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Supervisors: Dr. A. Akbari, Dr. G. Meershoek

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*Disaster Management of the Earthquake 2010 in Haiti: A Critical  
Analysis of the United States' and the European Unions'  
Development Politics*

Anna Höfer (s2828936)

## Abstract

Disaster management is becoming more important due to the increasing number of disasters and especially natural disasters caused by climate change. This thesis deals with the role of the United States and the European Union in the disaster management of the earthquake that struck Haiti in January 2010. The research question to be answered in this paper is the following: *What role did the European Union and the United States play in the different phases of disaster management of the earthquake 2010 in Haiti?* The involvement of the stakeholders in the phases “prediction”, “warning”, “emergency relief”, “rehabilitation”, and “reconstruction” is being investigated in this research. In the warning phase a special focus is put on Earthquake Early Warning Systems (EEW) and it is assessed how they work and if they have been in use before the earthquake 2010. The analysis of primary sources including documents of various US and EU agencies and institutions suggest that both actors show a high influence in the phase of emergency relief. Immediately after the earthquake, emergency relief including the provision of shelters, medication, food and sanitation was provided. However, the support was lacking in the proactive phase of disaster management when risks need to be mitigated and preparation for a disaster takes place. Additionally, the non-application of Early Warning Systems contributed to the high number of victims as timely evacuation was not possible. The analysis shows where development efforts of the EU and the US are lacking. Especially long-term, sustainable development efforts and approaches to building government capacities in Haiti are missing which are necessary to stabilize Haiti’s political and economic situation and make the country prepared for upcoming natural disasters.

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## List of Abbreviations

AWS	Cloud Computing Service of Amazon
EC	European Commission
EIB	European Investment Bank
et al.	Et alia (and others)
etc.	Et cetera
EU	European Union
EUR	Euro
FEMA	Federal Emergency Management Agency
GDP	Gross domestic product
G7	Group of Seven
HDI	Human Development Index
IDA	International Development Association
IDB	Inter-American Development Bank
IMF	International Monetary Fund
IO	International Organisation
JFT-H	Joint Task Force Haiti
n.d.	No date
NGO	Non-governmental organisations
ODA	Official development assistance
OECD	Organization for Economic Co-operation and Development
OFDA	Office of US Foreign Disaster Assistance
p.	Page
UN	United Nations
UNDP	United Nations Development Programme
UNOCHA	UN Office for the Coordination of Humanitarian Affairs
US	United States
USAID	United States Agency for International Development
USD	US Dollar

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# 1. Introduction

Haiti is a country located in the Caribbean and is currently facing a deep crisis as violent civil unrest is increasing in the aftermath of the assassination of Haiti's president Jovenel Moïse in July 2021 (United Nations, 2022a). The capital has been mostly taken over by “heavily armed violent gangs” (United Nations, 2022a) ever since. Other factors contributing to the current crisis are the high number of Haitians with acute hunger and in need of humanitarian assistance which is almost half of the country's 12 million residents (United Nations, 2022a). The country is also experiencing inflation and an economic decline with a negative GDP growth rate of minus 1.7% in 2022 (International Monetary Fund, 2023).

Haiti is highly affected by climate change which is leading to an increase in the number and intensity of natural disasters. This, in turn, is resulting in higher economic losses and costs for the countries affected (Coronese et al., 2019).

Due to their geographical location, developing countries in southeast Asia, Africa, Latin America and the Caribbean are increasingly affected by natural disasters. However, natural disaster management and reconstruction are highly dependent on a country's financial means and resources (Otero & Martí, n.d.). Many developing countries do not have the resources needed for effective disaster management, thus international support from international organisations, third countries, or Non-governmental organisations (NGOs) is often assumed necessary. Haiti is the poorest country in Latin America and has a high risk and vulnerability towards natural disasters and a high lack of coping and adaptation capacity, according to the 2022 World Risk Index (DesRoches et al., 2011, Atwii, 2022). Haiti is dependent on development aid from foreign countries which often direct their aid to local NGOs in Haiti. Foreign aid contributed 30-40 % of Haiti's budget in 2011, when the country's foreign debt was at 1.3 billion USD (Yates, Paquette, 2011).

