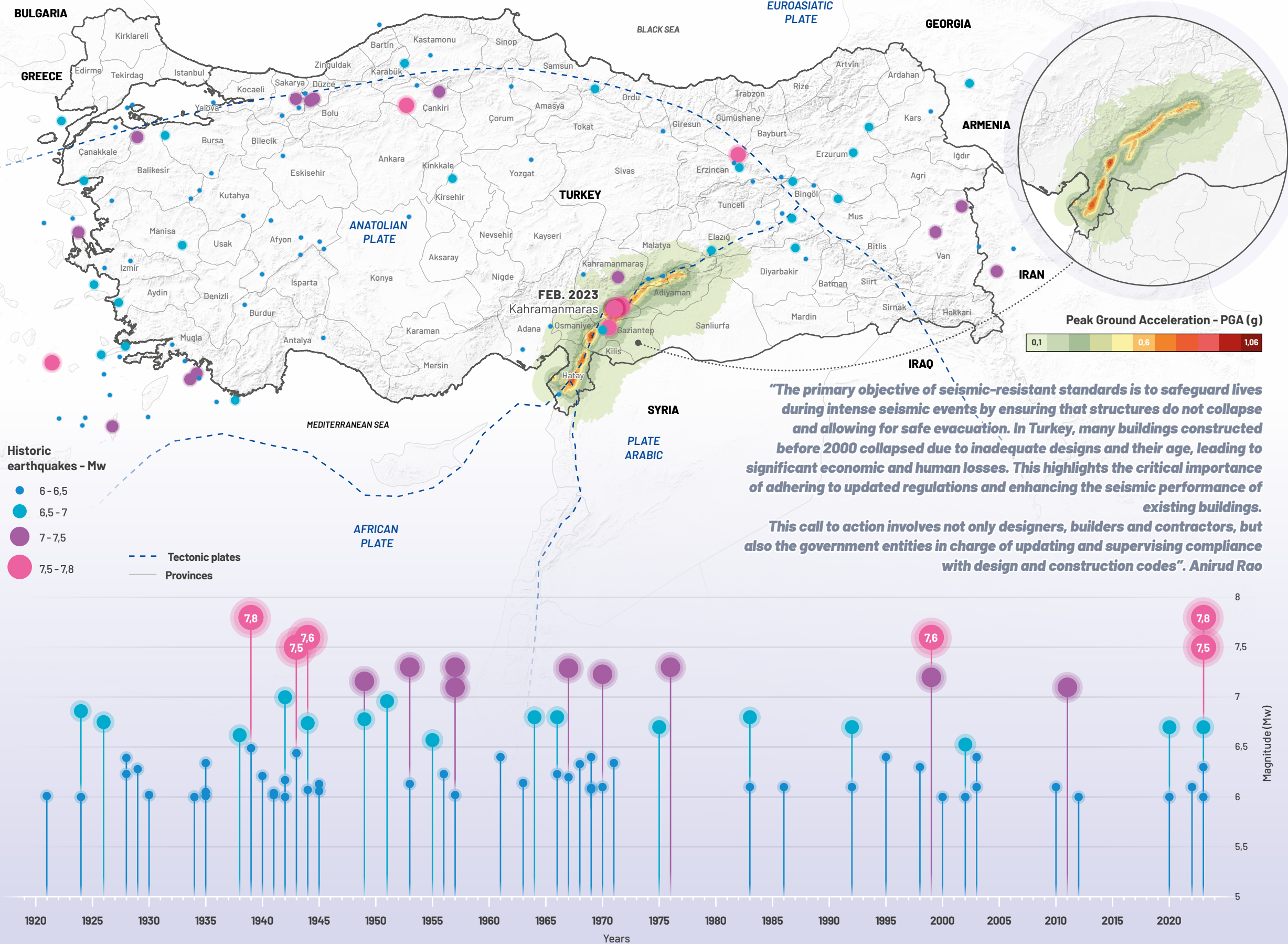
USD 34.2 billion in losses



Earthquakes mainly affected
10 provinces in Turkey and 5 in
Syria



If you want to learn more about affected provinces.



EVOLUTION OF THE TURKISH SEISMIC-RESISTANT STANDARD AND BUILDING PERFORMANCE

Turkey has experienced a series of large earthquakes that have influenced the evolution of its seismic design and construction code. The 1939 Erzincan earthquake marked the beginning of earthquake-resistant design in the country. Subsequent updates to the code reflect efforts to meet international standards and improve struc-

tural safety. Despite this, the 1999 Izmit earthquake highlighted the need for additional measures, such as the implementation of mandatory earthquake insurance. The damage caused by the 2023 earthquake underscores the importance of continuing to learn and update regulations to ensure greater structural safety in the future.

EVOLUTION OF THE TURKISH SEISMIC CODE AND ITS RELATION TO THE NUMBER OF BUILDINGS CONSTRUCTED IN THE COUNTRY (%) AND MAJOR EARTHQUAKES INFLUENCING THE STANDARD

