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Hurricanes ETA and IOTA in Honduras  
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## *Letter from the editor*

The Emergency and Disaster Reports is a journal edited by the Unit for Research in Emergency and Disaster of the Department of Medicine of the University of Oviedo aimed to introduce research papers, monographic reviews and technical reports related to the fields of Medicine and Public Health in the contexts of emergency and disaster. Both situations are events that can deeply affect the health, the economy, the environment and the development of the affected populations.

The topics covered by the journal include a wide range of issues related to the different dimensions of the phenomena of emergency and disaster, ranging from the study of the risk factors, patterns of frequency and distribution, characteristics, impacts, prevention, preparedness, mitigation, response, humanitarian aid, standards of intervention, operative research, recovery, rehabilitation, resilience and policies, strategies and actions to address these phenomena from a risk reduction approach. In the last thirty years has been substantial progress in the above-mentioned areas in part thanks to a better scientific knowledge of the subject. The aim of the journal is to contribute to this progress facilitating the dissemination of the results of research in this field.

This monographic issue is about Disaster Risk Profile: Hurricane ETA and IOTA in Honduras November 2020. Honduras has been struck by two hurricanes, Fifi (1974) a category 4 hurricane and Mitch (1998) a category 5, of which the latter is still the main topic on Honduran disaster management and disaster relief experience. Remembrance of Hurricane Mitch is still present in pending reconstruction projects which today remain incomplete. Although there are many lessons learned from past Disaster Management opportunities most have been forgotten over time. Many have been the efforts to avoid a second Hurricane Mitch scenario, for which a Disaster Risk Preparedness Assessment of Hurricanes Eta and Iota in Honduras has been reviewed. We will analyze the pre-disaster conditions, neglected vulnerability and socioeconomic factors that contribute to making Honduras a highly disaster prone country. Finally, we discuss on the events and future preparations that should be considered during the pre and post disaster management preparation.

*Prof. Pedro Arcos, MD, PhD*

Editor, Emergency and Disaster Reports

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## **Definition of Terms and Concepts**

Amo - Atlantic Multidecadal Oscillation

BID – Banco Interamericano de Desarrollo

CENAOS - Honduras Center for Atmospheric, Oceanographic and Seismic Studies.  
Centro Nacional para Estudios Atmosféricos, Oceanográficos y Sísmicos.

CEPAL Economic Commission for Latin America

COPECO Committee (National Emergency Operation Center)

DDI. - Disasters Deficit Index

DINAF - National Office for Children, Adolescents and Family (DINAF - Dirección Nacional para la Niñez, Adolescencia y la Familia)

EIRD - strategy for International risk reduction

ENOS - El Niño South Oscilations

HURDAT - Atlantic Basin Hurricane Databases

ICTs - Information and Communication Technologies

MAH - Hyogo Framework Protocol 2005 – 2015

NHC - National Hurricane Center

NOAA – US National Oceanographic and Atmospheric Administration

PAHO - Pan-American Health Organization (PAHO)

PCGIR - Integral Risk and Disaster Management Central American Policy

PMDN - Natural Disasters Mitigation Project

SEFIN - Finance Ministry

SEPLAN - Ministry for Planning Management

SERNA - Ministry of Natural Resources

SESAL - Ministry of Health

SICA - Central American Integration System

SINAGER – National Risk Management System



ORIGINAL RESEARCH



# Disaster Risk Profile: Hurricane ETA and IOTA in Honduras November 2020

*Mario Antonio Ruch Ordóñez*

## Introduction

Hurricane Season 2020 in the Americas reported an increased number of 30 Tropical Storm Systems in comparison to previous seasons. An increase in more Weather Systems, with potential to become Category 5 or above Hurricane threats, is projected to become a reality by most scientist models. Particularly in November 2020 Hurricane Eta and Iota, two Category 5 Hurricanes, affected the countries of Nicaragua, Colombia and Honduras within a two week timeframe. Besides direct devastation from these Climatological disasters, the most threatening factors which impacted the society were associated to increase in rainfall. The reported levels of Rainfall in such a reduced amount of time accounted for floods of entire cities and numerous landslides. Of the affected countries, Honduras was one of the most affected countries by the associated rainfall and gusty winds from these two events.

Honduras is ranked within the Global Climate Index as one of the most vulnerable places for natural disasters. Although seismic and volcanic activity are not so common in the country's territory, the recent past 50 years have accounted for a large number of devastations related to Tropical Weather systems and Hurricanes. Honduras has been struck by two hurricanes, Fifi (1974) a category 4 hurricane and Mitch (1998) a category 5, of which the latter is still the main topic on Honduran disaster management and disaster relief experience. Remembrance of Hurricane Mitch is still present in pending reconstruction projects which today remain incomplete.

Although there are many lessons learned from past Disaster Management opportunities most have been forgotten over time. Many have been the efforts to avoid a second Hurricane Mitch scenario, for which a Disaster Risk Preparedness Assessment of Hurricanes Eta and Iota in Honduras has been reviewed. We will analyze the pre-disaster conditions, neglected vulnerability and socioeconomic factors that contribute to making Honduras a highly disaster prone country. Finally, we discuss on the events and future preparations that should be considered during the pre and post disaster management preparation.

## **Objectives and Methods**

### **Main Objective**

- ï Generate a Disaster Risk Profile and a Literature Review from publications between November 2020 and May 2021 on the effects from Hurricanes ETA and IOTA in Honduras in November 2020.

### **Specific Objectives**

1. Analyse the information on different Disaster Databases and other online resources relevant to disaster management, vulnerability, and disaster risk factors from Hurricane Eta and Iota in Honduras within the appointed timeframe.
2. Compare disasters management preparedness, risk reduction actions and appropriate protocols before, during and after Hurricane Eta and Iota in Honduras with other similar historical events.
3. Describe the general country setting in terms of disaster management, policy making for risk reduction, international cooperation, population resilience and other factors that determine the magnitude within a disaster in Honduras.



## **Methodology**

This Disaster Risk Profile for Hurricanes ETA and IOTA in Honduras during November 2021 was conducted by reviewing secondary data, and publications relevant to the aftermath of the storms. A Bibliographic Literature Review was conducted through international online databases on disaster control and monitoring (EM-DAT, La Red, Desinventar), regional databases (CIDBIMENA, LILACS, SCIELO), and finally national databases (CIDBIMENA, BVS – Honduras, COPECO Honduras) among a few consulted. Information obtained was used to describe, illustrate, and discuss the events and actions taken place during these disasters. Information was collected to compare these disasters with similar previous disaster experiences. Risk reductions strategies and policy making are analyzed to generate comparison and guidance for future disaster event planning.

Literature Search methods included searches on databases like Pub Med, Google Scholar, MEDLINE, Reliefweb, NGOs and International Cooperation Websites. Boelian operations along with the following Keywords were used to conduct our literature review. These included: Honduras, Hurricane IOTA, Hurricane ETA, Flooding, November 2020, Meteorological Disasters and COPECO. Evidence and quality of literature for was summarized and analyzed using PRISMA methodology.

The cited information met the following inclusion criteria:

- Peer-review articles cited on indexed Journals.
- Articles published in English, Spanish and Portuguese
- Period of inclusion was set from October 2020 to May 2021.

Exclusion criteria:

- Not published or articles pending publications
- Articles outside the set time frame.

Finally, we undertake a discussion from the information presented in this report between similar natural disasters, and areas that require improvement. Recommendations are also included under conclusions to improve the country's Disaster Risk Management, strategies to build more resilient and independent communities, among others. Final comments are made on the country's current preparedness against natural disasters, post disaster response capability, institutional capacity, and resources.

## **1. General Overview**

Honduras has been considered as a country of major risk to disasters in the world by many international organizations. The major type of disaster impacts the country has faced in hydrometeorological according to historical records from the last 20 to 30 years. Honduras is considered one of the most affected countries in the western hemisphere due to the indirect impacts of climate change, which are only comparable to those in countries like Bangladesh and Burma, according to the Climate Risk Index. Despite having presence of similar and repeated potential dangerous natural events like landslides, flooding, hurricanes, and earthquakes within Central American countries, Honduras seems to be the most affected. The higher grade of impact in Honduras is due to different factors as are historical land use and occupation, non-sustainable land transformation.<sup>(1)</sup>

According to the Inter-American Development Bank (BID – Banco Interamericano de Desarrollo) in terms of risk, Honduras is in one of the worst case scenarios worldwide. Economically, it holds one of the lowest resilience levels when confronting disasters.<sup>(2)</sup> Other factors alike are lack of territorial security measurements in terms of development schemes. These factors and others, contribute to the increase in vulnerability of the country to environmental degradation, unsustainable population growth in flood prone areas. Other examples of vulnerability features are uncontrolled urbanization with deficient infrastructure, constructing in steep slopes or land slide prone areas. Furthermore, inadequate superficial water resources management, lack and control of land use. It is hard to ignore the constant unstable political and economical stability within the country, leading to social instability, which in part are also responsible for the losses and damages of non-natural disasters within the countries disaster risk context.<sup>(1)</sup>

### **1.1 Geography**

Honduras is located in the Central American isthmus, with an approximate total area of 112,492 kilometers squared. It is located between latitudes 14.5° and 15° North and towards parallel 87° West. The climate is subtropical, with mixed large leaf and tropical forests. It limits to the North with the Caribbean Sea on the Atlantic Ocean, to the South with El Salvador, Nicaragua, and the Pacific Ocean, to the West with Guatemala and El Salvador and to the East with Nicaragua. It posses a rich river system and many mountain range systems throughout the country. Due to these and other geographical characteristics, Honduras is affected frequently by natural disasters, of which most are Hurricanes. The last Hurricane to severely affect the country was hurricane Mitch in 1998 which that raged and devastated agricultural crops, caused serious flooding and soil erosion, hindering many Hondurans' access to resources that guaranteed their livelihood.<sup>(3)</sup>

## 1.2. Climate

Honduras exhibits a Tropical and sub-Tropical climate system, with a large variation in daily temperatures between the mountainous region, and cooler than those in the low-lying areas. This accompanies winter rain patterns between May to October, and great humidity levels with the Caribbean coast being the most humid.<sup>(4)</sup>

## 1.3. Population and Demography

Honduras has a total population estimated around nine million inhabitants projected for year 2021, it is one of the poorest countries in Latin America with an annual population growth rate of 2.6%. Population density is 57,4 inhabitants per square kilometer. Life expectancy is 75,3 year, 77,6 years for males and 73,0 years for females. The vast majority of inhabitants are mestizos with mixed European and indigenous ancestry, 5% being of black race and located along the northern coast.<sup>(3)</sup> Population below national poverty line: 54% GNI per capita: 860 US\$ GDP: 5.9 billion US\$ Infant Mortality General: 15,1 per 1,000 live births, Child Mortality rate for children under 5 Years of age: 17,5 per 1,000 live births, Maternal mortality ratio: 110 per 100,000 live births. Illiteracy: 26,1 percent male, 25,9 percent female above 15 years. Access to basic health care: 40 percent Access to safe water: 90 percent Human development index value: 0.634 (2017).<sup>(4)(5)</sup>

The majority of the population are Christians of which 90% the population practice the Catholic faith, and 10% are protestants. The country's population is characterized mostly as young, with lack of skilled hand work or qualifications within the work force, creating a complex situation for job creation and employment opportunities. Income is distributed unequally, along with unemployment and underemployment reaching 5.4% in the labor force and a 24% of the youth (15 – 24 year old) unemployed. A higher Birth Rate is seen among poor women, and it is seen as a cause of poverty transmission over generations. Women also have less opportunity to access education, enter the labor market, and making them more vulnerable than men. Honduras is considered a violent country, with a homicide rate of 38.9 per 100,000 people. Finally, the country is struggling with social violence problem and gender inequality, due to the current socioeconomic and political conditions, culture and tradition.<sup>(3)(5)</sup>

## 1.5. Political and Historical context

Honduras gained its independence from Spain in 1821 and joined the Central American Federation that lasted until 1842, when the country became totally independent from the Mexican Empire in 1843. During the early 1900s the establishment of large fruit production companies country became deeply influenced by the United States, coupled with massive foreign capital investments that

dominated the banana economy. Fruit companies had powerful stakes in domestic politics and the economy. These undermined the institutional development associated with the liberal reforms occurring in other countries of the region in the early nineteenth century. Honduras lived fifty years between authoritarian and military regimes from 1932 to 1982. Since the mid-nineties a civilian government has succeeded in subordinating the armed forces, for which only the past twenty to thirty years has democracy began to enter into the political canvas of the country.<sup>(3)</sup>