The earthquake on the 12<sup>th</sup> of January 2010 was one of the most devastating natural disasters in recent history and hit Haiti as well as the Dominican Republic. The earthquake has contributed to Haiti's current crisis as its overall damages and losses were estimated to be between 7 and 14 billion USD which is expected to be between 100 and 200 % of Haiti's gross domestic product during that time (DesRoches et al., 2011). The earthquake registered a 7.0 on the Richter scale, which is a quantitative measure of an earthquake's magnitude. Most severely affected was the Western third part of the island, where Haiti is located. The epicentre of the earthquake was located just 25 km southwest of Port-au-Prince, Haiti's capital, which experienced a massive influx of inhabitants in the years before the earthquake, leading to 24 % of the Haitian population (about 2.6 million) living in the Port-au-Prince metropolitan area (D'Aoust et al., 2022). It is estimated that the earthquake and its aftermath killed

more than 230000 people, injured more than 300000 and left 1.3 million Haitians homeless (US Department of State, 2011a; DesRoches et al., 2011). Additionally, 80 % of the Haitian civil service and 101 UN senior employees have been killed in the earthquake. Inadequate infrastructure, the lack of building codes, an unreliable electronic power system, and the general unpreparedness contributed to the high number of victims (Pallardy, 2023). Not only human lives were destroyed, but also physical infrastructure was damaged. About 115000 houses were destroyed and more than 180 government buildings, 1300 schools and 50 health centres collapsed. The earthquake also destroyed the main port of Haiti, parts of its only international airport in Port-au-Prince and important administrative documents such as land and civil registries, voter rolls and tax documents. Due to blocked roads, the damaged port and airport as well as unreliable communication lines, aid reached Haiti only sporadically (Pallardy, 2013; US Department of State, 2011a).

As the costs of rehabilitation far exceed Haiti's economic and organisational capacities, the involvement of international actors was necessary. Haiti has been dependent on development aid before the earthquake and the dependencies were only strengthened in its aftermath. Many of Haitian-based NGOs, international organisations such as the UN, many of its sub-organisations and numerous states such as the USA, Canada as well as the EU and its member states participated in emergency relief and reconstruction. The World Bank, the International Monetary Fund (IMF), the G7 and the American Development Bank (IDB) cancelled most of Haiti's debt so that the country can use that money for recovery (Pallardy, 2023). The US spent 5.1 billion USD for post-disaster relief, long-term recovery, reconstruction and development and the EU allocated 100 million EUR for emergency assistance covering basic needs such as food, water, sanitation systems, shelter, and health care (Pallardy, 2023; The White House, 2021; European Commission, 2013).

This thesis has a special focus on the European Union and the United States, which is why the thesis seeks to answer the following research question:

*What role did the European Union, and the United States play in the different phases of disaster management of the earthquake 2010 in Haiti?*

To answer this research question, first of all an overview over Haiti's history will be given to understand the country's current situation. It will be explained why Haiti is so dependent on foreign aid. In the theory section the argumentation of post-development theories will be summarised to be able to engage critically with the concept of development aid at a later stage. Furthermore, a technological background will be given by explaining the concepts of Earthquake Early Warning Systems (EEWs) and their role for timely evacuation. Different EEWs will be explained. The common theme of this thesis are the different phases of disaster management. The five different phases "prediction", "warning", "emergency relief", "rehabilitation", and "reconstruction" will therefore be explained. The influence



the United States and the European Union have had on Haiti will be analysed in order to investigate their role in each of the five phases of disaster management. In the “warning” phase a special focus will be put on EEWs and their role before and after the earthquake. Therefore, the question: *What role do earthquake early warning systems play in warning phase of disaster management? And what impact did the (non) application of disaster warning systems have on the devastating effects of the earthquake?*

In the discussion the challenges the two stakeholders had to face during disaster management will be analysed and their role will be critically evaluated with the theoretical background of post-development theories.

The management of disasters is playing an increasingly important role and is also increasingly being addressed in the scientific community. However, this thesis adds to this state of the art of the literature on disaster management by making use of a new approach by connecting phases of disaster management with a stakeholder analysis. Many authors either put a focus on general failures in disaster management or analyse the role of specific actors such as the US or NGOs when investigating the earthquake in Haiti (Piotrowski, 2010; Pierre-Louis, 2011; Svistova et al., 2018). In this thesis, however, efforts as well as challenges the stakeholders had to face during different phases of disaster management will be analysed and their involvement will be critically evaluated to give recommendations for more efficient disaster management in the future.