● Evolution of the building code or seismic code

● Historic earthquakes - Mw

SEISMIC HAZARD MAPS

1970 - 2000
Incipient earthquake-resistant design standards

2000 - ACTUAL
Modern earthquake-resistant design standards

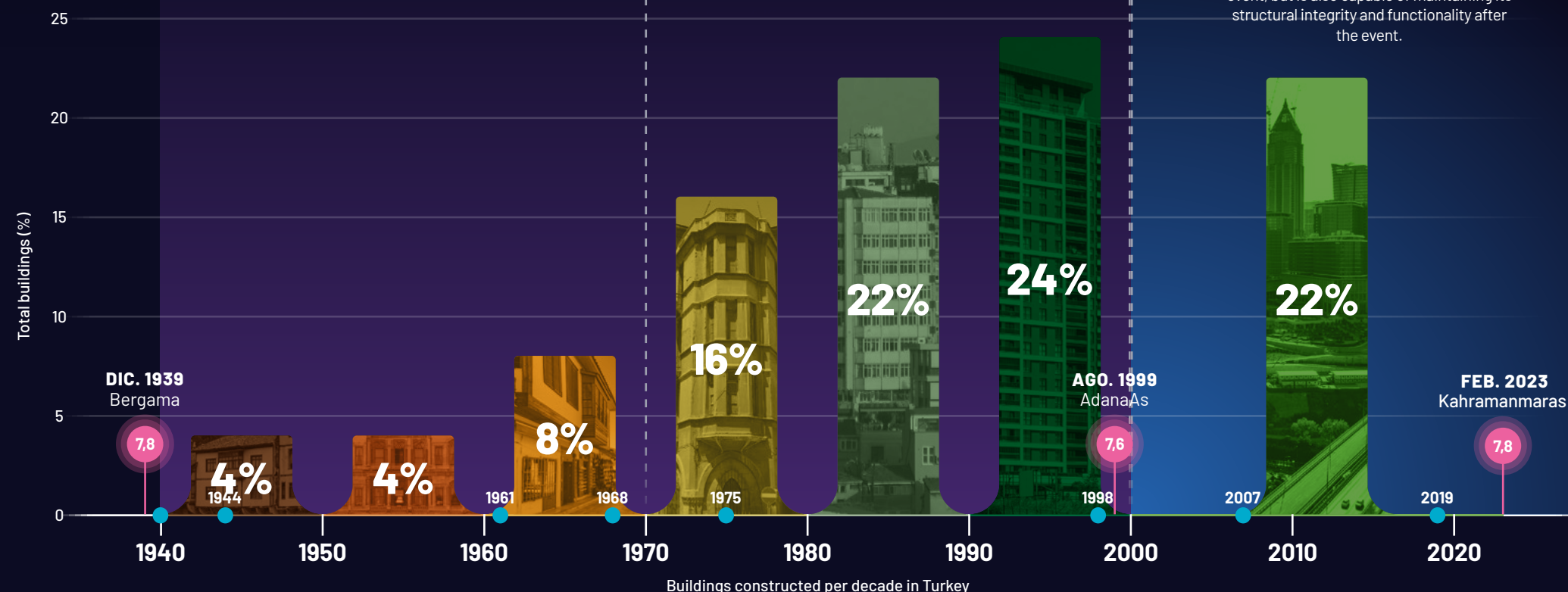
SEISMIC DESIGN CODES WITH MINIMAL OR NOT VERY DETAILED SPECIFICATIONS

Before the year 2000, the use of rebar in buildings was not required, which increases their vulnerability.

DETAILED AND RIGOROUS SEISMIC DESIGN CODE

Capacity-based design

Seismic design that seeks to ensure that a structure is not only safe during a seismic event, but is also capable of maintaining its structural integrity and functionality after the event.



Approximately 78% of buildings in Turkey were built before the year 2000, when seismic-resistant design standards were minimal or incipient. This situation partly explains the extensive material damage observed during the 2023 earthquakes.

DAMAGE OBSERVED IN BUILDINGS AFTER THE FEBRUARY 2023 EARTHQUAKES

1 Residential buildings, mainly those built before 2000, were the most affected. Although collapses were also recorded in more recent buildings, these occurred in smaller proportions and magnitude. These facts are evidence of the advances in seismic design proposed by modern codes, as well as the government's efforts to ensure compliance with building codes and the updates made after the 1999 earthquake.

2 In general, the structural elements (such as beams, columns, and walls) of buildings constructed after the year 2000 demonstrated good seismic performance. However, many non-structural elements (such as ventilation systems, sanitary pipes, electrical wiring, roofs, windows, and interior walls) were found to have collapsed in numerous cases. This caused significant economic impacts and, in some instances, necessitated the evacuation of buildings.

3 The earthquakes primarily impacted medium-rise buildings (between 6 and 12 stories). Approximately 15% of these buildings experienced severe damage or collapse, while buildings constructed after 2000 had a lower rate of collapse relative to the total.

4 In general, school buildings demonstrated adequate seismic performance. These structures are typically symmetrical, low-rise, and feature numerous walls, which enhance their rigidity and resistance. As a result, they performed better compared to residential buildings during the earthquakes.

5 Government buildings exhibited good seismic performance. These structures are noted for their symmetry and minimal irregularities. Moreover, they are relatively recent, with construction ages ranging from 5 to 10 years, indicating that their structural design adhered to more stringent seismic requirements.

Key to understanding the impact of the February 2023 earthquakes in Turkey is that the seismic demand was three times higher than anticipated in the structural design. This fact highlights the inherent limits of building codes, which seek a balance between protection and available resources for a building capable of withstanding the most extreme earthquake.

Building involves making decisions and compromises, so building codes are modified over time as the state of the art advances. The 2023 event, with a duration of 90 seconds and a magnitude of 7.8 Mw, was exceptional not only for its intensity, but also for its prolonged duration, which contrasts with the typical duration of earthquakes, which ranges between 20 and 30 seconds.

Therefore, it is very difficult to implement a building code that guarantees that all buildings will be able to resist earthquakes of great magnitude and duration, since building for extreme events will require more time and resources than those designed for smaller magnitude events.

LESSONS LEARNED

The 2023 earthquakes in Turkey offer valuable lessons for corporate companies, emphasizing the importance of establishing robust response plans. These plans should focus on anticipation, adaptation, and collaboration during disruptive events. By understanding these events and integrating them into their operations, companies can enhance their resilience and support the well-being of their employees and communities during times of adversity. Key elements include:

 SURA has the seismic risk assessment service, if you are interested please contact the Geosciences team - vgonzalezp@sura.com

WHAT CAN THE BUSINESS SECTOR LEARN FROM THIS EXPERIENCE?

- Perform a comprehensive diagnosis of the facilities to identify and understand the potential risks in the event of an earthquake, in compliance with the current building code.
- Identify those buildings critical to the company's operation in order to reduce their vulnerability and strengthen their resilience in the event of an earthquake.
- Ensure the reinforcement of structural and non-structural components in those buildings that need it. In addition, ensure the correct arrangement and fixing of contents to minimize the likelihood of falls or damage.
- Train personnel in earthquake safety and response measures, including periodic drills.
- Identify actors of the support network in case of emergency.
- Generate a culture of prevention and awareness among employees.
- Carry out drills and training activities on an ongoing basis.
- Design a plan to deal with catastrophic events allowing for a rapid response and recovery, in order to reduce the time of suspension of operations, ensuring business continuity and the safety of employees.
- Establish alliances with suppliers and customers to strengthen the resilience of the supply chain in the event of natural disasters.



WHAT CAN THE GOVERNMENT DO?

- Periodically update building codes, seeking a balance between the financial and logistical feasibility of projects and their seismic resistance capacity.
- Establish mechanisms to ensure strict compliance with building codes.
- Ensure that essential constructions, such as emergency response centers, are designed according to the state of the art, ensuring the resistance of both structural and non-structural elements.
- Conduct awareness campaigns aimed at the general public on the importance of earthquake preparedness and safety.
- Implement rehearsal and drill practices to keep security personnel always alert and prepared to respond effectively to seismic events.



ENSURING THE SAFETY OF ALL BUILDINGS



LESSON

It is essential to reconsider the concept of "essential buildings." Often, much is invested in protecting hospitals, schools and government buildings. However, the 2023 earthquakes showed that while these buildings performed adequately, the community as a whole was devastated. What is the point of having well-maintained schools if children no longer have a home to return to?



EXAMPLE

Prioritization of seismic assessment and implementation of safety measures in residential and commercial buildings, not only in critical infrastructure such as hospitals and schools.