Honduras needs to fortify its democratic institutions to effectively deliver policies that address human development, and to eliminate corruption to ensure that public resources are used properly to this end. The poverty reduction scheme in Honduras comprises creating proper legal, institutional and policy frameworks to strengthen further gender equality and the role of women in society. Quality education, health coverage for citizens, reducing high infant mortality and undernourishment of children are also part of the poverty reduction strategy. But special mention must be made to taking effective measures to counter the human immunodeficiency Virus and Associated Immunodeficiency Disease (HIV/AIDS) epidemic, improving environmental management, deforestation and soil erosion, and efficient disaster management systems.<sup>(3)</sup>

#### 1.6. Economy

Both economically and socially Honduras is characterized mainly for of a developing country with a low level of human development, high unemployment, a high degree of inequality of incomes, a low level of education and weak democratic institutions. Honduras has a per capita income of US \$970 and about two-thirds of its population lives in poverty. Income is very unequally distributed. Agriculture is essentially a two-crop sector producing mainly banana and coffee for export. Industry is a low-tech operation in which maquilas are preponderant. Its human development index (HDI) stands at 0.672 (2004), which ranks it 115th in the world. Non-traditional exports today include shrimps, melons, textiles and tourism. The trade is mostly oriented to the United States with two-thirds of exports destined to USA. Despite year of development and growth efforts, exports still represent only one half of imports. Balance of payments deficit is largely financed by remittances from Hondurans living abroad and by foreign transfers.<sup>(3)</sup>

According to the Economic Commission for Latin America (Comisión Económica para América Latina – CEPAL) the worst disaster events of the XX Century registered in the region affecting Mexico, Central America, Venezuela, Bolivia, Paraguay and Brasil were El Niño South Oscilations (El Niño Oscilación Sur – ENOS) 1982 – 1983, and 1997 – 1998, producing droughts and causing economic losses within the region that were estimated to approximately by CEPAL and BID to be close to \$15.480 million US dollars. The impact of these climatological events brought consequences in agricultural crop loses, forest fires, hunger, and communicable disease pandemics placing food security in peril as well as life quality of the population forcing many to migrate and be displaced with no access to appropriate resources. The majority of

disasters occurred during the cold phase of ENOS (La Niña) are floods present during the aftermaths of Hurricane Mitch (1998) and Fifi (1974).<sup>(1)</sup>

According to the mean Human Development Index the country ranks 106 on a global scale. The estimation of economic losses between 1993 and 2009 had been of 4,274 billion US dollars, with an annual average loss of 251 million dollars. The most affected sectors are infrastructure, agriculture, housing, water treatment, education and health, population wise the most vulnerable sectors are the indigenous population and homes with a single mother. Being these factors that contribute to the cycle of disasters, poverty and lack of development.<sup>(2)</sup>

### 1.7. Poverty

According to the National Statistics Institute ( Instituto Nacional de Estadísticas – INE), the homes in situation of extreme poverty and poverty for 2009 were reported as 36.2% and 59.2% respectively. On the other hand, CEPAL reported a population poverty of 68.9% from the total population based on a daily living expenses methodology, homelessness reached 45,6%, which reveals that poverty in the country is really high and which allows a better understanding of the level of exposure and social fragility against natural disasters and recurrent disasters.<sup>(1)</sup>

Honduras is the second country mostly affected by HIV/AIDS in the region, just behind Guatemala. Dialogue for the development of policy dialogue in order to approach HIV/AIDS problems further considering it as an exclusive health problem, but to incorporate a human rights perspective approach to this matter.<sup>(3)</sup>

### 1.8. Development Indicators

The human development index ranks in 2004 and 2003 was 115 out of 177 countries and 115 out of 175 countries, lower than previous years.<sup>(3)</sup> Income inequality is a major concern, with a Gini index at the level of 0.563 for which we can see a great deal of discrepancy between the rich and the poor. Income share received by top ten percent of the families correspond 44.4% of the total income while the lowest ten percent of the families receive only 0.5% of the total income (1998).<sup>(3)</sup>

### 1.9. Health

Health coverage is erratic in Honduras and the quality is questionable. It is estimated that the Government provides coverage to 50% of the population and Social Security Institute and private sector 20-25% The remaining 25-30% of the population has no access to public health care. Honduras is one of the countries most severely affected by the HIV/AIDS epidemic (1.8% of the population aged 15-49), tuberculosis and malaria<sup>23</sup> in Latin America. Although there is greater access to potable water, its cover- age is inefficient and the quality is poor. <sup>(3)</sup>



### 1.10. Education

Over the last 25 years educational facilities have expanded and this is reflected in increased primary level enrolment and adult illiteracy. Nevertheless, certain deficiencies are seen in quality and efficiency of education, mostly due to low public spending. The number of years of schooling (4.6 years) for the population ten and over has doubled in the past 25 years; the literacy rate (74.6%) has increased and enrolment in pre-school has doubled (44%). Nevertheless, Honduras lags behind most countries in the region concerning enrolment in secondary education and there are pockets of low primary school enrolment. <sup>(3)</sup>

## 2. Disaster Risks and Hazards by Origin

### Overview

The presence of Hurricanes, Landslides, Floods Droughts, and Forest fires does not determine the impact of disaster damage or risk in the country. Left alone, they are not primary determinants for the high vulnerability in which the population lives when referring to disaster and risk. The country's vulnerability is intertwined to the unorganized development growth process and is linked to the fragility and susceptibility of the lack of resilience the population is able to provide to disasters threats. In this manner, disasters within the country are the socio-environmental events which are present as a result of social development and infrastructure construction alongside high prone risk areas. The impact of natural phenomenon (which are more of a reflection of the real risk in which the population is living) is determined on a great scale to the political, social and economic preexisting conditions of the affected areas.<sup>(1)</sup>

### 2.1 Natural Hazards and Disasters

Due to its geographical location, Honduras suffers from multiple natural phenomena making the country highly vulnerable to such events, causes serious damage to its human, natural and physical base. Poverty and environmental degradation are closely linked. Great degree of environmental degradation is found in areas where the country's HDIs are the lowest. Land use planning is also poor in Honduras, which leads to insecurity of ownership and inability of proper care especially by the poor. About half of the country is covered with forests that are degrading. Their area was reduced from 53.4% in 1990 to 48.1% in 2001. There is a high rate of deforestation, soil erosion, and deterioration of biological resources, high level of contamination, as well as destruction and degradation of coastal marine resources.<sup>(3)</sup>

According to the Global Climate Index, Honduras is classified as one of the nations most vulnerable to natural disasters in the world. It was the scene of the hurricanes in 1974 (Fifi) and 1988 (Mitch),<sup>1</sup> which have been the most catastrophic weather events that have affected the country, causing human losses, material, economic, and health damages. It took many years and great resources for the reconstruction, which is still incomplete. By November 29, 2020, the national system of health (SINAGER) reported 107,513 confirmed cases and 2,905 deaths.<sup>2</sup> Besides, the country's economy has been plunged into a severe crisis by this pandemic and will undoubtedly be aggravated by recent natural disasters. At the end of October 2020, the formation of hurricane Eta was announced, a Category 5 hurricane, which would affect the lands of Nicaragua and Honduras. This event caused flood damage in some areas that have the highest reported COVID-19 cases. Some of the victims were refugees in roughly 1,000 shelters with little or no biosecurity measures. Others continue on the streets, along rivers, under bridges, and other public places where the health crisis will



worsen. The resurgence of dengue complicates the situation and is endemic in Honduras. Currently, the Health Information Platform for the Americas reported a total of 23,444 cases with a mortality rate of 0.1 per 100,000 population by dengue. <sup>(6)</sup>

## 2.2 Hydrometeorological

Flooding, although the most common event along with landslides affecting houses, roads, bridges, livestock, and cultivated land in the relatively flat coastal areas and river flood planes. <sup>(4)</sup>

Floods Honduras faces extreme flooding due to hurricanes on the northern coast. Floods are quite common in the country, yet only a small percentage of the population is directly exposed to floods (about 20 000 people). Then again, floods are one of the disasters that affect the most people out of all the hazards in Honduras. 2 Areas most prone to flooding are the coastal areas of the Caribbean and Pacific lowlands, and the estuaries of rivers. 3 Rainy season is from May to November. <sup>(7) (8)</sup>

The maximum occurrence sites for landslides are located on slopes greater than 25° where the typical geological outcrops are from Miocene volcanic and plutonic rocks in concave and straight slopes. Maximum occurrence to landslides are activated by well-identified triggering agents such as highly weathered substrates, seasonal (> 2500 mm annually) and cyclonic rains (between August and November), and the seismic-tectonic influence. The low-occurrence landslides territories are defined as extensive areas that encapsulate the regions of maximum occurrence with intense instability on mountain slopes where concave and straight morphologies predominate with inclinations between 16 and 63°, located on Miocene granite rock substrates. The potential areas for landslides are located on straight and concave mountain slopes less than 25°, on Miocene volcanic, plutonic and sedimentary substrates. Maximum floodplains are terrains with low inclinations (<15 °) and subhorizontal morphology. To this condition is added that in rainy seasons the soils are saturated, which helps the overflow of channels. Floods occur once the rainy seasons exceed the annual average, or are influenced by low pressure systems, temporary or both direct and indirect effects of tropical cyclones with a recurrence of less than 5 years. The maximum floodplains are associated with subhorizontal morphologies with inclinations less than 15° that are within the floodplains. These regions are activated during extraordinary rainy seasons in conjunction with extreme events such as the La Niña phenomenon, the atmospheric anomalies associated with the Intertropical Convergence Zone and the tropical cyclones of the Caribbean Sea and the Pacific Ocean. The conditions that favor the physical vulnerability of the study area are recognized in the floodplains of the General River where floods are frequent and are associated with intense rains, both seasonal like tropical cyclones. Landslides are frequent in the mountain area where the slope of the terrain exceeds 25°. These disasters brought deaths and serious economic losses on vital lines (communication routes, electrical wiring and aqueducts) as well as in the agricultural sector. <sup>(9)</sup>

## 2.3 Climatological

Hurricanes are the most frequent and feared national disasters in the country, for which Hurricanes Fifi (1974) and Mitch (1988) are examples. The most recent,



Category-five hurricane Mitch entered the northern Atlantic Coast of Honduras in December 1998. The great impact of this disaster lies mostly in rural areas having limited access to productive land which led the poor to exploit the natural resources in an unsustainable way. Deforestation and soil erosion contributed to the rapid swelling of rivers. Precarious housing in urban areas caused many deaths. <sup>(3)</sup>

Studies have been taking under to attempt clustering tropical cyclones and their further development into hurricanes in the Atlantic for over a century. When analyzing Atlantic Basin Hurricane Databases (HURDAT) considered observations in the eastern Atlantic and the region between the coast of Africa and the Caribbean Sea. The later is considered particularly the main hurricane development region. From the main development region, two large patches of overdispersion emerge. The first extends northward in the eastern Atlantic, and the second forms a “corridor” extending toward the Caribbean Sea. Significant overdispersion occurs within the Caribbean, and for some of the largest areas of reef development such as the south of Cuba and Jamaica, the Bahamas archipelago, the Florida Keys, and the Mesoamerican Barrier Reef System, which borders the land mass of Central America.<sup>(10)</sup>

A huge doubt still remains whether time variation in local rates on these records and inferences from the diagrams can be related to changes in large-scale climate patterns. A Poisson regression of counts on the large-scale flow indices, as has been done in previous studies but generally only for landfall or basin wide counts. The Atlantic Multidecadal Oscillation (AMO) can be seen to have a pronounced effect on the yearly impact rates for all tropical cyclones and hurricanes. The AMO is known to be linked to long-term variability of tropical cyclone and hurricane activity.<sup>(10)</sup>

Hurricanes and tropical storms have been the main disaster events. The north of the country has been the main area affected. Flooding has been the most common event, affecting houses, roads, bridges, livestock, and cultivated land in the relatively flat coastal areas and river flood planes.<sup>(4)</sup>

Drought An estimated 2.25% of the population is directly exposed to drought induced by El Niño, about 180 000 people.<sup>6</sup> Droughts occur regularly in Honduras, mostly in the central highlands, as well as the south-east of the country, in the departments of Lempira, La Paz, Intibuca, Francisco Morazan, Paraiso, Valle and Choluteca. A recent drought end 2009 struck these southern departments and a state of emergency was declared as many people were facing a severe food crisis.<sup>7</sup> In the past droughts have generally occurred from June through August and October to December.<sup>(8)</sup>

Hurricanes Honduras is extremely susceptible to hurricanes along the Caribbean coast. About 0.50% of the population is directly exposed to hurricanes. That ranks the country in the top third of most exposed to cyclones. The most exposed area to hurricanes is the northern half of the country nearest to the Caribbean Sea.<sup>9</sup> The country was devastated by hurricane Mitch in 1998, the storm affected over 2 million people and killed near 15 thousand people with storm surges, heavy rainfall and flooding. It left economic damages up to \$ 4 billion and was said to have set back the country for years.<sup>10</sup> Storm season generally runs from June to November.<sup>(7)(8)</sup>