# 1. Background Haiti

## 2.1 Historical overview

In the following an overview over Haiti’s history will be given to explain how various historical events have contributed to Haiti’s current economic and political crisis and lack of coping mechanisms for natural disaster management.

Haiti comprises a history of foreign occupation. Haiti was firstly evaded by Christopher Columbus in 1492, causing the Spanish enslaving the indigenous people of Haiti. French pirates entered the island in the mid-16th century, and landowners began importing African slaves (MacLeod et al., 2023). The western part of the island that comprises present day Haiti was ceded from Spain to France in 1697 and named Saint-Domingue. Saint-Domingue became France’s most prosperous and profitable colony, especially because of the huge export of sugar, coffee, cocoa, and cotton. In the 18th century the majority of the population consisted of African slaves who started a slave revolution because of their dissatisfaction with the discrimination they faced under the French colonialists. The country finally gained independence in 1804, which was recognized by France in 1825 under the condition that Haiti pays USD 22 billion as compensation for lost property to France until 1887. This payment caused an

economic downfall of the country in the following years. The US intervened in Haiti for the first time in 1890 and its marines finally occupied the country from 1915-1934, when the US dominated Haiti financially and politically. In 1957 Francois Duvalier was elected as president and established a de-facto police state during his presidency causing international isolation, a decline in tourism and withdrawal of US aid. The first free election in Haiti took place in 1990 when Jean-Bertrand Aristide was elected as president. However, after only eight months in office, Raoul Cédras deposed Aristide and in 1994 US troops began occupying the country once again as the government stepped down. In 2001 Aristide returned to power causing international aid sanctions, a general economic downfall, and rising violence. Therefore, Aristide fled the country again in 2004 which caused violent protests and conflicts. To address these conflicts and stabilize the situation US forces were sent to Port-au-Prince by the UN security council. In the following years, political instability continued to increase due to rising prices, protests, discontent and lack of governmental leadership after Hurricanes reached Haiti in 2008 and displaced hundreds of thousands (MacLeod et al., 2023).

## 2.2 Consequences for Economic and Political State today

As can be seen from looking at Haiti's past, foreign occupation of the country, political instability and economic decline go hand in hand. This was the case for the first time as a result of the French occupation from 1697 until 1804. Because Haiti had to pay 20 billion US dollars to France as a compensatory payment for its independence, the country became so heavily indebted that it could not recover the state of prosperity it had enjoyed during the French occupation. US occupations in the 20<sup>th</sup> century were accompanied by forced labour, violence and control over Haiti's finances (MacLeod et al., 2023). Following dictatorships for instance of the former president Duvalier caused indebtedness and international political isolation which has contributed to Haiti's weak economic and political state today. Nowadays, Haiti is often called the "poorest country in the Western Hemisphere" (Méheut & Gebrekidan, 2021; Labrador & Roy, 2022). In 2010 it ranked 145 out of 169 in the HDI, which is the lowest rank in Latin America and the Caribbean (United Nations Development Programme, 2010). The HDI measures key dimension of human development, which are, according to the UN: "a long and healthy life, being knowledgeable and having a decent standard of living. "(United Nations Development Programme, 2023). Haiti's GDP in 2010 was 3.95 in thousand USD per capita, compared to a GDP of 5.69 in thousand USD per capita of its neighbouring country, the Dominican Republic (International Monetary Fund, 2023).

## 2.3 Dependency on Development aid

Due to its weak economic state, Haiti is highly dependent on international development aid. According to the Organisation for Economic Co-operation and Development (OECD), the Net official

development assistance (ODA) from all donors to Haiti has risen steadily before the earthquake 2010, from 2002 until 2008 (OECD, 2023a). In 2002 the ODA was around 200 million USD, while in 2008 it amounted to around 870 million USD. Most of the development assistance went into development aid from 2005 until 2008 followed by peacekeeping and finally humanitarian aid. The top ten donors of ODA from 2007 until 2008 where, from first to last, the US, Canada, the IDB Spanish Fund, the European Commission (EC), France, the International Development Association (IDA), the IMF, Spain, the Global Fund and Italy (OECD, 2023a)

## 2. Theory

### 3.1 (Post)-development

The main development and post-development concepts will be described in the following to get a deeper insight into Haiti's dependency on foreign development aid and to engage critically with this dependency at a later stage.