GOOD PRACTICE

Subsidy or tax incentive programs for homeowners who make seismic improvements to their properties, encouraging public participation and awareness.



TEAMWORK



LESSON

- To ensure the construction of safe and cost-effective buildings, it is essential to promote collaboration between design teams, builders, government authorities and applicable regulations.
- Companies have understood the importance of training their employees in safety measures and making all stakeholders aware of the importance of being prepared for natural disasters.
- The importance of collaboration between companies, local authorities and communities to respond effectively to emergency situations has been demonstrated.



EXAMPLE

Establishment of interdisciplinary roundtables that bring together engineers, architects, government officials, and community representatives to design disaster preparedness and response strategies.



GOOD PRACTICE

Implementation of joint training programs for design and construction teams, promoting a greater understanding of the needs and challenges of all parties involved.



DESIGN TO REPAIR OR MINIMIZE DAMAGE



LESSON

The earthquakes in Turkey highlighted the challenges of repairing buildings that remained standing. In some instances, damage to non-structural elements was so extensive that the buildings had to be abandoned and eventually demolished. It is crucial to consider the impact of this damage on building functionality after a seismic event. Therefore, from the structural design stage, it is essential to ensure that non-structural elements perform well and can withstand seismic forces.



EXAMPLE

Development of innovative construction technologies that enable fast, safe, and cost-effective repairs to earthquake-damaged buildings, such as modular systems and resilient, environmentally friendly building materials.



GOOD PRACTICE

Establish post-disaster rapid response teams to coordinate the assessment and repair of critical buildings, reducing downtime and disruption of essential services. In addition, it is crucial to have the necessary capital for repairs. This can be achieved by transferring the risk to an insurer or establishing a savings fund to cover expenses, among other options.



UNDERSTANDING RISK



LESSON

Buildings are designed to protect the lives of their occupants by ensuring they do not collapse and allowing for safe evacuation following a seismic event. **However, even if a building does not collapse, it does not guarantee immediate operational or habitable conditions.** Factors such as the time needed for repairs, interventions, or rehabilitation can affect habitability and extend the period required for full recovery.



EXAMPLE

- Public awareness campaigns that educate citizens about seismic risk and personal and community safety measures.
- Joint and coordinated work between private enterprise, the business sector, academia and the community to design joint response plans that allow for rapid damage assessment and repair.



GOOD PRACTICE

Integration of disaster preparedness education into the school curriculum and the work environment, training future generations, but also employees and the community at large, so that they are well prepared to respond safely and effectively in the event of an earthquake.



WORKING TOWARDS RESILIENCE



LESSON

- The seismic events in Turkey resulted in the forced migration of people to neighboring cities due to the destruction of their homes, leading to the disintegration of many communities and connections. This scenario poses a significant challenge for engineering, regulation, construction companies, government, and civil society. It is essential to build the necessary capacities, including infrastructure, services, and personnel, to ensure that affected communities can recover after the event. This approach will help avoid the mobilization or complete abandonment of previously urbanized and productive areas.
- Companies have recognized the importance of diversifying the supply chain and establishing strong relationships with suppliers to mitigate the impacts caused by supply chain disruptions.



EXAMPLE

Creating action plans that involve local residents, non-profit organizations and government, the business sector and academia in building resilient infrastructure and creating support networks.



GOOD PRACTICE

Implementation of early warning systems and evacuation plans, using accessible technology and training employees and local leaders to coordinate emergency responses.

SOURCES

Anirudh Rao: Senior Seismic Risk Modeler at the Global Earthquake Modeling (GEM) Foundation in Pavia, Italy. At GEM, Anirudh works on the development and validation of seismic risk models, as well as on the architecture and scientific testing of the OpenQuake platform risk calculators. He has experience working in several countries in collaboration with universities, local and national government institutions, private engineering and (re)insurance companies, and multilateral agencies such as UNDRR, the World Bank and the Asian Development Bank, towards more robust seismic risk assessment and risk-informed decision making. Anirudh obtained his BTech(2008) in Civil Engineering from the Indian Institute of Technology, Bombay (IIT-B). He earned his MS in Structural Engineering(2010) and PhD in Earthquake Engineering(2014) from Stanford University.

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For references to this article.

04

DROUGHT

Causes, effects and mitigation

Meteorological drought

An abnormally negative event that generates a prolonged absence of rain or snow, producing high evaporation rates, moisture deficit, and dryness stress that can reduce the amount of available continental water (rivers, lakes, ice, or snow layers).

Hydrological drought

Water scarcity in river basins, where the availability of surface and subsurface resources (lakes, aquifers, reservoirs) falls below the ecological flow, facilitating the onset of low water levels (periods of minimum flows).

Agricultural drought

In the absence of rainfall, soil moisture is depleted by evapotranspiration (water from stems and leaves released by plants is transferred to the air in the form of water vapor), and percolation (water seeps into deeper layers), resulting in successive months of water deficit, which subject crops to water stress and wilting during the critical months.

Ecological drought

Deficit in water reserves for ecosystems leads to states of vulnerability and creates multiple tensions between them.

Socioeconomic drought

When the demand for some good or service directly associated with the availability of water resources, such as food, hydroelectric power, and industrial processes, exceeds supply.

There are two phenomena related to droughts that are sometimes confused with each other

HYDRIC STRESS

It occurs when the water supply is affected during a given period because the water demand exceeds the available supply or when its use is restricted due to low quality.

HEAT WAVES

A period of extremely high temperatures, unusual for the region in contrast to the average temperature.

Various approaches have been proposed in the literature to define droughts. However, the official definition of the World Meteorological Organization (WMO) refers to droughts as: "a prolonged dry period within the natural climatic cycle, caused by the absence of rainfall over a certain region, and which may cause water shortages".

This definition suggests that a drought event declaration may be subjective, since it depends on who determines that there is insufficient water. Insufficient for whom, or for what type of use?

In order to better frame the definition of drought and to consider the sensitivity that different geographies and productive sectors may have to this phenomenon, five types of droughts have been defined, which may be related to each other.