## 2.4 Geophysical

The Central American Region sits on the Caribbean Tectonic Plate which interacts with the Cocos Tectonic Plate along the Pacific Ring of Fire. Nonetheless, Honduras and Belize are the two central American countries that least experience major earthquake devastation or other related seismic activity casualties. A record dating from the Spanish colony both countries have experienced major earthquakes, like the earthquake from November 24<sup>th</sup> 1539 which caused a tsunami on the Caribbean coast of the Gulf of Honduras. In this same manner other major events were reported in the XVIII, XIX and XX century, affecting individual population groups. This is the case of the May 28<sup>th</sup> 2009 earthquake on the Gulf of Honduras which affected the country producing damages to Port Infrastructure, housing, and bridges along the Caribbean coast and the Bay Islands Department of Honduras.<sup>(1)</sup>

While seismic movements are common, devastating earthquakes have been rare. While movements up to 7.4 on the Richter scale have been recorded (1956 in the West of Honduras), most movements have been on a much smaller scale. In 1999, for example, 800 seismic movements were recorded in Honduras, 72% of which measured at or below 3.5 on the Richter scale.<sup>(4)</sup>

Landslides - After hurricane Mitch many landslides and mudslide affected the country due to heavy rainfall. Generally, the whole country, especially the highlands, faces a landslide hazard.<sup>4</sup> Local disaster risk experts indicated that since Hurricane Mitch's catastrophic events, the country has become even more vulnerable to landslides due to widespread deforestation and soil degradation.<sup>5</sup> Landslide risk is highest from May to October, during the rainy season.<sup>(7)(8)</sup>

Earthquakes Honduras experiences frequent but generally mild earthquakes. Most earthquake hazard is south of the country, where the majority of earthquakes originate in El Salvador. Also the northern Caribbean islands of Roatan and Guanaja are prone to earthquakes.<sup>12</sup> More than 5% of the population is directly exposed to earthquakes of a lower classification, the generally do not affect people severely or take many lives, only few leave a significant amount of damage.<sup>(7)(8)</sup>

## 2.5 Biological

Epidemics In the country the degree of risk related to diseases is high. The most common diseases are bacterial diarrhea, hepatitis A, typhoid fever, dengue fever, malaria and leptospirosis. Honduras also faces outbreaks of diseases once every few years. In 2010 the Americas faced a dengue epidemic where 65 people died of the disease in Honduras alone.<sup>(8)</sup>

## 2.7 Man-made and Technological

Weak infrastructure, lack of entities to supervise construction, disaster risk preparedness and development planning malinvestment are some of the main reasons for man-made disasters in Honduras. Lack of financial resources, economic growth, and investment opportunities have made the population in general the most vulnerable to any kind of disaster. Alongside, must mention massive disparities in the distribution of wealth, the weakness of the state, and unfavorable global economic

conditions. These conditions have increased insecurity levels, delinquency, and an everyday deteriorating socioeconomical condition.<sup>(4)</sup>

Land degradation Honduras faces issues of deforestation from logging and land clearing for agriculture. Continuing development and improper land use exacerbate degradation and soil erosion. Large coffee and banana plantations have caused massive land degradation and deforestation across the country. This leaves many areas very vulnerable for landslides after heavy rains and storms.<sup>(7)(8)</sup>


Extractives Honduras holds several gold mines. The most advanced gold project in Honduras is Glamis Gold's San Martin project, located north of Tegucigalpa. First Point Minerals owns the Cacamuyá Gold-Silver property in Honduras. The Cacamuyá Property is located in southern Honduras in the Department of Choluteca and the Municipality of San Marcos de Colón. Mining activities are polluting fresh water sources, as well as the main ones, namely the Lago and Yojao, with heavy metals. Many allegations have been made against gold mining companies that the activities have polluted the waters and research confirms this.<sup>(7)(8)</sup>

Water In several regions in Honduras water is a major issue. Water is polluted affecting the human population and the environment. Water pollution is primarily due to agricultural run-off and untreated effluents from mining activities. Many of the pesticides used become toxic effluents that contaminate rivers and seep into groundwater tables. Heavy metals that escape from mining operations along the Gulf of Fonseca have become a problem and untreated wastewater originating from large towns and cities has often been discharged into nearby waterways, especially in the case of Lake Yojoa.<sup>(8)</sup>

Insecurity One may speak of a level of internal insecurity in the country. Social inequality is very high and there are problems of chronic unemployment and crime. Drug trafficking contributes to violent crime conducted by youth gangs called 'maras'. Meanwhile, police officers have been implicated in high-profile crimes, and the police are thought to have been involved in the murders by death squads of youths and street children. Thousands of Hondurans leave the country each year, most of them for the US. The money sent home by the overseas workers is an important source of income for many families.<sup>(8)</sup>

## 2.8 climate change

The fact that in 2010 Honduras is considered, along with Bangladesh and Burma, as one of the three major countries in the World with a high Climate Risk Index, demonstrated the effects of environment transformation, disorganized occupation, and unsustainable development. In view that the major natural disasters that affect the country are linked to environmental degradation, inappropriate land use, and territorial organization. There has been an increase the amount of natural disasters present in Honduras in a period of 30 years according to EMDAT databases there were 51 major natural phenomenon casualties reported. Being climate related disasters those which report the most human and financial losses, reporting the greatest amount of human loss in the past 40 years. These being mostly floods and land slides secondary to hurricanes and tropical storms. In 2004 the UNDP considered Honduras as one of the most countries with most relative vulnerability against hurricanes. The past 21 hurricanes that have affected the country directly or



indirectly have generate statistics of on average 1,300 human deaths per climatological phenomenon. Hurricanes Mitch (1998) and Fifi (1974) have been climatological events with major historic impact in the country, having a 23% and 38% of total affected population respectively. In economical terms the equivalent damages rise to 72% and 52% of the country's GDP respectively. Corresponding to EMDAT database registries, the major impact of disasters as they have required great attention from the authorities and request of international cooperation. There major disasters have been reported as a total of 51 disasters caused by droughts, earthquakes, floods, landslides, hurricanes, and forest fires. Economic loses have bene estimated as US\$4,500 million dollars. Although this data indicates enormous problems for the development of the country, special attention has to be given to the lesser recurring disasters which constantly exacerbate conditions that favor poor living scenarios, as these rarely receive the proper attention from the government and international agencies. The lack of external assistance favor the preexisting risk to be present during upcoming disasters making sustainable development impossible for the most poor sector of the Honduran population which are the most exposed segment of the population.<sup>(1)</sup>

### 3. Disaster Management and Risk Reduction context

#### 3.1 International Risk Reduction Management Context

Under the guidance of the United Nations through the Hyogo Framework Protocol 2005 – 2015 (MAH – Marco de Acción de Hyogo) proposed in Japan, January 2005, gives rise to a complementary strategy for International risk reduction (Estrategia Internacional para la Reducción de los Desastres – EIRD). EIRD constitutes a central pillar of UN efforts to confront issues related to risk and disasters at a global scale. The MAH 2005 – 2015 has proposed to create the necessary conditions to increase each nations and community's resilience against disasters. The proposed result of the Hyogo Framework is to reduce considerably the occurred losses due to disasters, both human lives and social, economic and environmental goods of communities and countries.<sup>(1)</sup>

To reach the proposed results the conference resolved to adopt 3 strategic objectives: a) Effective integration of Disaster Risk as a topic of politics, planning, and sustainable development programs at a national level, with special emphasis on disaster prevention and mitigation, preparedness for disaster cases and vulnerability reduction. b) Creation and strengthening of institutions, mechanisms, and resources at all levels, particularly at the community level, which may contribute in a systematic manner to increase resilience to threats. c) During the reconstruction phase of affected communities, systematic incorporation of criteria for risk reduction in the design and execution of preparedness programs for emergency situations, response and recovery. Alongside these objectives a set of priority actions were also adopted: (i) Oversee that disaster risk reduction constitutes a national and local priority provided with a firm institutional base of features, (ii) Identify, evaluate and oversee disaster risk and strengthen the early warning systems, (iii) Use the knowledge, innovations and education to create a culture of security and resilience at all levels, (iv) reduce the overlying risk factors, (v) Strengthen disaster case preparedness with the aim to ensure an effective response at all levels.<sup>(1)</sup>

International cooperation has been working alongside the region after Hurricane Mitch in 1998, with the purpose to advance in the transformation and adaptation of a legal and institutional framework. The United Nations Development agency destined nearly \$0,65 million dollars for the strengthening of national institutions, aid on disaster planning, studies, and construction of mitigation infrastructure for disasters, along with other partner institutions the total efforts sum up to nearly 7,0 million dollars. The Government of Honduras participates on a Risk Management Round Table, where it teams up with the UNDP, UNFPA, UNICEF, OIM, bilateral cooperation agencies ACIDI, KICA, GTZ, COSUDE, USAID, Italian Cooperation, World Bank, Interamerican Development bank (Banco Interamericano de Desarrollo – BID).<sup>(1)</sup>

As a complementary strategy, in June 2010, the National Government requested the BID support with the design of a Funding Program for Emergent Risks, identifying the needs and drafting of the Integral Disaster Risk Reduction Management Plan (Plan de

Gestión Integral del Riesgo de Desastres – PGIRDN). The PGIRDN allows a fast access to monetary funds in the event of a disaster of great magnitude within the national territory under the BID.<sup>(1)</sup>

The UNDP has supported different initiatives related to Early Recovery, strengthening the government's capacity, UNDP, and the Humanitarian Network. As a complement to these efforts, the UNDP has collaborated in the elaboration of normative frameworks, guidelines and instruments, and technical toolkits. It is also important to mention the implementation of training and preparedness processes for the building of focus on gender, early recovery, climate change adaptation, and risk reduction. The UNDP has also helped in the database update of the country's information on Desinventar, generation of threat maps in coordination with the National Autonomous University of Honduras (Universidad Nacional Autónoma de Honduras – UNAH) through the Honduran Institute of Earth Sciences (Instituto Hondureño de Ciencias de la Tierra). These efforts have also led to the coordination of the DIPECHO project (financed through the European Commission), focused on disaster preparedness. Providing support in helping incorporate the responsible national entities for climate change adaptation at the United Nations Convention on Climate Change, and in the design of national strategies on climate change of the Republic of Honduras (Estrategia Nacional de Cambio Climático – ENCC) in coordination with the Ministry of Natural Resources (Secretaría de Recursos Naturales – SERNA) with adaptations to the different guidelines and work task force appointments. Other endeavors, as the Swiss Cooperation – COSUDE have incorporated a technical consultation team specialized on climate change adaptation, encouraging and guiding the proposals for the National Plan for Integrated Risk Management.<sup>(1)</sup>

### 3.2 Regional Risk Reduction Context

The most relevant contribution within the region is the Integral Risk and Disaster Management Central American Policy (Política Centroamericana de Gestión Integral de Riesgo de Desastres - PCGIR), approved in Panama on June 30<sup>th</sup>, 2010 under the XXXV Ordinary Meeting of Chiefs of State and Government from the countries that integrate the Central American Integration System (Sistema de Integración Centroamericana – SICA). The PCGIR has been adapted to include the former work frame from the Regional Disaster Reduction Plan (Plan Regional de Reducción de Desastres - PRRD).<sup>(1)</sup>

PCGIR is composed of guidelines, political agreements, with long and short term goals organized in a politics – strategy – plan structure. These are further arranged in 5 Pillars, which include: (i) Disaster risk reduction of the investment for sustainable economic development, (ii) Development and compensation for social reduction of vulnerability, (iii) Environment and climate change, (iv) Territorial management, governability, and governance, and (v) Disaster and recovery management.<sup>(1)</sup>



### 3.3 National Risk Reduction context

The COPECO Committee (National Emergency Operation Center) is the body in charge of dealing with Natural Disasters and Emergency Situation Nationwide. It is responsible for the implementation of mechanisms and methodologies in the strengthening of local capacities in risk management. UNDP has subsequently provided COPECO with technical and legal support in terms of the law for National Risk Management System and the new construction code promoted by COPECO.<sup>(3)</sup> Between the years 2000 and 2010 COPECA executed the Natural Disasters Mitigation Project (Proyecto de Mitigación de Desastres Naturales – PMDN) under the name of “MITIGAR”.<sup>(1)</sup>

Honduras has developed under guidance of the Pan-American Health Organization (PAHO) and the Ministry of Health (Secretaría de Salud – SESAL) within the framework of the Vulnerability Reduction and Disaster Preparedness project, on the Methodology Guidelines for Health Planning in Emergency Cases and Disasters at a Local Level. This Program is looking to strengthen the different capacities of the Health Sector in the Country for preparedness in disaster and emergency settings. These guidelines are a national framework for decision making provided to decision making stakeholders at any level. The legal framework that sustains these guidelines for vulnerability and risk diminishing are based on Decree No. 30 on the 30<sup>th</sup> of March 1973, and the Legislative Decree No. 9-90-E approved on the 12<sup>th</sup> of December 1990 under the Law of National Disasters, which on Article 3 creates COPECO.<sup>(11)</sup>