In the time after the second World War the term "development" and its concepts, mechanisms, and institutions emerged. Especially the US, under the newly elected president Harry Truman, used the term development to differentiate between the developed and underdeveloped respectively rich and poor areas of the world, or between the first world and the third world (Harry S. Truman Library & Museum, 2023). In his inauguration speech Truman introduced a "Point four program" the US would follow in the years of his presidency. The fourth point deals with how the US can "embark on a bold new program for making the benefits of [their] scientific advances and industrial progress available for the improvement and growth of underdeveloped areas" (C-SPAN, 2009). Truman's point of view was that greater production is the key to prosperity and peace and that democracy could solve issues such as hunger, misery, and despair in the "third world".

Post-development arose in the 1990s from a poststructuralist and postcolonial critique of development (Escobar, 2012). Escobar, who is one of the most famous representors of post-development theories, makes use of a macro sociological approach to post-development theories and argues that "the discourse and strategy of development produced [...] massive underdevelopment and impoverishment, untold exploitation and oppression" (Escobar, 2012, p.4). Therefore, all the efforts taken after the second world war, with the establishment of international organisations and agreements did not achieve what they were supposed to achieve: prosperity and peace in underdeveloped areas of the world. In Escobar's opinion it caused rather the opposite: the debt crisis, increasing poverty, malnutrition, violence and the Sahelian famine all lead back to development efforts taken by the Global North. The main aims of post development are to decentralise development, which means to displace it from discussion and representation and to deal with alternatives to development (Escobar, 2012).

Next to Escobar, multiple other authors have engaged with development theories and development aid and have come to different solutions. Dourcouliagos and Paldam (2009) in their study find that “After 40 years of development aid, the preponderance of the evidence indicates that aid has not been effective”. (p. 443). Nowak-Lehmann et al. investigated the relationship between aid and per capita income and found an insignificant or minus negative significant effect of aid on per capita income. Aid can also have negative effects on institutions, rule of law, accountability and can lead to corruption according to Bräutigam and Knack (2004). However, some studies find a positive effect of foreign aid on the economies of receiving countries. Juselius, Framroze-Moller and Tarp (2013) find support for a positive long-run impact of foreign aid on the macroeconomy in 36 sub-Saharan African countries. Arndt, Jones and Tarp (2015) underline the long run nature of aid-financed investments and state that there are no reasons justifying a negative effect of aid on productivity.

Theories that illustrate alternatives to development are for example market-based approaches including modernisation, neoclassical theories and neoliberalism, state-based approaches such as structural and neo-marxist theories and approaches including grassroots and alternative development (McGregor, 2009). In contrast, community-based approaches, postcolonial and feminist theories or an ethnography-oriented approach as part of post-development neglect the whole idea of development and its concept of Western supremacy and power (Schöneberg et al., 2022).

### 3.2 Definition Crisis & Disaster

After explaining different concepts of development, as a next step the focus lies on disaster management. Before proceeding to the explanation of phases of disaster management, first of all, it needs to be clarified what can be understood as a disaster or a crisis. Christensen et al. define crises as “situations where there is a serious threat to the basic structures or fundamental values and norms of a system and where critical decisions have to be made quickly under highly uncertain circumstances” (Christensen et al., 2016, p. 321). A crisis “may be managed to avoid or minimize the threat” (Boin & Bynander, 2015, p. 124). A disaster, however, requires improvised organisations and responses cannot be planned well. A disaster is an already materialised threat. The Emergency Disasters Database (2006) defines disasters as technological or natural disasters (Below, 2006). According to the database to be classified as a disaster some conditions need to be fulfilled, which are the following: at least 10 people must be reportedly killed and/or 100 must be affected and/or there must be a call for international assistance or a declaration of a state of emergency (Below, 2006). The earthquake in Haiti can therefore be categorised as a natural disaster because of the severity of the damage, the huge number of people killed, and because there was a call for international assistance.