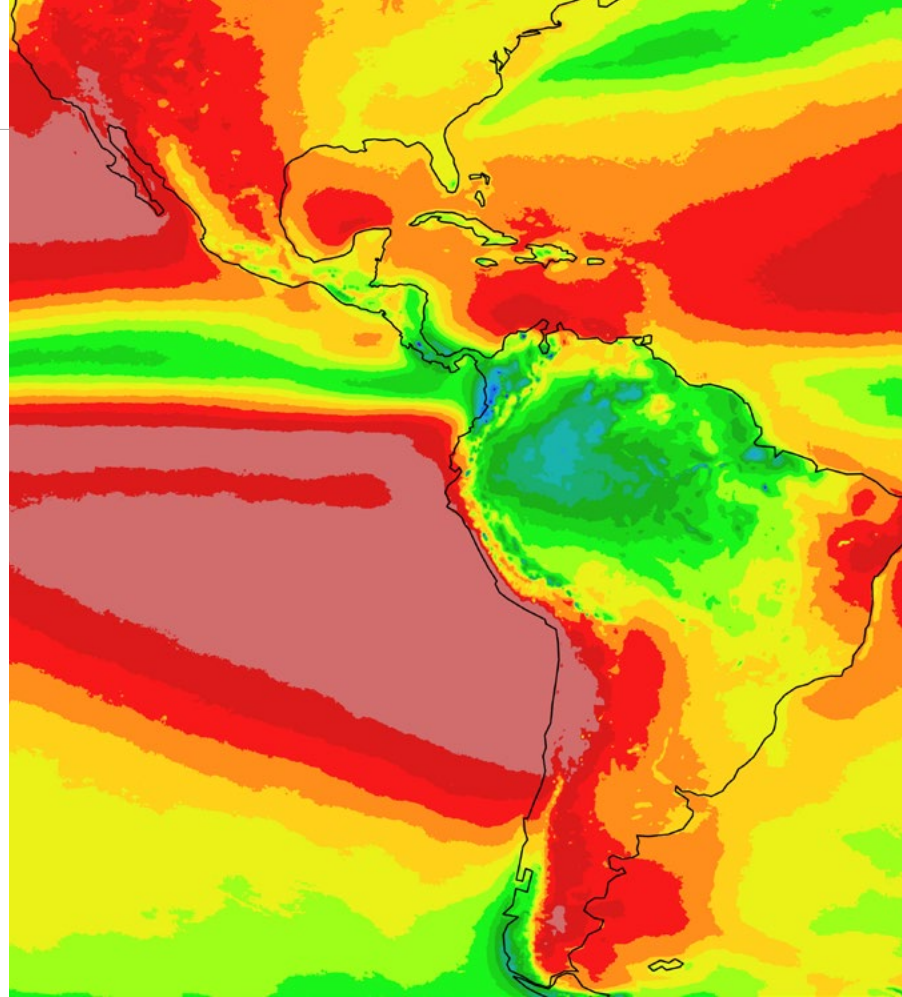
CAUSES OF DROUGHTS

Droughts are not a new phenomenon. Throughout history, there have been cases of extreme droughts all over the world, long before there was even talk of climate change, and they have been the cause of the collapse of ancient civilizations. For example, the global megadrought that occurred some 4,200 years ago reduced rainfall by approximately 30% in Africa, Asia, Europe, and North America, influencing the decline of the Akkadian Empire and civilizations in Greece, Egypt, and the Indus Valley of Pakistan.

The factors linked to drought are related to natural processes such as the hydrological cycle, along with certain anthropic activities such as the damming of rivers or deforestation.

ATMOSPHERIC CIRCULATION AND NATURAL HYDROLOGICAL CYCLES

The Earth's rotation and translation effects generate significant temperature differences between the polar regions and the equator. These temperature gradients, together with atmospheric circulation and thermohaline circulation (global movement of oceanic water masses driven by differences in temperature and salinity), are responsible for global circulation patterns that redistribute temperature and humidity on the planet. This helps to regulate the high temperatures in the equatorial region



Number of rainy days (annual average).

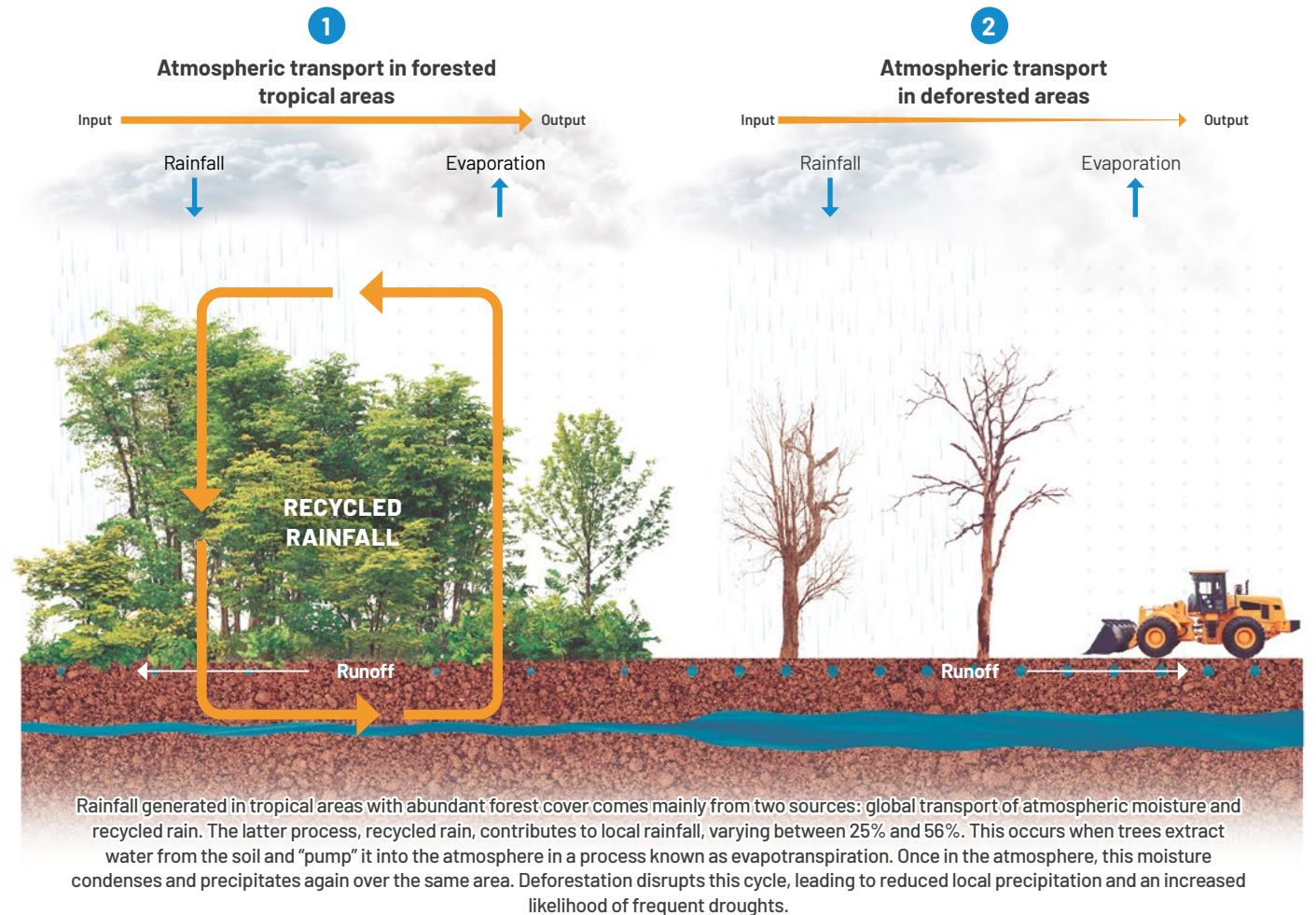
and the low temperatures in the polar zones and mid-latitudes, avoiding overheating in the equatorial regions and excessive cooling in the polar regions. However, in the process of atmospheric circulation, certain patterns are generated that give rise to phenomena such as the El Niño/Southern Oscillation (ENSO), the Quasi-Biennial Oscillation, the Pacific Decadal

Oscillation, the North Atlantic Oscillation (NAO), the Waves of the East, and Cold Fronts, whose interaction modulates the amount of precipitation that can be generated in a specific region, depending on physical factors such as topographic relief, according to Emel Enrique Vega, Meteorologist and Research Professor at the National University of Colombia.