The Local Health Committees for Disasters and Emergencies must make front to emergency and Disaster situations during, before and after such events. Before the presence of Disasters, the Committees must analyze the risk profile of their community, study past experiences, identify threats and risk, elaborate a sanitary risk map with resources located close to the risk area, appoint spaces for temporal shelter, identify the local human, material, and technical resources, perform a vulnerability analysis, make community consciousness, train volunteers. During the presence of a disaster the following actions must be considered by the stakeholder members: activate emergency centers, hold meetings with the work task forces, establish interinstitutional coordination, maintain a good flow of information, execute the Operative Health Plan in emergencies, provide sanitary material, keep health institutions open and operating, keep the population informed. After the Disaster the committee must: Elaborate a Final Sanitary Evaluation of Damages and Needs Analysis (Evaluación de Daños y Análisis de Necesidades – EDAN-Salud) report, reinstall health services within the least amount of time, follow up and evaluation of affected communities, coordinate the evaluation of victims, cadaver management, and environmental clean-up.<sup>(11)</sup>

The committee must install Emergency Operations Center (Centro de Operaciones de Emergencia – COE) with the aim to facilitate the tasks of affected people’s assistance, evaluate the results from sanitary operations and keep updated the statistics and factors related to the disaster. COE is in charge of receiving information and verification, make decisions according to the established guidelines and current situation.<sup>(11)</sup>

Priority actions in technical health areas is a core capacity of the COE, in identifying the priority actions to be taken in the briefest time. As well as define vulnerability in the affected area, quantify water production capacity, define storage and supplies, rehabilitation time, impact to previous existing services, monitoring of recurring risk situations. The COE is also incharge of Waste management, Water supply, Trash, Vector, Nutrition and Food, Shelters, Zoonotic Diseases.<sup>(11)</sup>

### 3.3.1 Legislation

Under the Constitutional Order of the Republic of Honduras, the approved constitution stipulated on January 1982 through the Decree No. 131-1982, does not make reference to Disaster Risk Reduction. Only reference to adequate and secure planification of development is made reference under Article 329, and Article 340 mentions the protection of natural resources as rational and technical exploitation, as a means of utility and public necessity, uphold to the State's rational regulation of national convenience and collective interest.<sup>(1)</sup>

The National Risk Management System (Sistema Nacional de Gestion de Riesgo – SINAGER) under its regulations and Law (Decree 151-2009) along with its Bylaws (Executive Agreement 032-2010) it establishes the needs of a Legal Framework for the country's risk management oriented to prevention and reduction of disaster risk, state preparedness, social response, and recovery from associated damage secondary to natural phenomenon or man-made disasters. This law is constituted as a intersectoral regulation framework, in order to provide the necessary law without trespassing other institutional and organizations agreements or regulations appointed by the law. It has been prepared in order to strengthen institutions' organization and coordination for complementary risk reduction efforts, along with direction a common objective. The purpose of this Law in accordance with the Constitution, is to protect lives, existing material resources, natural territorial environment, and coordinate the necessary activities to overcome any existing disasters. It's mechanism is to coordinate and potentiate disaster risk management through coordination each appointed government institution and linking their purpose towards Social Prevention. This law establishes the grounds for the creation of a Prevention Technical unit (Unidad Técnica de Prevención) as indicated in bylaws Chapter VI, in which in appoints that this is the responsible entity to elaborate the Institutional Plan for Risk Management and Disasters. Different work committees are appointed as follow: (i)Emergency and/or Disaster Preparedness and Response Management, (ii) Disaster Risk reduction, (iii) Education and Research, (iv) Environment and Climate Change, and (v) Resource Management.<sup>(1)</sup>

### 3.4 Foreign Assistance

Foreign Aid is received particularly from the United States and multilateral lending agencies since mid-1980's. This Foreign Aid culture has created a debt dependency, along with the changing political context caused the aid flow to wane external debt to rise to \$5.5 billion in 2001, nearly 90% of GDP. Domestic financing deteriorated and with surging insecurity and violence in the late nineties foreign investments declined.<sup>(3)</sup>



### 3.5 National Relief Plans

Honduran law recognized the Contingencies Standing Committee (COPECO – *Comité Permanente de Contingencias*) has structured a Plan to orient in risk reduction during national emergencies, natural and man-made disasters. The main objective within the guidelines of this plan is to orient national authorities and the general population in the implementation of strategies when facing different disaster circumstances. This document states the policies and preparations adopted to attain better knowledge and monitoring of risk, mitigate and take prevention actions against hazards in a timely manner. Strengthen the answer capacity and recovery, allow better participation and cooperation of the government, NGO's and the population in general through information socialization.<sup>(1)</sup>

This plan is structured in 9 different chapters, of which the first two chapters represent the previous historical events, legislation, and background information for Risk Management. The third chapter corresponds to the diagnosis and analysis of hazards and risk related problems in the country. Chapters four and five defined the principles that rule the responsible entities and the objectives to be reached after the implementation of this plan. Chapter six establish the action protocols in eight strategic work lines. The final chapters highlight responsibilities and different strategies assigned to national institutions.<sup>(1)</sup>

The efforts to update and establish a coherent action plan to make front to hazards and disasters is a joint collaboration between entities of National Risk Management System (SINAGER – *Sistema Nacional de Gestion de Riesgos*), under COPECO. It's elaboration started in year 2011 with the participation of consultations from the Interamerican Bank for Development (BID – *Banco Interamericano de Desarrollo*). Other institutions collaborated alongside, as where CEPREDENAC and PNUD, Swiss Cooperation – COSUDE. <sup>(1)</sup>

The National Relief Plans have been characterized for weak early warning systems and underestimation of the hurricane's magnitude severely reduced the ability of the Government and of the citizens to react to the disaster. Mitch also laid bare the social, political and environmental vulnerabilities of the country, its institutional fragility and its inability to respond to emergency situations.<sup>(3)</sup>

### 3.6 Sustainable Development

Honduras is involved in important regional integration arrangements for economic and social development. The most relevant are the Central American Court of Human Rights, the Free Trade Area of the Americas, the Northern Triangle and the free trade agreement between Central America and the United States.<sup>(3)</sup> By 2002 local capacities for risk management were strengthened in at least 4 municipalities in vulnerable watershed areas.<sup>(3)</sup> UNDP also worked closely with COPECO in the implementation of mechanisms and methodologies for strengthening local capacities in risk

management, such as community organization, early warning, contingency plans, drills, and hydrological scenario. <sup>(3)</sup>

A few key areas are required to be strengthened when referring to sustainable development of the country and building a good resilience capacity. Of which we can mention a couple examples like extreme poverty and hunger which is linked to a weak food security and nutrition institutional infrastructure and capacity. Education is lacking an effective education system, it is characterized as deficient and of low quality in teaching and learning methods, as well lacking decentralization to ensure national coverage. Gender Equality has been characterized as a topic still pending to be incorporated within the educational curricula and establish the labor conditions to confront the limitations of adequate incorporation of women to the workforce, the effective participation of women in the electoral voting processes, and the absence of a gender agenda on different governmental levels to draw nation relief plans. Child Mortality presents a weak institutional and technical capacity to reduce the associated factors and conditions, alongside with a lack of financial resources support to implement a preventive focus. Maternal Health lacks the sufficient information to generate indicators and therefore identify the correct implementation strategies to help reduce the statistics, an outdated Sexual and Reproductive Health Policy which has led to closing down related health programs and projects, mostly due to an inefficient resource management model. This indicator is characterized for a high adolescent Fertility rate, lack of a contraceptive strategy implementation, and social appropriation on sexual and reproductive health. HIV/AIDS and Other Diseases present a weak prevention system framework, attention, care and support, lack of an adequate strategy, guiding information that supports the respective institutional implementation and multisectoral initiatives, programs and projects. Environmental Sustainability requires the correct implementation of environmental norms, despite the weak local capacities for decentralization, financial resources destined to protected green areas systems and multisectoral coordination difficulties. Public policies have been considered as non-congruent in terms of management and agricultural development, protection, and biodiversity conservation. Along with a high index of population growth, young population, internal migration, and informal access to housing, all which favor settlement of this marginalized population in risk prone areas. Development Alliances present weak institutional and financial support in terms of formulating, negotiating and implementing an international commercial policy. There is a low stimulus in national and international investment, with a poor investment culture. Foreign aid is hindered by the government's poor coordination within stakeholders, and limited national execution of funds, high and excessive public spending, weak taxation culture to solve the external debt problems. The proposal of Information and Communication Technologies (ICTs) between the government and the private sector has experienced drawbacks because of lack of political consensus. There is no approved regulatory framework, and there is no financial support to lessen the digital divide, training and project development of social investment related to ICTs.<sup>(1)</sup>


#### **4. Institutional Arrangements**

The National Plan for Risk Management of Honduras has contemplated different institutional arrangements to carry out its objectives and strategies, which will guide in the attainment of the different proposed goals. In this manner it identifies the government entities responsible for taking the proper actions before, during and after a disaster. These can be separated according to strategies and actions to be taken by each. The first strategy aims to Strengthen the attainment of Knowledge and Risk monitoring, in which the responsible institutions to carry out the different activities are Scientific Technical Entities, Research Institutions, and the Standing Commission for Risk Control (COPECO), the National Meteorological Service, Seismic Research Institutes, and the National Geographic Service. The second strategy aims to risk and vulnerability reduction and is divided in 2 different work programs. The First Program of the Second Strategy is focused to adequate planification and development of the territory safety, for which the appointed institutions responsible for this strategy are: Ministry for Planning Management (Secretaría de Planificación – SEPLAN), the Finance Ministry (Secretaría de Finanzas – SEFIN), COPECO, and all other Ministries tied to development and growth. The second work program is oriented to Management and Follow-up of human Settlements, infrastructure mapping in risk areas, and has additionally incorporated the participation of Engineering Schools, Ministry of Natural Resources (Secretaría de Recursos Naturales – SERNA). The third strategy focuses on Institutional Capacity Strengthening and Capacities Development, and works towards Adequate and Safe Interventions for Development and Territorial Planning, and incorporates the following institutions: COPECO, SINAGER.<sup>(1)</sup>

## 5. Advancements in Risk Reduction Management

According to the BID-IDEA about Risk Indicators and Risk Management for Honduras, the country presents a Vulnerability Prevalence Index (VPI) equivalent to 42,28 points for year 2007 (on a scale from 0 to 100, being 80 a high level). The VPI analysis the prevalent conditions of vulnerability in the country in terms of exposure to prone areas, socioeconomic fragility, and lack of resilience. Aspects that favor direct physical, indirect and intangible impact in the event that a dangerous phenomenon becomes present. The considered conditions for inherent vulnerability analyzed are problems caused by inadequate growth, and others which could have been stopped with the appropriate interventions for sustainable development and growth. Along with illustrating Honduras' relation of risk to development, mostly caused by a unequal distribution of resources which end up in creating less access to a safe territory, or when economic growth does not go alongside with positive planning and sustainability. The BID-IDEA also identified Honduras has the least economic capacity within the region to confront situations of great magnitude disasters under the Disasters Deficit Index (DDI). It is estimated that the costs associated to extreme events are 7 folds superior to that of the present financial protection to take action against a large scale disaster. In relationship to the Risk Management Index (RMI), the country has undertaken relevant progress in terms of public policy for disaster risk management, knowledge and understanding processes, and general risk reduction, placing the country on a positive tendency within this indicator rising from a 17,21 points in 2005 to 55,34 points in 2008. A study performed in 2011 by DARA, AECID, and EIRD, analyzed the conditions and capacities of risk reduction within countries of the region. This study proposed 4 dynamic processes or "drivers", which explain the high susceptibility of the country against any type of potential threatening phenomenon, and which maintain a high risk for Honduras:

1. Environmental degradation: persistent factors like natural resources overexploitation, as is water, deforestation and land overuse have made it impossible to reduce risk.
2. Socioeconomic conditions: limited access of the poor to drinking water, waste management services, and a quality education. Adding up, unemployment, lacking of food safety, along with limited coverage to the States assistance programs have exacerbated risk conditions within the most marginalized and outdriven sectors of society.
3. Territorial Management: land use without the guidance of appropriate formulation and application of strategic planning for territorial management. Furthermore, these strategies have not implemented risk analysis in disasters and in other occasions they are not given sufficient resources to conduct public investment required for risk reduction.
4. Governability: The aspects of the government which most worsen risk reduction is corruption, lack of coordination between different government levels, and high bureaucracy levels. Additionally, there is evidence of weak risk reduction mechanisms and norms, plus a limited institutional capacity for decision making.<sup>(1)</sup>



The following are the contemplated strategies proposed for Risk Reduction and Disaster Management within the scope of the National Plan for Disaster Management of Honduras.