### 3.3 Phases of Disaster Management

In the following the five generic phases of disaster management proposed by Lin-Moe and Pathranarakul (2006) will be illustrated. The phases are the following:

- 1) Prediction
- 2) Warning
- 3) Emergency relief
- 4) Rehabilitation and
- 5) Reconstruction

In the first phase of *Prediction*, mitigation and preparedness are the essential activities. Structural measures to limit the impact of natural disasters as well as non-structural measures to respond to the impacts of the disaster effectively, for example by applying early warning systems and evacuating people in time, need to be taken. The second phase of *Warning* is mainly about “the provision of timely and effective information, through identified institutions [...]” (Lin-Moe & Pathranarakul, 2006, p.400) to alert and notify the public. *Emergency relief* is about providing assistance during or immediately after a disaster. The phase of *Rehabilitation* means taking actions to go back to pre-disaster living conditions while also taking actions to reduce disaster risks. Lastly, *Reconstruction* includes activities from all previous phases and is therefore about mitigation, preparedness, response and recovery. It is about mitigating risks and preparing for upcoming disasters which can be summarised under the term “proactive approach” while still responding to and recovering from the current disaster as a “reactive approach”.

## 3. Methods

### 4.1 Research Design / Description of the Case

The research design that has been chosen for this thesis is a single exploratory case study design. Case studies can explore “an event or phenomenon in depth and in its natural context” (Crowe et al. 2011, p.1). The case study is exploratory as the purpose is to receive new findings by connecting a stakeholder analysis with disaster management. Priya (2021) describes a case study as exploratory whenever the purpose of a case study is to “study a phenomenon with the intention of ‘exploring’ or identifying fresh research questions” (p. 96). To analyse how different stakeholders have an influence on Haiti in managing disasters the case that has been selected is the earthquake 2010 due to the following reasons:

1. The gravity and severity of the event
2. The involvement of multiple stakeholders

3. The status of Haiti as a developing country
4. The high vulnerability of Haiti towards natural disasters

The earthquake in Haiti reportedly killed 220000 people, left 330000 injured and in the aftermath of the earthquake about 1.5 million Haitians became homeless (United Nations, 2022b). According to Pallardy the number of victims would make the earthquake “one of the worst natural disasters in recorded history” (Pallardy, 2023). Moreover, many actors were involved in the disaster management of the earthquake. Among others, international organisations involved were the UN and its sub-organisation like UNICEF or the United Nations Development Programme (UNDP), the World Bank, the IMF, or NGOs like OXFAM or Food for the Poor. The Haitian government, but also the governments of several other states like the US or of many EU states, participated in managing the earthquake and can therefore be evaluated regarding their efforts in disaster management. Moreover, Haiti has been selected as it is an example of crisis management in a developing country. Haiti is the poorest country in Latin America and of the so described “western hemisphere” (The World Bank, 2023). According to the WorldRiskIndex of 2022, Haiti has a vulnerability towards natural disasters of 35.89 which is classified as a “very high” vulnerability (Atwii, 2022). Haiti also has a “very high” lack of adaptability towards disasters with a number of 69.73.

According to Stake (2000) these characteristics make the case study an “intrinsic” type of case study which means the case is a unique case of a crisis and of crisis management. However, this type of case study has a limitation, which is that it is difficult to generalise and put into broader context. This is also given by the fact that only one case is analysed and no collective case study is conducted to compare between cases. Nevertheless, this can be reasoned with the possibility of a more detailed and in depth-analysis and the limitations in word count and size of the paper.