ANTHROPIC ACTIVITY

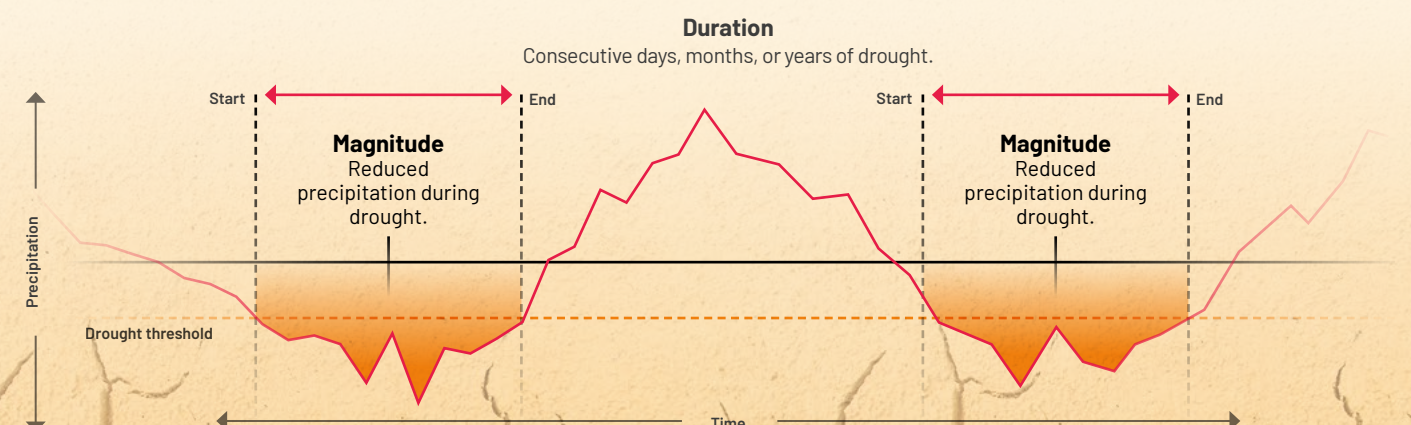
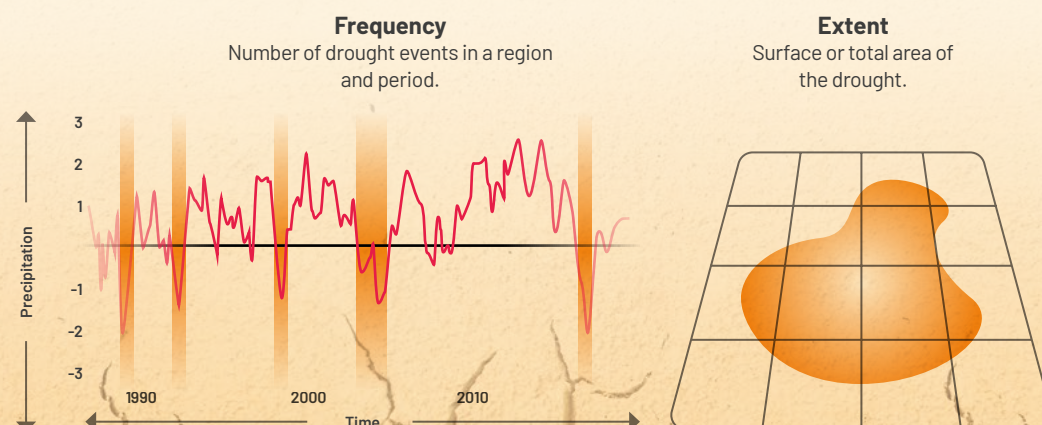
Human activities can have a significant impact on the behavior of climate variables. Actions related to changes in land use, such as deforestation, and processes of construction and draining of lakes and swamps, may generate changes in

the dynamics of local precipitation, which, according to Professor Emel Vega, may cause droughts and desertification processes. This occurs because of the reduction of water stored by forests in tropical regions, which favors soil erosion and aggravates water availability conditions in the face of deficit rainfall scenarios.



Source: Luiz E. O. C. Aragao, "Environmental science: The rainforest's water pump", *Nature*, Sep. 5, 2012.

PARAMETERS DEFINING DROUGHT SEVERITY



IMPACTS OF DROUGHTS ON DIFFERENT PRODUCTIVE SECTORS AND SOME MANAGEMENT MEASURES

Droughts generate different cascading effects that can, directly and indirectly, impact all actors in the supply chains of various economic sectors.

The following are some of the main impacts and mitigation measures of this phenomenon in some productive sectors:

AGRIBUSINESS



IMPACTS

- Reduction in the quality and quantity of water needed for agricultural and livestock production.
- Changes in the discharge of nutrients and suspended material from the rivers to the ocean, affect the area's fauna and flora and impacts the fishing resource and harmful algal blooms.
- Limitation of the crop irrigation process, which may cause crop and pasture loss.
- Possible increase in pest and disease outbreaks for crops, forage, and livestock, increase in forest fires, and alterations in nutrient cycles, among others
- The loss of crops generates a domino effect in other sectors, for example, a reduction in the demand for inputs (fertilizers, seeds, and labor), a reduction in the supply of products for food processing companies, and restaurants, among others.



CROSS-CUTTING MITIGATIONS

- Implement alternative water supply systems such as water recycling or recirculation systems with water treatment.



MITIGATION

- Have access to early warning systems to strengthen resilience to droughts and facilitate adaptation.
- Identify and implement crops with lower water demand, especially in areas with low availability.
- Protect and maintain vegetation cover and reforest with native plants.
- Avoid burns, as they expose the soil, reducing water infiltration, losing moisture, and promoting erosion.
- Cultivate in flat areas where there is better retention of runoff water.
- Implement rainwater harvesting systems or water captured from the air for reserves to maintain crop irrigation during water scarcity.
- Make efficient use of the resource, for example, using drip irrigation systems.