### 5.1 Policy, Institutional Capacity, and consensus

As a main goal to achieve Institutional Strengthening and Capacities Development the National Risk reduction Plan proposes to promote actions and strengthen institutional development. Use of Territorial plans are oriented to promote and coordinate the elaboration and application an organizing action scheme of institutional management. Supported by a strong Normative Framework and instruments available to different institutions to guarantee integral intervention and coordination.<sup>(1)</sup>

The strategies aim to enhance planning and answer capacity through more efficient mechanisms. The government must guarantee, in spite of the already existing risk factors, that itself and the society count with the technical knowledge, preparedness protocols, adequate response strategies, financial and technical resources, to ensure a quick recovery, rehabilitation, and reconstruction.<sup>(1)</sup>


Disaster Attention and reduction of the Government's Financial Vulnerability, these strategies look towards ensuring different financial strategies. Identifying, promoting and monitoring the development of permanent capacities for normative organizational and cultural strengthening of institutions, society and private sector. Identifying every party's roll will help identify tasks and financial resources for risk reduction, recovery in post disaster settings. This strategy aims to reduce non planed investment and resources, better assignment of resources to development and attention in disasters. Prioritizing in this manner investment towards taking care of critical situations present during disasters and looking towards reducing unnecessary investments.<sup>(1)</sup>

### 5.2 Monitoring Disaster and Risk Assessment

To comply with the strategy of Enhance better Knowledge and Risk Monitoring, the plan looks to strengthen basic and applied scientific research methods. Scientific research and the attainment of new knowledge on risk from natural and man-made risk constitute the basis for decision making, planning and territorial development. This process contemplates developing methodologies to identify and evaluate risk through analysis, evaluation of potential threat, and vulnerability. Applying these finding to regional and social sector in the implementation of public policies.<sup>(1)</sup>

Proper and reliable information access is crucial in reducing risk conditions. These information systems must guarantee easy access and constant update, access to technical information on behalf of decision makers, registries and checklists, population data. In terms of decision making from stakeholders, information must be unified, updated and count with the means for quality verification.<sup>(1)</sup>

This strategy focuses on attaining and strengthening an Early Alert System, elaboration of seismic microzonification studies, network diagnosis of flood and landslide prone areas, monitoring systems for risk detection and alert systems to



inform the population, install an alert system in case of seismic activity, finally guarantee proper maintenance.<sup>(1)</sup>

### 5.3 Resilience, Education and Disaster Preparedness culture effort's

Working on the strategy to reduce vulnerability to risk, different efforts are looking to incorporate technical information and adequate planning, taking as a priority the community's economic prosperity in the future. These risk aftermath planning instruments, at all national levels, are fundamental to guarantee safe investment, more benefits from the social and economic point of view.<sup>(1)</sup>

A proper risk reduction culture is another important aspect in the implementation of these strategies. Preparing the population and assigned institutional staff to incorporate a preventive attitude culture and acceptance of preventive actions from the State. This must be accompanied with proper process of information sharing from behalf of the assigned authorities to execute the different risk reduction and recovery strategies. This strategy aims to work on formal and non-formal education in embedding daily society actions and professional labor activities that allow the reduction of actual and future potential risks.<sup>(1)</sup>

This strategy entails attaining and working towards population settling maps, technical assistance, promote and test the proposed actions strategies and protocols. Additionally, install building verification strategies, create a diagnosis of risk for existing infrastructure, review and update river flow plans, implement strategies for soil and environment conservation, proper use protocols for water resource use, promote environmental protection strategies, promote environmental responsibility, society participation in risk reduction. In terms of human settlement and infrastructure the different strategies implement overlooking and guiding infrastructure development planning, create a checklist for potential risks and non-mitigated cases, technical assistance to risk prone areas, proper infrastructure proposals for potential risk areas, reinforcement and demolishing of risk prone infrastructure, relocation of population settled in high risk areas with threat of flooding and/or landslides, promote infrastructure suitable for flood control and prevention, evaluate government buildings capacity's for resilience to disasters. All these strategies require the conformation of a Multisectoral Working Taskforce, society involvement, population consensus and promotion of proposed strategies, information and basic indicators data sharing.<sup>(1)</sup>

## 6. Results and Discussion

### Overview

As mentioned in previous chapters, Honduras is considered by many International Organizations as one of the most affected by natural disasters, and climate change in the western hemisphere. Additionally, it is one of the most vulnerable countries when confronting a disaster situation. The following tables obtained through EMDAT database summarize the number of disaster events of the past century in Honduras. We will also compare the country with neighboring Central American Countries.

**Table 1: Disaster Type Count per Country from year 1900 - 2020**

(Source. EM-DAT, CRED / UCLouvain, Brussels, Belgium. [www.emdat.be](http://www.emdat.be) (D. Guha-Sapir).) <sup>(12)</sup>

Count of Events per Country								
Disaster Type	Belize	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Panama	Grand Total
Biological		2	4	6	6	5	2	25
Climatological		5	4	7	10	8	4	38
Complex Disasters						1	1	2
Geophysical		19	13	28	3	15	4	82
Hydrological	3	30	19	43	36	22	37	190
Meteorological	15	9	16	22	18	22	6	108
Technological	1	6	12	28	19	10	13	89
<b>Grand Total</b>	<b>19</b>	<b>71</b>	<b>68</b>	<b>134</b>	<b>92</b>	<b>83</b>	<b>67</b>	<b>534</b>

When compared with other countries in Central America over time, we can find differences in the amount of people affected, amount of money invested, and the amount of people killed.



Fig 1. Total Number of Population Affected a Natural Disaster in Central America from 1900 - 2020 (Source. EM-DAT, CRED / UCLouvain, Brussels, Belgium. www.emdat.be. Guha-Sapir.)<sup>(12)</sup>

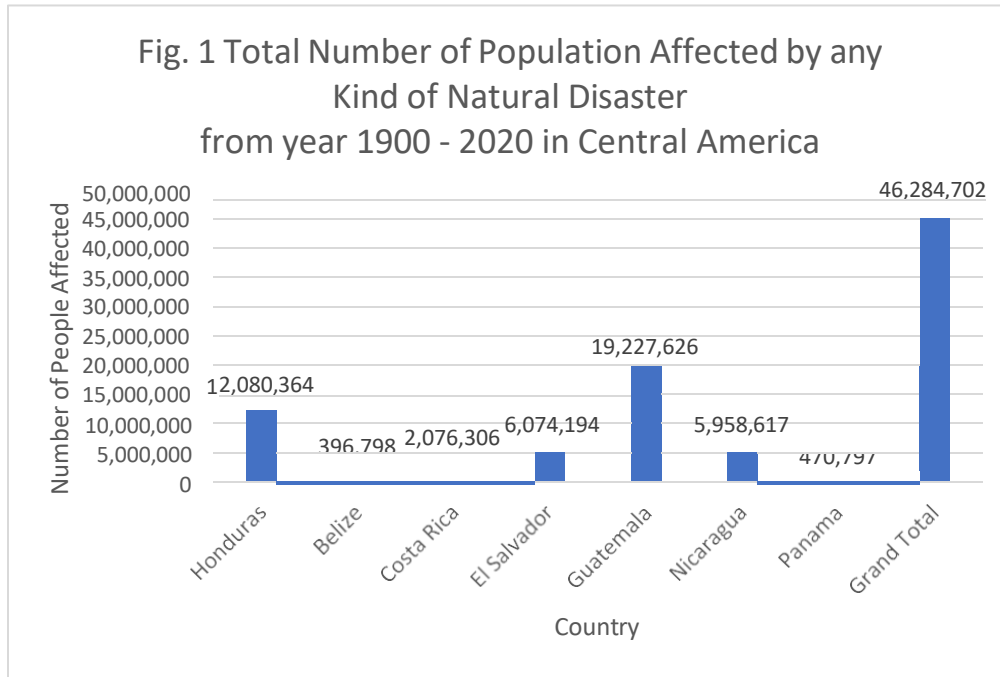
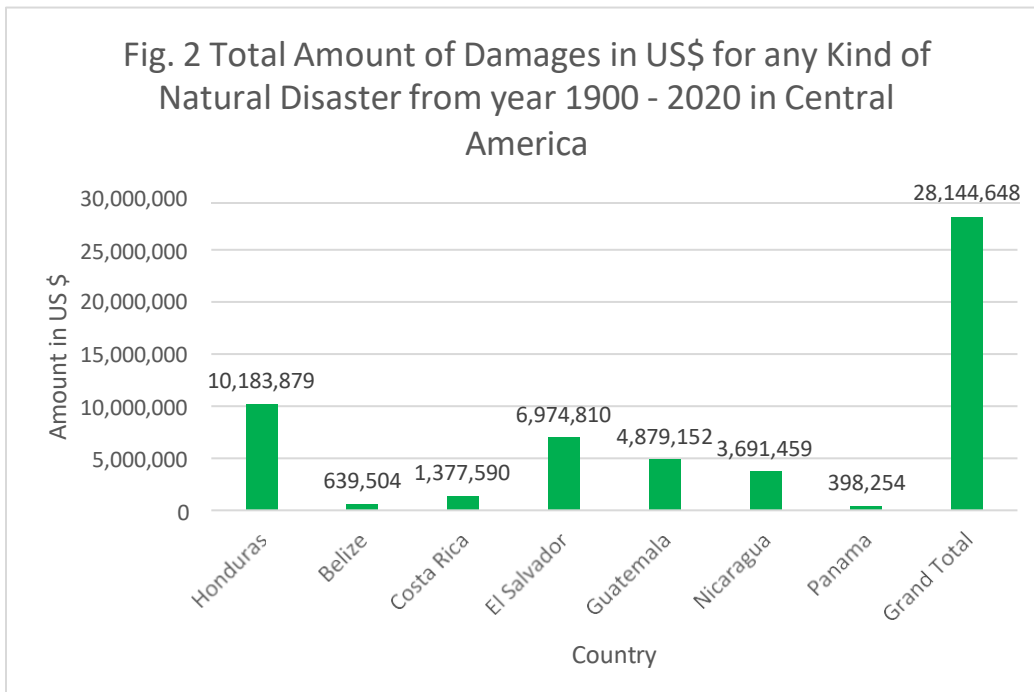


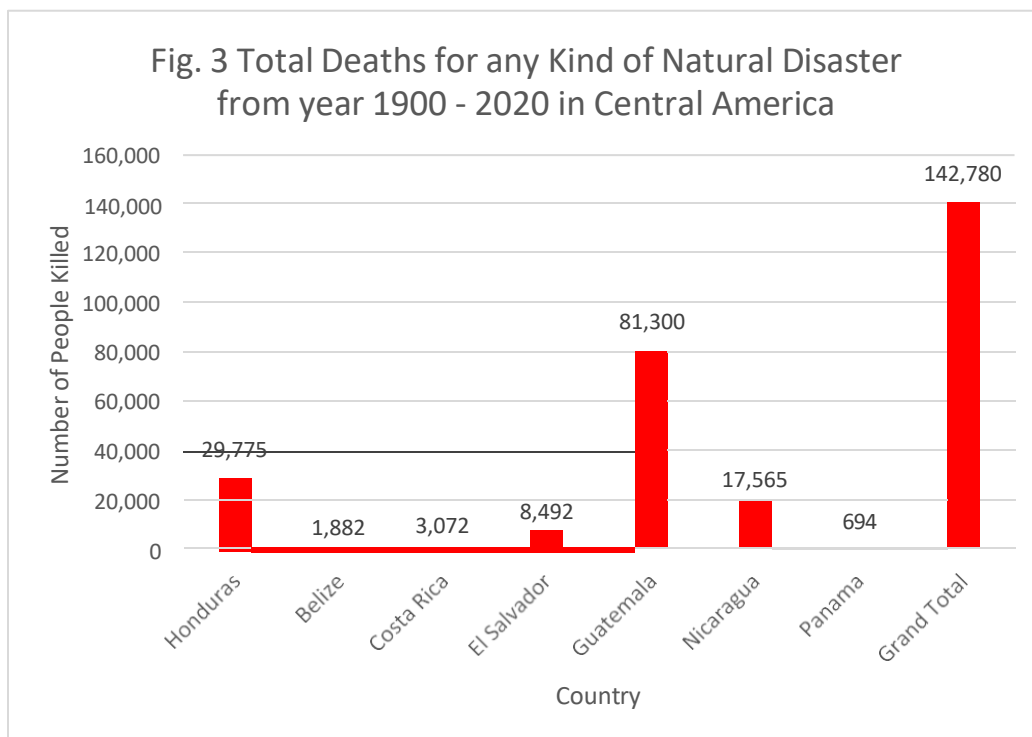
Fig 2. Total Amount of Damages in US\$ in damages due to Natural Disaster in Central America from 1900 - 2020 (Source. EM-DAT, CRED / UCLouvain, Brussels, Belgium. www.emdat.be (D. Guha-Sapir.)<sup>(12)</sup>





As shown in Figure 1 a 25% of people affected by a Natural Disaster between 1900 – 2020 were found in Honduras, followed by Guatemala with a 41%. Guatemala and Honduras have a higher population number in Central American. Perhaps this accounts for having the highest number of people affected by a Natural Disaster. Also taking into consideration that the most populated cities are vulnerable to landslides, and flooding. Figure 2 on the other hand shows Honduras as the leading country with a 36% of amount of money used to repair damages in Central America during natural disasters. Finally Figure 3 shows Honduras as the second country with most deaths due to natural disasters in Central America with a 20.4%, compared to Guatemala with 57%. Many features are to be considered in terms of geological terrain and distribution of resources.