#### 4.2 Data Collection

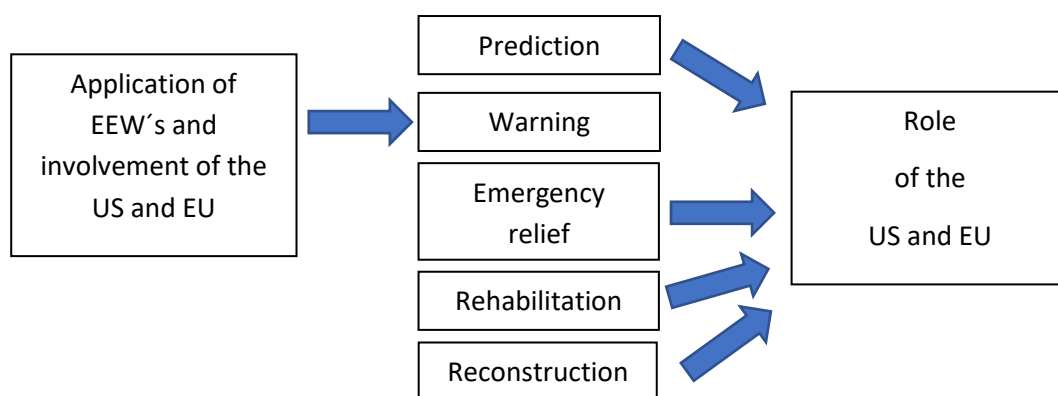
This study makes use of a Qualitative Content Analysis. For conducting the stakeholder analysis and analysing the involvement of the stakeholders in the phases of disaster management, sources that have been used were mainly primary. Policy and government documents of the US and EU have been collected. The documents that have been found include various stakeholders in both countries. For the US, Documents of the Congress and the Congressional Research Service, the Department of Homeland Security (DHS), the US Agency for International Development (USAID) and the US government have been collected for the analysis (US Congress, 2014, US Department of Homeland Security, 2010, USAID 2013, The White House 2010). EU Documents that have been collected include factsheets, reports, decisions, and resolutions from EU institutions (European Commission 2010a, 2010b, 2011, 2013). A detailed description of the Documents can be found in Tables A1 and A2 in the Appendix.

Databases that have been conducted to find relevant secondary literature such as scientific articles, journal articles or books for the Background, Theory and partly for the Analysis and Discussion are Google scholar, FindUT<sup>1</sup>, the online platform of the Universität Münster and Springer Link. Due to the usage of already conducted research of others, special focus was put on evaluating the quality of the sources. Therefore, different tools such as the Journal Citation Report, the Scimago Journal & Country Rank or the Eigenfactor rank and journal quality indicators established by Beaubien & Eckart (2014) have been used. The use of secondary sources can be justified by the fact that a lot of research has already been carried out on the topic of crisis management, and that the 2010 earthquake in Haiti was studied by many scientists from a wide range of disciplines due to its severity and extensive media coverage. However, the aim of this paper is to fill the research gap on analysing the influence of EEW's and different stakeholder on the disaster management.

#### 4.3 Data Analysis

Figure 1.

##### *Steps of the analysis*



*Note:* own representation to give an overview over the steps of the analysis.

Figure 1 shows the steps of the data analysis. To analyse the steps taken in each phase of disaster management, the role of the key stakeholders has been investigated, to see which impact they had in each of the phases described in the theory section. The “warning” Phase has a special focus on the usage of EEW systems. Their importance in earthquake preparedness has been described before conducting the analysis and is supposed to show if EEW was applied before the earthquake and if the stakeholders were in some way involved in the application for example by funding the application of technologies.

Before conducting the stakeholder analysis, Earthquake Early Warning Systems have been described. To investigate their application at a later stage, the five different systems “Front-Detection”, “P-wave”, “on-site or single-station warning”, “Regional Warning” and “Geodetic networks or GPS/GNSS

<sup>1</sup> FindUT is the digital platform for the Library of the University of Twente

networks” have been described to give a seismological<sup>2</sup> as well as technological background. Afterwards, to detect the US and the EU as key stakeholders, the methodology of Reed et al. (2009) has been used. They describe a methodology for conducting stakeholder analysis in natural resource management. However, this approach can also be transferred to disaster management as the methodological framework of identifying stakeholders and constructing an interest-influence matrix (see Appendix B) can be applied in the same manner. The authors define interest as “what constitutes a legitimate ‘stake’ in the affairs of other individuals or groups” (Reed et al., 2009, p. 1941). Influence is linked to power and in social psychology means the effect of a stakeholder on thoughts, behaviour and feelings of another person (Nelson; Quick, 1994). Reed et al. differentiate between Key players, Context Setters, Subjects and the Crowd. Key players have high interest in as well as high influence over the issue, while context setters have little interest but high influence meaning they pose a risk and according to Reed et al. (2009) should be monitored. Subjects on the other hand have high interest but low influence because they lack capacity for being influential, their opportunity to gain influence is by forming alliances. The Crowd has little interest as well as little influence on the issue. To conduct the stakeholder analysis, first of all, important international actors and their efforts in disaster management have been described. By applying the Interest-Influence matrix the EU and the US have been detected as key stakeholders. However, it is important to mention that this does not imply that they are the most important or the only key stakeholders. Nevertheless, the US and the EU are the biggest providers of development assistance and their influence worldwide and also in Haiti regarding the promotion of good governance, economic development and fighting hunger can be categorised as high (OECD, 2023b).