WATER SUPPLY



IMPACTS

- Restriction of water supply, which means less availability of this resource for productive activities.
- Creation of sanitation problems and detriment to public health.
- Cost overruns related to the adequacy of infrastructure for aquifer exploitation due to the unavailability of surface water.
- Water quality reduction due to increased sedimentation in the source, caused by drought.
- Possible damage to infrastructure due to non-standard operation, such as lower-than-design flows and increased sedimentation due to loss of flow.



MITIGATION

- Include in the plans for renovation and expansion of the water supply system the updating of the supply infrastructure, with designs that consider climatic variations to avoid damage to the system.
- Implement storage systems to help meet demand during times of drought.
- Optimize drinking water and wastewater treatment plants with technologies that increase treatment capacity and efficiency.
- Prevent water leaks or losses in distribution systems.

ENERGY



IMPACTS

- It affects energy production and may even cause the temporary shutdown of generation plants, especially in the case of hydroelectric power or plants that are highly dependent on the resources for their operation and cooling systems, as is the case of thermoelectric and nuclear plants.
- The significant decrease in the level of reservoirs leads to a reduction in the amount of energy generated by hydroelectric power plants.
- The efficiency of thermoelectric plants is reduced since they need the resources to run the steam turbines.



MITIGATION

- Adaptation of infrastructure and technology for the generation with lower flow rates or water consumption, or increase generation capacity to maintain supply, considering drought events.
- Develop strategies for water resource conservation in the area of influence.
- Achieve energy transition through diversification of the energy matrix with renewable energies, technological innovation to increase system efficiency, and development of projects with natural resources compatible with the environment and communities.
- Innovation in processes focused on reducing water consumption and recycling.

MANUFACTURING



IMPACTS

- The reduction or interruption of water supply can reduce productivity and even suspend operations.
- Industrial processes with high water demand such as washing, dilution, and cooling, among others, are compromised affecting production.
- The production of elements with a high-water footprint is reduced, as is the case of some foods, paper, and chemicals, among others. This impacts the supply chain, generating a shortage of raw materials for other processes.



MITIGATION

- Implement programs for saving and efficient use of resources.
- Invest in low-consumption technologies.
- Innovate and redesign products and production processes that require minimal use of resources.

LOGISTICS AND TRANSPORTATION



IMPACTS

- Reduction in the carrying capacity and navigability of vessels due to the significant drop in river depth. This leads to possible increases in river transportation costs and even an interruption of these, thus affecting the price of products and other economic sectors.
- Overexploitation of aquifers generates a phenomenon called subsidence, a sinking of the ground, which can damage road infrastructure.
- The pavement quality of roads and airport runways may be affected, and railroad tracks may buckle due to the high temperatures that normally accompany droughts.
- Possible road and airport closures due to forest fires, which are more frequent during droughts.



MITIGATION

- Consider extreme weather events in infrastructure design and planning.
- Reduce the use of concrete, use water-permeable asphalt if possible, and implement green roads.
- Monitor the depth and navigability of channels. Perform bathymetric analysis of sedimentation conditions and carry out scheduled maintenance dredging.
- Identify, classify and geographically reference critical sites and resource needs to prioritize and generate transportation alternatives.

PUBLIC HEALTH



IMPACTS

- Increases respiratory diseases, such as bronchitis and asthma, due to the increase in particulate matter. It also causes skin problems, and gastrointestinal infections, increases mortality rates, and affects mental health.
- It affects public health due to the scarcity of resources and the loss of water quality. This is due to increased salinity, algae production, and reduced dissolved oxygen levels.
- Dry conditions associated with droughts can increase the reproduction of fungi in soils and cause diseases such as coccidioidomycosis, also known as valley fever.



MITIGATION

- Conduct health system response capacity assessments before or at the onset of drought to identify the need for resources and their possible procurement.
- Conduct public health vulnerability analyses to identify the population that may be most affected and the health problems that may be generated.
- Improve the infrastructure and coverage of medical centers in the areas at greatest drought risk.
- Train and educate the most vulnerable population on issues such as water care, health effects, and techniques for capturing, storing, and purifying water at the household level.



RECREATION AND TOURISM



IMPACTS

- Low water and snow levels can impact recreational activities, reducing income in the supply chain and impacting the local, regional, and even national economy.
- Reduced water quality, forest fires, and the impact on the fish population, among others, affect tourism and the opportunity to develop recreational activities such as fishing, water sports, visits to reserve areas and camping, and the risk of fires, among others.
- Hotel demand is reduced and, in some cases, can lead to the closure of their facilities due to the lack of tourist attraction generated by the drought.



MITIGATION

- Implement water-saving systems in all facilities.
- Promote reforestation and protection of forests and watersheds.
- Collaborate with the government to improve public health conditions and water quality.

SOURCES

Emel Enrique Vega: Meteorological Engineer, M. Sc. in Meteorology from the Odessa Hydrometeorological Institute, and Ph. D. candidate. He is currently a Graduate Professor of Meteorology at the Universidad Nacional de Colombia.

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05

BUSINESS RESILIENCE

Keys to develop a business
continuity plan

Nowadays, companies face the challenge of guaranteeing the continuity of their operations in the face of disruptive events such as natural disasters, cyber-attacks, economic crises, political instability, or public health problems, among others. A business continuity plan not only establishes the strategies and actions necessary for action during and after such situations but also, through risk management, companies can anticipate, mitigate damage, and develop business resilience.

Companies must be able to maintain their operations in the face of any risk, as this aspect constitutes one of the most significant evidence of successful cases of business resilience in recent years: IBM during the 9-11 (2001) terrorist attacks in the United States; Toyota during the earthquake and subsequent tsunami in March 2011 in Japan; or even the hundreds of small, medium and large businesses that during the pandemic and COVID-19 confinement between 2020 and 2023 rethought their production, service delivery and productivity models (remote work, strengthening their virtual means of promotion and marketing, etc. What did they do? How did they prepare? What lessons were learned? These answers offer keys to strengthening the business continuity plan and promoting resilience.

SUCCESS STORIES IN BUSINESS RESILIENCE

Uncertainty and constant change are characteristic elements of the business world, therefore, ensuring business continuity and even moving towards the improvement of an organization after adversity requires observing and learning from the experiences that have led many companies to face great challenges. Adopting and adapting the lessons learned in their businesses is fundamental to this process. Below, we present the success stories of the multinationals IBM (American) and Toyota (Japanese), which stand out worldwide for being among the most resilient companies.