Fig 3. Total Amount of Deaths due to Natural Disaster in Central America from 1900 – 2020. (Source. EM-DAT, CRED / UCLouvain, Brussels, Belgium. [www.emdat.be](http://www.emdat.be) (D. Guha-Sapir).)<sup>(12)</sup>



## **General Scenario and Impact of Hurricanes Eta and Iota in Honduras**

Category 4 Hurricane Eta and Category 5 Hurricane Iota made land fall Haulover located 1,700 south of the Port City of Puerto Cabezas, on the Nicaraguan Atlantic Coast. Both Hurricanes landed on November 4th and November 17<sup>th</sup> respectively, bringing gusty winds of approximately 260 km/hr and two week torrential rains. Guatemala reported the most affected site with deathly Land slides in Alta Verapaz and 100 deaths.<sup>(13)</sup> According to CEPAL, the amount of economic losses in Honduras reached US\$15 million US dollars, including economic losses due to COVID for up to US\$2.250 million US dollars from the country's GDP. The main roads that connect the Cities of San Pedro Sula and La Lima in the northern part of the country were flooded. Local affected families had started to clean up their homes, remove the excess mud, trash, and dead animals when they received the news a second Hurricane would be bringing floods and mud once again. Given the previous warning from Hurricane Eta, one third of the most vulnerable families of San Pedro Sula and La Lima City in Honduras decided to evacuate.<sup>(14)(15)</sup>

The number of refugees and human casualties reported in Guatemala was 5,200 people living in shelters, and 128,000 people had to leave their homes. In Nicaragua, the storms left 21 human deaths, US\$742 million US dollars in economic losses, and 160,000 refugees. Nonetheless the most concerning figures are reported in Honduras reporting an approximately 200 reported deaths, and an estimate 4 million inhabitants displaced and need for shelter, along with significant destruction of crops, bridges, roads, homes, etc.<sup>(15)(16)</sup>

### **Displaced settlers, Shelters and the Aftermath**

Survivors of these disasters had to endure the terrible consequences of the disaster and inhumane conditions until aid and government action would reach the area. More than 60 families were still taking refuge under a bridge on the Southern exit way of San Pedro Sula City after surviving the damages left by Hurricane Eta. In less than 15 days they were informed of a second Hurricane with worse consequences was heading to Honduras. Proper water supply for personal hygiene and latrines for human waste management was not insured within the first 15 day period.<sup>(14)</sup> Displaced families had not just to endure terrible and inhumane and hostile living conditions, but make front to sexual abuse, violence, female discrimination, psychological trauma, sexual violence, among others.<sup>(15)</sup>

Female discrimination, abuse and rape represent an ever-present situation for most females living in refugee camps and temporal shelters. According to Honduran authorities at National Office for Children, Adolescents and Family (DINAF - Dirección Nacional para la Niñez, Adolescencia y la Familia) more than 6,400 minors were placed under their custody and reallocated to other temporal shelters due to sexual violence. After Hurricane Eta and Iota, at least 8 reports of sexual violence were presented from temporal shelters in Honduras. Within the different Central American shelters in Guatemala, Nicaragua, the Colombian Islands of San Andrés and Honduras the most reported acts of abuse came from Legal Guardians, unaccompanied minors

left alone with strangers, child prostitution, female hygiene discrimination, strangers having access to the shower area, among others.<sup>(17)(18)</sup>

Fig. 4. Accumulated Rainfall Totals after Hurricane Eta became a Tropical Depression. (Honduras rainfall totals (mm) associated with Eta during the period 31 October–6 November 2020. Source: Graphic courtesy of the Centro Nacional de Estudios Atmosféricos, Oceanográficos y Sísmicos (CENAOS) & NOAA Tropical cyclone ETA Report.)(19)

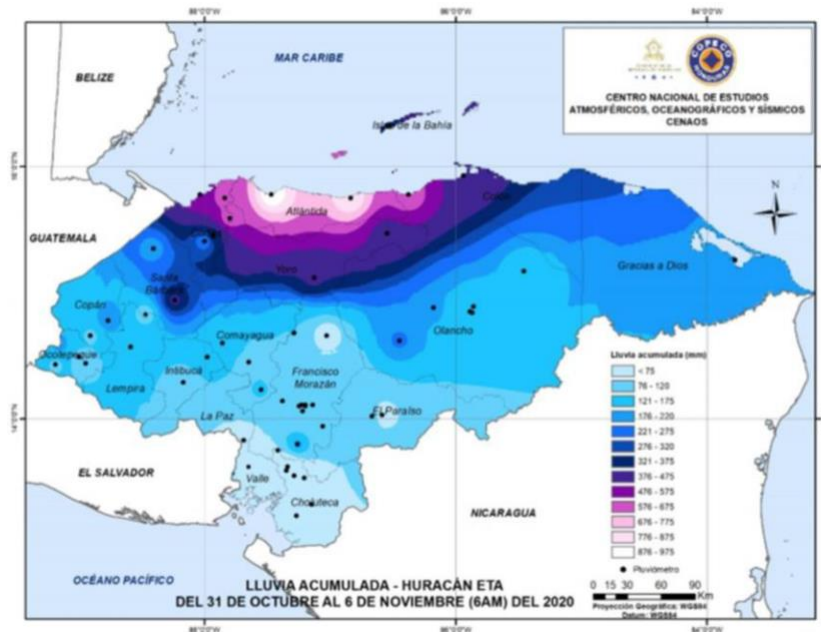
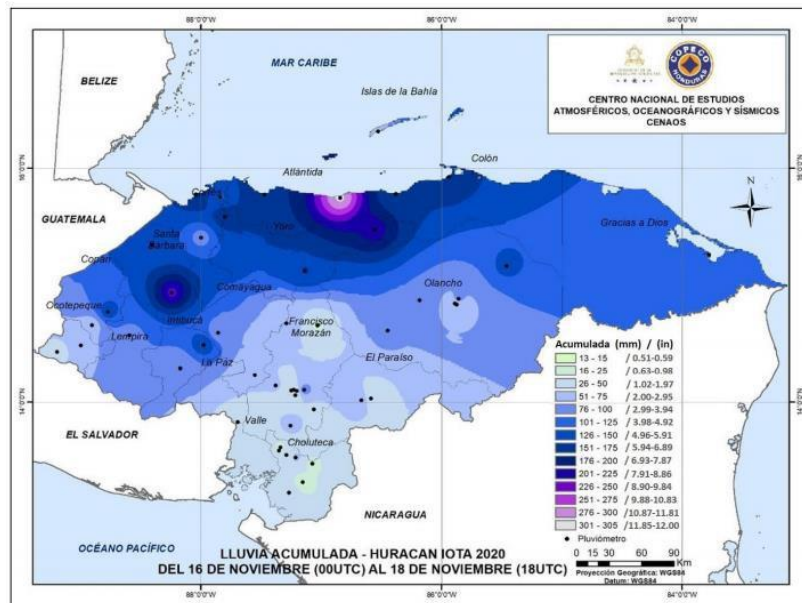



Fig. 5. Accumulated Rainfall Totals after Hurricane Iota became a Tropical Depression. (Honduras rainfall totals associated with Hurricane Iota during the period 16–18 November 2020. Source: Graphic courtesy of Centro de Estudios Atmosféricos, Oceanográficos y Sísmicos/CENAOS (Honduras Center for Atmospheric, Oceanographic and Seismic Studies)/NOAA.)<sup>(20)</sup>



The increased effects of coastal flooding have been documented through the relationship of Sea Level Rising (SLR) and Tropical Cyclone (TC) patterns. Coastal flooding responds to both sea level rise (SLR) and storm climatology change. SLR varies from place to place due to the ocean circulation and glacial isostatic adjustment, and climate change results in an interbasin variation of cyclone characteristics. Recent research has shown that the spatial variability in SLR and extratropical cyclone (ETC) climatology change results in flood hazards that vary across the basin and global scales. However, the most destructive coastal floods are caused by tropical cyclones (TCs). Understanding the basin to global scale variation of TC flood hazards and their future evolution is critical, if we are to identify the current and future degree of flood risk in different regions and to prioritize adaptation and mitigation investments. An effective approach is to statistically generate large samples of synthetic TCs for reanalysis or GCM-projected climate conditions<sup>19,20</sup> to drive hydrodynamic modeling and assess flood hazards. In 41% of coastal counties in the Gulf of Mexico, the TC climatology change is projected to be the main cause of increase in the future 100-year flood level.<sup>(21)</sup>

Tendencies show in tropical Cyclone synthetic modeling that an increase in the number of slow-moving TCs and a decrease in the number of fast-moving TCs. Slower TCs allow winds to blow onshore for longer periods of time, resulting in possibly larger and longer coastal flooding. Increasing flood levels induced by TC climatology change, especially in lower-latitude regions, suggest that the frequency, intensity, and/or size of TCs could increase by the end of 21st century. Computational projections oversee that on all six climate models agree that the largest impact of TC

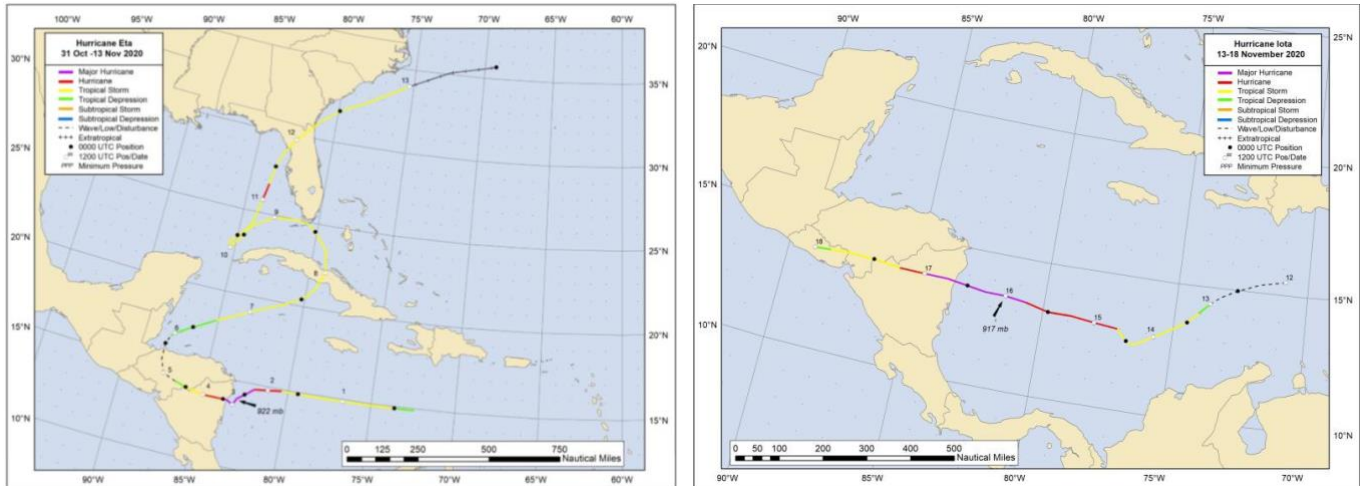


climatology change on the 100-year flood level takes place in the Gulf of Mexico. TC flood risks are evolving along the US Atlantic and Gulf Coasts, owing to SLR and TC climatology change in the western North Atlantic Ocean basin. The rate at which sea level is changing varies from place to place<sup>1–3</sup>, affecting future flood hazards locally. The impact of TC climatology change in the basin could spatially vary too although, to our best knowledge, this was not investigated prior to the present study. Here, for the first time, we showed that TC climatology change would substantially increase flood return levels, with the highest and lowest impacts in the Gulf of Mexico and Gulf of Maine regions, respectively. We found that the effect of late 21st century TC climatology change on 100-year flood levels exceeds the effect of SLR for over 40% counties along the Gulf of Mexico coast. Projections from NM14 for the New York City (The Battery NY) indicate that SLR causes an increase of 0.8 m in the 100-year flood level from 2014 to 2114 under the modified NRC-III rate SLR scenario and an increase of 1.29 m under the modified NRC-III rate (USACE High) SLR scenario.<sup>(21)</sup>