After identifying the US and the EU as key stakeholders, their role in the phases of disaster management has been analysed. The Software Atlas.ti Web has been used to get a first overview over their involvement. Atlas.ti is a software for qualitative data analysis and can be used for coding Interviews or literature (Atlas.ti Scientific Software Development GmbH, 2023). It has been used to search for the keywords “prediction”, “warning”, “emergency relief”, “rehabilitation” and “reconstruction” and according synonyms in the previously described documents to get an overview over the occurrence of each of the five phases and the context they have been used in. Additionally, the keywords “growth”, “development”, “sustainable/sustainability”, “long-term”, “preparedness”, “mitigation”, “governance”, and “democracy” have been searched for in the documents. The occurrences of each keyword can be found in Appendix C. It is important to mention, however, that differences in occurrences between the US and the EU can be explained by the different number of documents used for each stakeholder. For the US eight documents have been analysed and for the EU five. There is also variance in length of the documents which can contribute to very high or low numbers of keywords found. For example, for the

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<sup>2</sup> Seismology is the study of earthquakes and of the propagation of seismic waves within the earth (Britannic, 2021)



European Commission decision 2010, only one code could be generated while for the document about disaster preparedness and mitigation nine codes, with accordingly high frequencies could be detected (European Commission, 2010; USAID, 2009).<sup>3</sup> The results should therefore serve as a support for the argumentation, but the documents are analysed not only based on those results but also independently from them.

## 5. Earthquake Early Warning

In the following, different methods of earthquake early warning (EEW) will be described to then investigate which of these, if any, have been in use before the Haiti earthquake. EEW's "have the potential to provide warning prior to significant ground shaking" (Allen et al., 2009, p. 682). EEW's can issue an alarm to provide for timely evacuation and shutting down of key facilities, but they are not supposed to provide exact earthquake parameters. Nakamura & Saita (2007) provide 6 characteristics to measure the quality of EEW's. According to the authors, EEW's need to be fully automated, quick and reliable, small and cheap, independent, easy to connect network and accurate.

One of the first EEW systems developed in the history of EEW is *Front Detection*. Front Detection works by detecting ground shaking at one location close to the earthquake's epicenter and then transmitting a warning to another location ahead of the seismic energy. Some metropolises like Istanbul and Mexico City make use of Front Detection. In Istanbul ground shaking at the Marmara Sea can be detected and then a warning can be transmitted to the city. In Mexico-City instruments along the coast can detect earthquakes and transmit warning 320 km to the city (Allen et al., 2009).

Another mechanism of EEW is using the *P-wave*. Compressional (P) waves as well as transverse (S) waves spread outward from the epicentre of any earthquake. P-waves travel faster than S-waves and EEW systems like ShakeAlert place sensors in the landscape so that P-waves trip these sensors and transmit data to ShakeAlert (US Government Geological Survey, 2023). ShakeAlert can then analyse the data and illustrate the location, estimate shaking and size of the earthquake. ShakeAlert Partners can then produce an alert and notify people. Allen et al. (2009) argue that using the P-wave can increase warning time everywhere, reduce the radius of blind-zones, and provide warning at the epicenter.

According to Spallarossa et al. (2019) *on-site- or single-station warning* is "one of the most modern and technological response of society to seismic risk [...]" (p. 919). On-site warning delivers real-time alert messages, including information of S-waves ground shaking at one station predicted by measurements of P-waves at the same station. Compared to front detection, which uses one or more front stations between the seismic source and a populated city, on-site warning uses only one station

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<sup>3</sup> The keywords "preparedness" and "mitigation" alone make up for overall 54 quotations in this document.

and can therefore issue alerts faster than front detection, which can take up to 60 seconds, for instance to estimate an earthquake in Mexico City with the epicenter being at the Pacific coast (about 300 km away from the city) (Hoshiya, 2013). In on-site warning, the time difference between the early P-waves and the following S-waves can be measured to take actions to mitigate seismic risks. UrEDAS (Urgent Earthquake Detection and Alarm System) is an on-site warning system consisting of one station and three component seismometers<sup>4</sup>. It can estimate the damage potential of an earthquake by relating the magnitude, depth and epicentral distance of an earthquake within three seconds after the P-wave detection and can issue an alarm to the areas affected (Saita & Nakamura, 2003).