IBM: FORWARD PLANNING AND CONTINUOUS INNOVATION



The September 11, 2001, terrorist attacks in New York and Washington, D.C., caused major economic and financial repercussions for important companies such as IBM, whose losses were especially related to decreased demand for products and services, as well as economic uncertainty. In the aftermath of the attacks, consumer and business confidence declined, generating a contraction in economic activity that affected the revenues, operations and business of IBM and many other companies. The multinational technology company demonstrated its great resilience by adapting, recovering, and continuing to thrive in adversity. How did it do it? The key lies in its solid business continuity plan, which has been implemented in this and other challenging events and which is mainly based on the following aspects:



Risk assessment

IBM conducts comprehensive risk assessments to identify potential threats and vulnerabilities in its operations. This allows them to anticipate potential crises and develop strategies to mitigate their impact.



Response strategies

The company has clear and well-defined response strategies to address a wide range of crisis scenarios, including detailed plans to maintain continuity of operations, protect employees and clients, and minimize damage.



Flexibility and adaptability

IBM stands out for its ability to adapt quickly to ever-changing situations and find creative solutions to overcome challenges. This allows them to adjust their operations as needed and respond effectively to new threats or emergencies.



Technology and resources

The company invests in technology and resources to support its business continuity operations. This includes redundant communication systems, secure data centers, and trained emergency response teams.



Tests and exercises

IBM regularly conducts tests and simulation exercises to test your business continuity plan and ensure its effectiveness. This allows them to identify areas for improvement and adjust their strategies as needed.

IBM's success story highlights the importance of planning, critical infrastructure redundancy, rapid response, and continuous innovation in building business resilience and ensuring business continuity; factors that also enabled it to deliver its services during the COVID-19 confinement and led it to digital business transformation through data analytics, cloud computing and artificial intelligence strategies.

TOYOTA: MANAGING RISKS AND VISUALIZING OPPORTUNITIES



On March 11, 2011, an earthquake with a magnitude of 9.1 and a depth of 29 kilometers struck the northeastern coast of Japan (the largest earthquake ever to occur in Japan) triggering a devastating tsunami with waves of up to nine meters. This event caused the death of at least 15,703 people and brought estimated economic losses of 309 billion dollars. The earthquake severely affected the country's infrastructure and the operations of many companies in the region. However, the multinational Toyota, whose headquarters are located in Aichi and Tokyo (Japan), handled the situation effectively and demonstrated its ability to give continuity to its business. These are some of the key actions they took:



Supplier diversification

Toyota had a global network of suppliers and their business model was, at that time, based on the diversification of key suppliers. This allowed them to avoid dependence on a single source of supply and facilitated the transition to other suppliers when some were affected by the disaster.



Strategic inventory

Toyota maintained a strategic inventory that allowed them to continue production even when faced with supply chain disruptions. Having adequate storage of critical components helped cushion the impact.



Collaboration with suppliers

Toyota worked closely with its suppliers to help them recover. They provided technical, financial, and logistical assistance to accelerate the recovery of affected suppliers, recognizing the interdependence in the supply chain.



Production flexibility

The ability to quickly shift production and adjust to changing circumstances was crucial. Toyota adapted its production and adjusted resource allocation to meet demand and minimize disruptions.



Transparent communication

Toyota maintained transparent communication with its customers, suppliers, and employees. They reported on the status of operations and actions taken to address disruptions, which helped maintain trust and collaboration.



Toyota's proactive approach to diversification, supply chain planning, and effective collaboration with business partners were key elements that enabled it to recover quickly and maintain business continuity even after a major natural disaster.

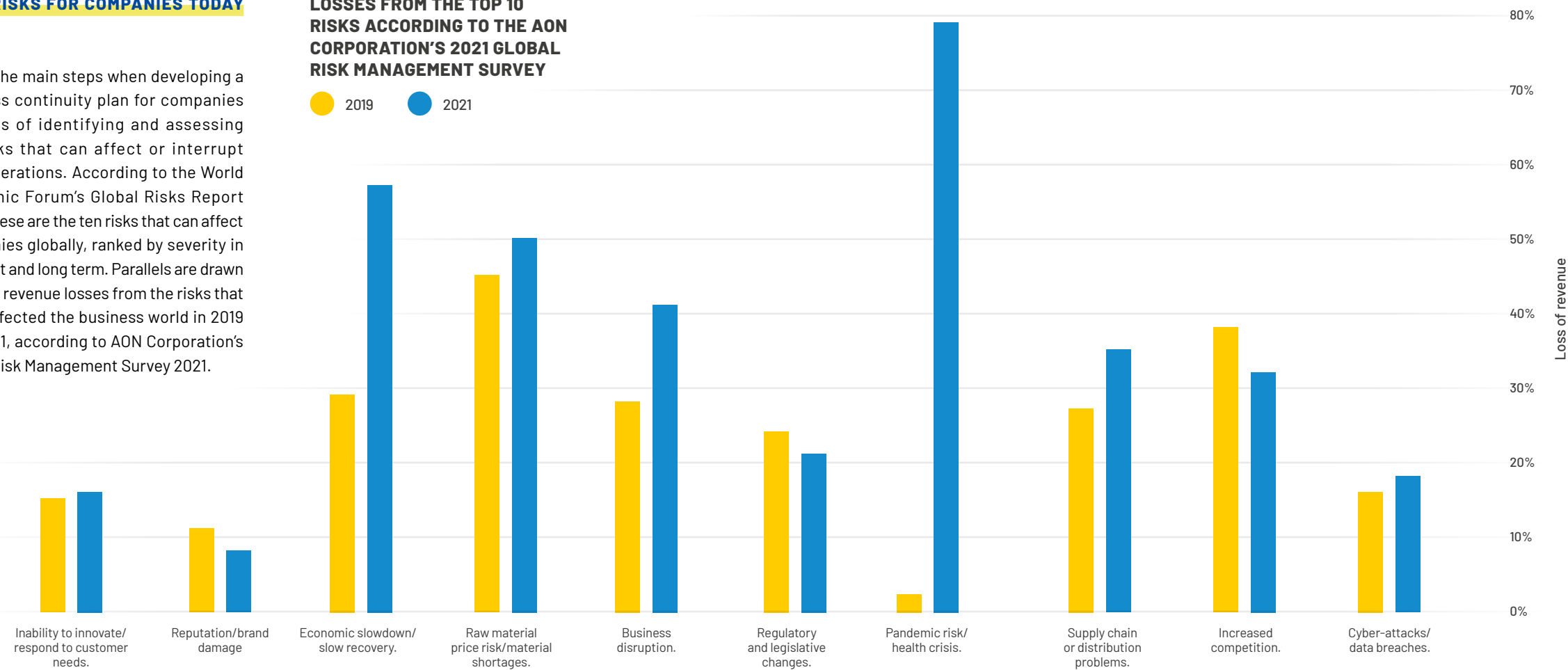
Six years later, as a lesson learned from these natural disasters, Toyota created the fuel cell system that generates electricity from a reaction between hydrogen and oxygen and advanced in the development of hybrid electric technology, innovations that were incorporated in two of its automobile references, and that have the purpose of supplying electricity in case of emergency, which facilitates the rescue work. This example highlights the importance of preparedness and flexibility in supply chain management in the face of natural disasters. It also highlights the need to innovate the technologies used in vehicles to turn them into energy providers when the energy infrastructure fails, as happened due to the destruction of the Fukushima power plants.