The basin-scale approach adopted in this study allowed us to evaluate the spatial variation of flood return levels at the county level. Regional-scale (and local-scale) studies and flood mapping require a more detailed variation of flood levels along the coast- lines to support regional flood mitigation strategies. Basin-scale studies reveal whether a regional-scale study is essential for a specific region (and how urgent it is), prioritizing regional-scale flood hazard and mitigation studies. Regional scale studies cover a smaller area and thus can have a higher resolution than basin- scale studies. Such studies may also account for elements that are usually missing in larger scale studies such as inundation over coastal floodplain. Thus, regional-scale studies may be informed by the basin-scale studies, and the results of regional-scale studies in turn may be used to evaluate the accuracy of basin-scale studies. Another benefit of a basin-scale flood hazard study such as presented here is that it reveals regions where SLR, storm climatology change, or both play a role in future changes in flood hazards. Regional-scale studies for regions where the storm climatology change does not impact future flood hazards (e.g. 100-year flood level in Gulf of Maine) may focus on the effect of SLR, while regional-scale studies for Gulf of Mexico should consider the compound effects of SLR and storm climatology change.<sup>(21)</sup>

Hydrometeorological disasters number in Costa Rica have been growing during the last decades: especially annual floods and landslides in both, urban and rural areas. This trend is consistent in Central America, a region commonly affected by tropical cyclones due to its position and high vulnerability. an increase of heavy rains is predicted for future decades in the Caribbean of Costa Rica, and a greater number of tropical cyclones, occurrence in the Atlantic catchment have been forecast, Concordantly, global tendencies indicate that disaster risk have been exacerbated by climate change increasing its frequency and intensity (UNDRR). Developing countries and smaller economies, challenge a more difficult economic situation after a comparable disaster than do developed countries or bigger economies.<sup>(9)</sup>

Figure 6. Best Track Plot of Hurricane Eta and Iota  
 (Plot of National Hurricane Center (NHC) for hurricanes Eta (left) and Iota (right)  
 with a 6hr track forecast. Source: NOAA Tropical Cyclone Eta and Iota Reports).<sup>(19)(20)</sup>




### 5.1.1.1 COVID and the Current Hurricane Season

In spite of the terrible consequences the COVID pandemic has left in Honduras, the Government promoted different strategies to revive the economy amid an uncontrolled pandemic and a Hurricane warning from the Miami Hurricane Center.<sup>(14)</sup> According to recent history, the virus did not seem to represent any novelties. We already knew about SARS-CoV (Severe Acute Respiratory Syndrome-related Coronavirus) in 2003 (Huang et al., 2005) of the H5N1 influenza virus in 2005 (Webster et al., 2006), influenza H1N1 virus in 2009 (Cohen et al., 2009) and MERS-CoV (Middle East Respiratory Syndrome-related coronavirus) in 2012 (Lau, 2013). Following the announcement of the onset of type 2 coronavirus (SARS-CoV-2) or COVID-19, our lifestyle as Hondurans as well as that of the rest of the world did not change at all. It was thought that this time would not be the exception to the routine of the viruses that come and go, especially since our country is 14,460 km from Wuhan.<sup>(22)</sup>

Recalling similar cases of the famous 1918 pandemic caused by the type A influenza virus, subtype H1N1 were then revived. It killed about 50 million people, mainly young adults between the ages of 20 and 40 and lasted about 2 years, and then, it probably disappeared due to the phenomenon of "herd immunity".<sup>(22)</sup>

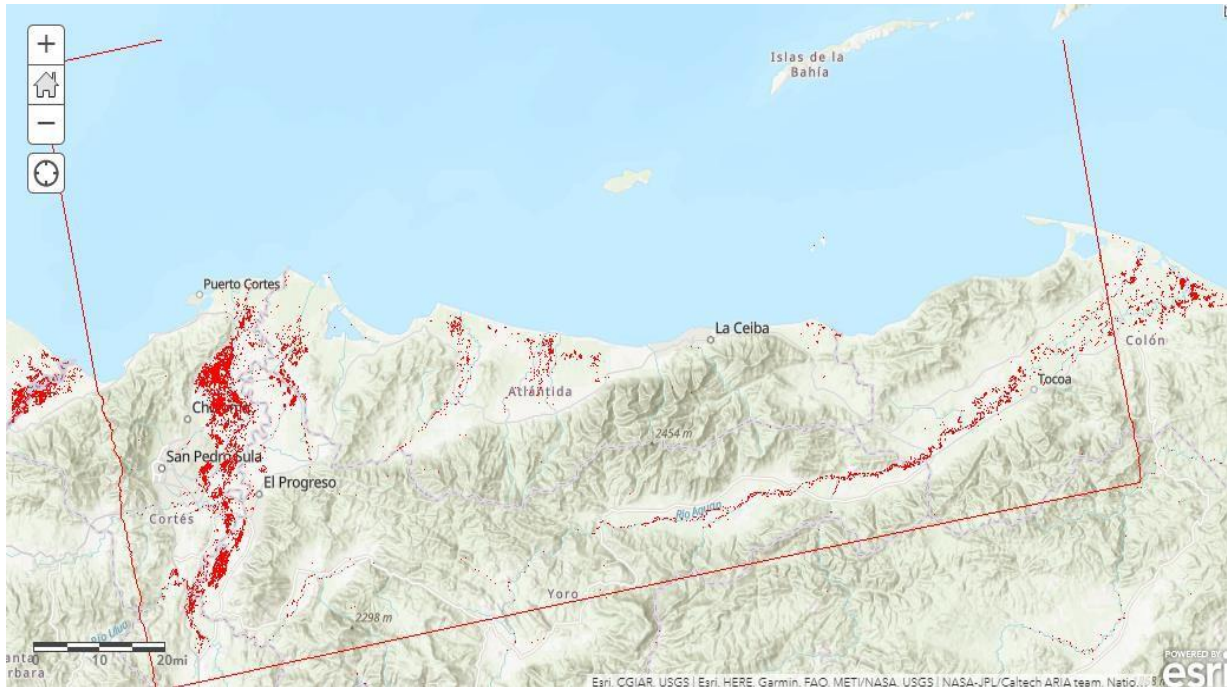
Colombia, Nicaragua, and Honduras have had a particularly long and brutal rainy season. Iota was only the second category 5 hurricane to occur in November in the Atlantic, and came shortly after hurricane Eta, which caused huge damage across the Caribbean. As storms continue to batter the region, experts and health authorities are worried about the strain they might put on fragile health systems already rattled by the COVID-19 pandemic and seasonal outbreaks of tropical diseases. As expressed through the Colombian Health Ministry, Secretary Julian Fernández, Director of Epidemiology and Demography at Colombia's Health Ministry, told The Lancet. "It's





very difficult to isolate people with COVID-19 or mosquito- carried diseases when hurricanes or rains force people to shelter together.” In addition, like much of the region, rainy months bring outbreaks of mosquito-borne diseases such as yellow fever, dengue, malaria, Zika virus disease, and chikungunya. “With each season, we will always see outbreaks of respiratory diseases and tropical, mosquito-borne diseases, but this year with the COVID-19 pandemic, it is much less advisable that people shelter indoors as before, as that only contributes to the spread of that disease, and so that’s the first worry with the rainy weather events—that of increased transmission of diseases. The second is how logistics and infrastructure essential to health care are affected.” The rainy seasons, which usually peak in May and November, often expose weaknesses in the centralised nature of care, where advanced hospitals are located in the major cities, mostly in the inland highlands, far from the rural areas hardest hit by flooding. When heavy rain causes landslides and blocks roads, communities can be cut off from health care and other state services for weeks. Ongoing conflicts and social violence are currently ongoing, which may add up to the problematic of limited access to the most affected population. “Generally, we can say that particularly rural populations face both higher disease burden and poorer access during and soon after these peak rainy months. Amid isolated communities administrators rely on a network of community leaders in the field. However, with communications often severed by the rain, or not there to begin with, help seldom arrives. Many other places were similarly affected. Landslides are common, with highways often blocked from one day to the next. Riverine communities are at risk of being washed away, while logistics nationally are hamstrung.<sup>(23)</sup>

Fig 7. Flooding Areas in Honduras after Hurricane Eta November 2020.  
 (Major flooding areas in Northern Atlantic Corridor of Honduras, especially the Sula Valley River, one of the biggest urban area in the country, and important economic district. Source: NASA Disaster Library Map Package - ARIA Flood Proxy Map (Copernicus Sentinel-1) for Hurricane Eta 2020. <https://maps.disasters.nasa.gov/>)(<sup>24</sup>)



### 5.1.2 Previous Hurricane Experiences in Honduras

Hurricane Mitch pounded Honduras from 25 to 31 October 1998, severely impacting various regions of the country. Out of a total population of 5.6 million, the hurricane left 6 600 confirmed dead, 8 000 to 14 000 missing, and drove 2.1 million people from their homes. Damages to infrastructure and industry were estimated at US\$ 1.34 billion. Tegucigalpa, the capital city, lost 230 factories and workshops. Land erosion severely affected agriculture, and it is estimated that 70% of the basic grain and export crops were destroyed. Satellite imagery suggested that this was not passing damage, and that the storm's severe impact might compromise future agricultural production and food security in Central America. In addition to the immediate repercussions, natural disasters like Hurricane Mitch may also have substantial secondary public health effects resulting from crop destruction, widespread flooding, and the relocation of affected populations into overcrowded and unsanitary resettlement areas. There is a critical gap in our understanding of the long-term nutrition and health consequences of hurricanes and tropical storms, an unmet need that becomes more pressing in light of disasters such as Mitch and the torrential rains and flooding that hit Venezuela in December 1999. Although casualty rates may stabilize during the postdisaster phase, undernutrition is most likely to develop over the long term among affected populations. The elevated levels of stunting, wasting,



and underweight found in the Nueva Choluteca and Tegucigalpa settlement samples indicate that these populations were confronting severe chronic and acute assaults on their nutritional status 9 months after Hurricane Mitch. Additional information to compare nutritional status comes from a series of health and economic surveys conducted in Honduras between 1987 and 1996. In these surveys, the national-level statistics showed minor changes over time. Looking at data collected in the Tegucigalpa metropolitan area before and after Hurricane Mitch, stunting increased from 1987 to 1994. During the mid-1990s, however, both stunting and wasting declined substantially. In the 1996 National Micronutrient Survey, 38.5% of sampled children ages 12 to 71 months were stunted and 24.5% were underweight, but only 1.5% were wasted. In general, the processes of resettlement and reconstruction do not automatically guarantee improvements in the lives of affected populations. Food insecurity, economic marginalization, and social disruption are just a few of the risks identified with community resettlements the world over.<sup>(25)</sup>

Hurricane Mitch hit Honduras (and other areas of Central America, especially Nicaragua) from 25 October to 1 November 1998. The hurricane moved inland and remained static over the isthmus for days, resulting in the largest natural disaster experienced in Honduras in recent memory. Rapid population growth, combined with massive disparities in the distribution of wealth, has compounded this vulnerability. Emigration, to the USA in particular, has been one response by significant numbers of Hondurans. Emigration has resulted in remittances being a major source of income for Hondurans. The immediate impact of the disaster affected over 1.5 million people, the highest on record for any disaster in Honduras, including: 6 • 5,757 dead, 12,272 injured and 8,058 reported missing • 441,150 people displaced (to relations or friends or to other temporary shelter: 1,375 collective centers were established) 4.2 million people lost access to running water ( 70% of the entire population). Immediate response activities included search and rescue, emergency public health care, food, blankets, domestic items, temporary shelter distribution, and sanitation programs, including the disposal of human and animal remains. The distribution of potable water was a priority given the massive water shortage. Emergency sanitation activities were required given the damage to or loss of sewerage and drainage systems. Health problems included gastro-intestinal infections, acute respiratory infections, dehydration, and injuries caused by the floods. Leptospirosis (spread by rodent urine), which had been virtually non-existent in the previous year, reappeared.<sup>7</sup>

Agricultural output dropped dramatically, as livestock were lost or drowned, and land was eroded, stripped of fertile soil, or covered in mud. Roads, hospitals, even prisons, were damaged or destroyed on a massive scale. The loss to the economy has been estimated at some US\$4 billion. Unemployment and migration increased. Preliminary estimates of damage and replacement costs prepared by UNDP and ECLAC estimate total direct and indirect damage of US\$3.6 billion. This was the equivalent of 74% of Honduras' 1997 GDP (there is considerable variation among estimates by different organizations). Reconstruction costs are estimated at US\$5 billion.<sup>(4)</sup>