MAIN RISKS FOR COMPANIES TODAY

One of the main steps when developing a business continuity plan for companies consists of identifying and assessing the risks that can affect or interrupt their operations. According to the World Economic Forum's Global Risks Report 2024, these are the ten risks that can affect companies globally, ranked by severity in the short and long term. Parallels are drawn with the revenue losses from the risks that most affected the business world in 2019 and 2021, according to AON Corporation's Global Risk Management Survey 2021.

LOSSES FROM THE TOP 10 RISKS ACCORDING TO THE AON CORPORATION'S 2021 GLOBAL RISK MANAGEMENT SURVEY

● 2019 ● 2021



THREATS IN THE NEXT DECADE

According to the World Economic Forum's Global Risks Report 2024, the aftermath of the COVID-19 pandemic and the ongoing Russia-Ukraine war could bring further global shocks in the long-term outlook, adding to other risks that have prevailed such as inflation, trade wars, capital outflows from emerging markets, widespread social unrest and geopolitical confrontations. Among the most severe global risks identified in the report, environmental risks (extreme weather events, critical Earth system changes, biodiversity loss) stand out, followed by technological risks (misinformation and misinformation, adverse outcomes of artificial intelligence, cyber insecurity) and social risks (involuntary migration, polarization). However, according to this report, the individuals and companies surveyed say that "there is a window to shape a secure future through more effective preparation." Therefore, the current challenges must focus decisively and with a long-term vision of recovering confidence in multilateral and collective processes to prevent and respond to emerging problems. Hence, investing in mitigating risks and increasing resilience is key to generating solutions that will enable us to chart a path towards a sustainable world.

10 RISKS FOR BUSINESS IN THE SHORT AND LONG TERM ACCORDING TO THE WORLD ECONOMIC FORUM'S GLOBAL RISKS REPORT 2024

● Economic ● Geopolitical ● Technological
● Environmental ● Social

SHORT-TERM RISKS - TWO YEARS



LONG-TERM RISKS - TEN YEARS



IS YOUR COMPANY PREPARED TO MAINTAIN ESSENTIAL OPERATIONS IN ADVERSE SITUATIONS?

Adversity occurs at any time and usually unexpectedly; it is a scenario of uncertainty for which companies need to prepare and plan strategies and actions that will allow them to anticipate any eventuality and thus guarantee the **continuity of their business**, a concept that represents a tool to anticipate the future.

Business continuity (also known as Business Continuity Management or BCM) is the ability of an organization to maintain its critical functions in times of disruption or crisis. Its fundamental objective is to ensure that the organization operates relatively normally, or at least minimizes the negative impact, after facing disruptive events. It involves proactive planning and implementation of measures to prevent, prepare for, respond to, and recover from these events, as well as to protect a company's reputation and assets. Hence, it is one of the main tools of resilience.

Some key elements of business continuity include:



- A Business Impact Analysis:** This is the identification and evaluation of the organization's critical processes and functions, as well as the quantification of the financial and operational impacts associated with their interruption.



- B Business continuity planning:** Development of detailed plans outlining specific actions to be taken before, during, and after a disruption. This may include the assignment of roles and responsibilities, the identification of essential resources, and the implementation of recovery strategies.



- C Data backup and recovery:** This is the implementation of backup systems to ensure the integrity and availability of the company's critical information. This includes planning for data recovery in case of loss.



- D Training and drills:** This is the preparation of personnel through regular training programs and drills to ensure an effective response and the correct execution of continuity plans.



- E Crisis management:** This is the establishment of a crisis management team and the definition of procedures to coordinate and direct response activities during critical situations.

Many business continuity practices are framed in international standards such as ISO 22301.

These plans are oriented to the protection of people, as well as the timely restoration of processes, critical services, and infrastructure in the event of interruption or disaster.

PHASE 1. ORGANIZATION AND PLANNING

01 STEP
Determine the purpose of the business continuity plan and select the team and person who will lead its implementation

The BCP encompasses activities throughout the company and requires active participation in different areas.

PHASE 2. IDENTIFICATION AND EVALUATION

02 STEP
Determine the priority or critical activities for the operation of the company

The partial or total interruption of these activities represents serious consequences or even the total closure of the company.

03 STEP
Risk assessment

Events that may affect the business: human resources, physical infrastructure, production processes and information systems and relevant data **C**.

04 STEP
Damage assessment needs analysis and recovery time estimation

This is the business impact analysis **A**. Potential damages in the face of adversities are estimated in advance and the necessary resources and operational capabilities are identified.

05 STEP
Estimate the maximum tolerable period of interruption and recovery times

These times are estimated in advance allowing the business to continue operating without jeopardizing its sustainability.

STEPS TO DEVELOP A BUSINESS CONTINUITY PLAN



SURA can help you develop and implement the business continuity plan your company needs to achieve high levels of resilience

Some of the benefits of the business continuity plan include: identifying in advance the risks that could affect the continuity of operations, implementing the business continuity culture as part of business management, and knowing the critical recovery times after an adversity without compromising the sustainability of the business, reducing

costs by reducing downtime, preventing or minimizing losses, and protecting assets and business know-how.

Although each company creates its business continuity plan according to its particularities (activity, size, resources, budget, among other variables) and under the regulations of the country in which it operates, ten steps are recommended to develop the plan:

PHASE 3. STRATEGY FORMULATION

06 STEP
Risk reduction strategy

The necessary actions to avoid, control, and reduce the risk or impacts of potential events are identified and implemented in advance.

07 STEP
Emergency and disaster response strategy

Mechanisms to respond quickly and effectively in the event of an emergency or disaster. This step includes the formation of a crisis management team **E**.

08 STEP
Strategies for resuming operations

The objective is to reactivate priority internal and external activities (suppliers, raw materials) within the ideal recovery time.

09 STEP
Financial Strategy

Prepare the necessary measures to reduce impacts and avoid bankruptcy, even if revenues are interrupted.

PHASE 4. EVALUATION AND MONITORING

10 STEP
Performance Evaluation

From the formulation to the implementation of the BCP, activities are monitored to ensure that the purposes and requirements of the BCP are met. This step includes training and drills to ensure the correct execution of continuity plans **D**.

SOURCES

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For references to this article.



Mauricio Gómez Jaramillo

Untitled, 2006

Oil / Canvas

SURA Art Collection