Lessons learned from the most recent past major hurricane catastrophe are: Physical reconstruction: visible but incomplete. The state was not able to generate and ensure

adequate standards for recovery to be applied across projects and geographical areas, The quality of the NGOs that implemented housing projects has frequently been inadequate, Self-help projects were often poorly managed, unsupervised, and ineffective. Transformation has not taken place • transparency and good governance • ecological and social vulnerability • decentralization and local development • trade • migration. Economic recovery has not taken place Interviews indicate that individual families, as a rule, have not recuperated their losses in property and savings that were used up during the disaster. Economic recovery programs were few-and-far between, compared to the proliferation of physical reconstruction projects. Vulnerability reduction: . Rivers have changed their courses, and beds have been choked with sand and stones. Thus, flooding is now more likely. This phenomenon is compounded by deforestation.<sup>(4)</sup>

Enhance skill formation and capacity, Improve technical expertise in the area of poverty reduction and rural development. Enhance the linkage between governance and poverty. Prioritize market oriented development alternatives. Reduce standalone projects to the minimum and enhance systematic monitoring and evaluation.<sup>(3)</sup>

It is important to consider that two hurricanes struck Honduras (Eta and Iota, respectively, making landfall on 3rd and 17th November 2020). This caused heavy rains, flooding, deaths and devastation nationwide. The COVID and Dengue Observatory at UNITEC University and with the aid of international collaborators, an ArcGIS Online platform for COVID dashboards donated by Esri's Disaster Response Program was transformed into a story map to track hurricanes and to forecast flooding.<sup>(26)</sup>

In view of the many limitations, particularly in technology, Honduras should turn their eyes to new technological tools. These technologies will help develop real time maps available for data visualization and geographic information systems.<sup>(26)</sup>

1. The recovery phase is an artificially delimited concept. It is an integral part of ongoing developmental processes at all levels – national, regional, and local. Recurring lessons mostly point to accepted good development practice, albeit adapted to a recovery phase. Post-disaster recovery can rapidly feed into risk management, prevention, mitigation and preparedness activities, all core components of good development programs. Second, the avoidance of recurring problems.

2. existing local development plans should form a basis for recovery activities. Aims to bring about major socio-economic, cultural and political changes during a post-disaster recovery process are probably over-ambitious, given the fragility and weaknesses inherent to a post-disaster context. 3. Transparency and equity

3. Recovery aid should be provided in a fair, transparent, and balanced manner. This requires the inclusion of remote areas and vulnerable sectors where the impact of the disaster may not have been as visible or dramatic as in more accessible areas. Gender and ethnic equity should be assured. The public should be kept aware of recovery programs and their entitlements to assistance through public information campaigns. Risk management



4. A culture of risk and vulnerability reduction (prevention and mitigation) should be fomented at all levels, before, during, and after a disaster. This includes international, national, and community levels. Risk reduction requires awareness and action.
5. Training and information campaigns on risk reduction and management, utilizing appropriate communication technology, are examples of awareness-raising. Practical, technical training in risk and vulnerability analysis, and crucially how to conduct risk reduction, should be provided to all actors potentially involved in physical reconstruction programs, including key donor staff.
6. Action to reduce vulnerability, thus reducing the need for recovery, requires a complex mixture of socio-economic, political, cultural and material aspects, central to all developmental processes. Strengthening offices for emergency response or running sporadic risk management training courses are insufficient and piecemeal. Action may well be required which will affect vested interests in vulnerable societies. A strong political will is a key requirement for success.
7. Donors should make long-term commitments to developing the risk management capacity of countries.<sup>(4)</sup>


Current flood risk mapping from the US Federal Emergency Management Agency (FEMA) has not accounted for the effects of climate change. future flood mapping and flood mitigation planning account for the effects of SLR and TC climatology change. future flood mapping and flood mitigation planning account for the effects of SLR and TC climatology change.<sup>(21)</sup>

should be enhanced and the cartography of natural hazards must be improved, through proposed (ii) a morphogenetic mapping, and (iii) a hazard zonation mapping for landslides and floods for general river systems.<sup>(9)</sup>

Geomorphometry is a practical tool for disaster risk mitigation to determine susceptible floods and landslides areas. However, it requires a correction with the landforms to specify the areas to be affected from a more accurate mapping. These procedures can be baseline assessments for the territorial management of hydrographic catchments and political-administrative units at local and regional scales.<sup>(9)</sup>

#### International Aid and Lessons still to be Learned.

The Standing National Committee of the Office for Coordination of Humanitarian Affairs (OCHA) presented their follow up report on the 14<sup>th</sup> of April 2021. This report highlights the assistance of more than 600 thousand people, of which 13% are girls, 14% are boys, 38% are women, and 35% are men. The most affected areas in terms of housing were reported in 1) Cortés with a 24.8% of the total reported damaged homes, followed by Yoro (10.2%), Copan (8.7%), and others. The direct amount of people assisted due to the disaster raised to 417,000, of which nearly 2,000 still remain taking refuge in shelters in the Departments of Cortes and Santa Barbara. 2,225.94 Liters of water have been delivered to ensure access to clean a potable water. Investment in reconstruction has reached US\$52 million US dollars, which is




estimated to cover only 56% of the actual costs. After 5 months of the disaster most household experience lack of life resources, mud is still covering their homes, or these are found completely destroyed. Flooding is still a constant threat as the rivers lack the proper anti-flood infrastructure to maintain them in their course.<sup>(27)</sup>

UNICEF estimated more than 1,127 communities require still assistance, of which 417,000 people are still contemplated to need aid. Most of the temporal shelter have been deactivated and the population in need was sent anticipatedly back home to give way to the presidential and other governmental elections process. The most affected by these decisions are children, pregnant women, the elderly, and the handicap, as they require more assistance to their special needs. Special attention has been given to the migratory movements known as “Caravans”, which entail large groups of people, children under 5 years of age, and unaccompanied minors to look for a better life in the US. They adventure into unknown paths without proper equipment, resources, and expose themselves to sexual abuse, human trafficking, and others. The current situation after both natural disasters stroke the country might push people to opt for participating in these caravans and expose themselves to unnecessary danger.<sup>(28)</sup>

Different women activist organizations point out that the most affected population sectors are women, children and LGBTQ+ due to the effect of the COVID-19 Pandemic and both Tropical Storms Eta and Iota. These entail feminization of poverty, increase in gender violence, worse living conditions, and loss of productive life years due to unemployment, subemployment, and non-remunerated house work. Important to mention suspension of health services within the affected area, due to interruption of access and security, as are important justice and rights protection. Not to forget the precious COVID pandemic situation in the country with saturated hospitals, poor cooperation to suspend holidays, social distancing, electoral processes, and a late vaccination program for health care workers barely reaching a 53%.<sup>(27)</sup>

One of the most notable international participations during the recovery phase of this disaster was the aid provided by the Kingdom of Spain through a personal visit from her Majesty Queen Letizia Ortiz. During her two day visit she organized international aid organizations in Honduras to maximize efforts in helping the most needed after the disaster. The 120 thousand tons of aid delivered in shelter, consisted of 2,000 blanquettes, Tents, 332 Stoves, 7,800 drinkable water container, 3,500 Mosquito nets, 2,000 foldable beds, 24,000 rapid COVID test kits, along with other primary need essentials. Besides bringing essential goods, she destined to talk with the displaced families, women’s heads of family and children who had been affected and traumatized by the disaster.<sup>(29)</sup>

Hurricanes Eta and Iota affected Honduras and the Central American region in many ways, the aftermath of the problem may be review through different aspects. First many people were left in a hazardous Food Safety situation due to the loss of basic grains (rice and beans) in homes that depend solely on agriculturally due to flooding and torrential rains. Left not alone the tropical storms, the past year a drought was




responsible for the loss of basic grains and food, affecting 84.7 of homes. This increased the price of essential food products, but nevertheless also had an indirect impact on health services, bad water quality, interruption of agricultural activities, fishing and others. In terms of health, we can mention that there still remains a lack for provisional health services at the primary level of clinical care (prenatal care, pregnancy monthly controls, family planning) and second level health care (birth care, C-sections, surgical voluntary sterilization). Not to forget stocking of supplies for medical care in different health clinics in the context of emergencies is still deficient.<sup>(28)</sup>

Gender Violence of migrants from third countries have shown specific needs in women, which may also be applied to those affected by these natural events, looking at migration as their only choice. For which to it is important for NGOs and government offices to provide correct migratory information in different languages, access to health and reproductive health, create shelters capable of attending sexual violence victims, safe spaces for women and girls, promote good mental health culture. Child Protection should be ensured by strengthening the different child protection mechanisms that identify vulnerable cases in minors. Special emphasis should be paid in shelter settings to provide protection to minors victims of abuse and provide service for family reunification. Shelters should guarantee safe spaces for children, promote a sense of protection in children, and access to integral services. These to guarantee the good being and dignity of the minors. Authorities should also be sensitized towards the risks children face when left unaccompanied during an emergency, as well as creating a sense of community and citizenship towards the adequate care of children.<sup>(28)</sup>

Shelters require adequate medical care assistance, medication and treatment for chronic diseases and specialized attention care for people with disabilities. During the current COVID-19 pandemic it has become indispensable to count with shelters that provide face masks and gel alcohol to diminish the risk of infections. Promote community talks to share information on COVID and install a proper security protocol for disposal of masks and plastic waste. Emergency information resources should be used to help identify lost relatives, and missing people after a disaster. Additionally, technological resources should be made available through phones and social media apps to ensure a faster recovery of the community and displaced people. Use of technology to the most affected can provide job resources and opportunities for individuals and families to become independent and go back to a normal life as soon as possible.<sup>(27)</sup>

Finally, we can mention water and hygiene, as the affected areas from the tropical storms Eta and Iota continue to use improvised shelters and have limited access to adequate life lines. This is an indicator of need for humanitarian assistance to families in process of returning to their normal life and homes. Progressive closure of shelters is a positive indicator of recovery, but is not reliable to account for bad water conditions back home or poor hygiene. It is also vital to ensure the access to water for human use that can cope with quality, quantity, and continuity. All these efforts



should be accompanied with the priority to avoid new infections from COVID-19 and follow all the biosecurity protocols as well as good practices of both COVID-19 and water born disease.

## 7. Conclusions


It is impossible to dream of a country that will be prepared for the worse disaster, nonetheless we are only able to be prepared to confront any circumstance that a disaster might bring forth. In the case of Honduras, we observe a lot of deficiencies in terms of Disaster Risk Preparedness, Vulnerability reduction, and actions to mitigate after a disaster has occurred. Hurricanes Eta and Iota are not the first hurricanes to cause so much damage and flooding in the country. It is a pity that the government system does not learn from previous experiences in order to prepare for a next event. There weaknesses are seen in the current relief strategies missing in the disaster relief plan.

We can summarize some of the major experiences of Eta and Iota, and state that the Government must make every effort to educate the population in disaster risk reduction, along with providing them with the resources and tools needed through a National Plan of Disaster Relief. The population has to contribute in following proper disaster safety behaviors, as is to avoid exposing themselves to danger when a threat has been warned, or when danger is imminent. The current situation in Honduras contributed to a failed disaster relief response, as the country was already submerged into a COVID Pandemic which consumed most of the resources for disaster relief. Honduras needs to update its disaster preparedness protocols and adapt them to multicausality disasters as were the events lived with COVID and a double hurricane thereat.

In terms of the accomplishments on disaster management, protocols already established have to be respected and followed to ensure the safety of the population and a proper return to normality after the disasters. Lessons learned from previous Hurricane Mitch point out that little has been done since 1998, and that more serious commitment from all sectors of society and Government have to take part in contributing to a safer society. Pre disaster preparedness and proper finance may help reduce the number of casualties and reduce the mortality, which is currently one of the highest in the central American region. Investment in technological devices may help warn and give enough time for preparedness before a casualty strikes.

We can also mention that it is necessary to ensure the correct infrastructure is constructed according to the needs, that land is destined to more suitable and sustainable means of production, with low impact to climate change. Honduras would benefit from applying recommendations on update of shelters, making disaster relief programs more inclusive, and oriented to reduce poverty. Let's not forget discrimination, sexual harassment, violence and child abuse are commonly reported in shelters and within people with high vulnerability. Thinking of post disaster relief is also lacking in the country, as shelters may be closed early and seen as a positive marker of recovery. More has to be put into thought, especially on the conditions in





which people will return to their homes, have access to basic need and ensure food security.


Finally, not all has to be criticized independent of the wrong actions or decision taken during a time of much national stress. The help and contribution of foreign aid, and the different stakeholders that look towards reducing suffering and loss. The numerous contributions and solidarities of the Honduran and International society have to be reinforced and make available when needed. Maybe many lessons from Hurricane Mitch have been forgotten after 20 years, but the bonds of brotherhood and principles of humanity have to acknowledged and promoted to future generations. Along with this Literature review, we hope that this information becomes helpful for future references.



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