Another important EEW mechanism is *Regional Warning*. Regional warning uses seismic networks and includes components of Front Detection, the usage of P-waves and on-site processing (Allen et al., 2009). Seismic station networks are installed in expected epicentral or high seismicity areas. They shall report information for 1) detecting the earthquake, 2) estimating the location of the earthquake, and 3) estimating the magnitude of the earthquake. After collecting that information, the parameter of step 2 and 3 are used to “predict ground shaking at target sites located further away from the fault rupture (Step 4). According to Cremen, Galasso and Zuccolo (2022) regional EEW systems are currently operating in nine countries (including Japan, Mexico and the US) and have been tested in further 13.

*Geodetic networks* or *GPS/GNSS networks* can provide information about size of an earthquake, direction and amount of the shaking (Rowan, 2017). While seismic networks making use of the P-wave-based method are effective at detecting small and moderate earthquakes (magnitude < 7) they are not very efficient in rapidly and accurately detecting large earthquakes (Allen et al., 2009). Real time constraint provided by GPS networks could detect these larger earthquakes more efficiently. Many geodetic networks estimate source location and magnitude of the earthquake to then predict ground shaking strength by relating ground motion with distance (Hoshiya, 2013). Japan’s nationwide EEW system makes use of the network approach by applying more than 1100 station to detect seismic signals.

## 6. Analysis

### 6.1 International Response to the Earthquake

As it has been explained before, Haiti has undergone a history of foreign occupation and political instability. The country is highly dependent on foreign aid due to its weak economic state making it unable to deal with natural disasters alone. Thus, a huge number of different countries, international organisations and NGO’s was involved in the management of the earthquake. To detect the key

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<sup>4</sup> Seismometers can “detect and measure earthquakes by converting vibrations due to seismic waves into electrical signals [...]” (British Geological Survey, 2023)

stakeholders the interest influence matrix of Reed et al. (2009) is applied in the following (see Appendix B). The US with 231 million USD is by far the largest provider of development assistance to Haiti in the years 2007 and 2008 (OECD, 2023a). This is also the case for post-earthquake relief as the US provided 5.1 billion USD in assistance. Other important actors involved in the disaster management were the World Bank, the UN, the Red Cross, the EU and several NGOs. UN agencies such as the UN Office for the Coordination of Humanitarian Affairs (UNOCHA) coordinated search and rescue teams and UNICEF identified and reunited children with their families (OCHA, 2010, UNICEF, 2020). The World Bank was involved in a Disaster Risk Management and Reconstruction Project for supporting disaster response capacity and enhancing resilience of critical transport infrastructure (The World Bank, 2021). The World Bank financed the project with 60 million USD. The World Bank together with the IMF, the G7 and the American development bank also managed to cancel most of Haiti's debt, so that that money could be used for recovery (Pallardy, 2023). As a direct response to the earthquake, the EU allocated 100 million EUR for emergency assistance which covered basic needs like food, water, sanitation systems, basic shelter, and health care (European Commission, 2013). From 2010 until 2013 the EU also spent 213 million EUR for humanitarian assistance especially focusing on providing permanent housing for people still living in camps. The Red Cross and especially the American Red Cross contributed to emergency assistance by helping Haiti with 490 million USD received as donations in multiple areas like emergency relief, shelter, cholera prevention, health, and many more (American Red Cross, 2020). Other examples of NGO's that pledged support in response to the earthquake are Oxfam International which established "programs on reconstruction and growth in urban, suburban and rural areas [...]" (OXFAM, 2023) or Food for the Poor that states that it "has sent more than \$100 million worth of aid to Haiti, since the 7.0 magnitude earthquake devastated the country on Jan. 12." (Food for the Poor, 2010).

#### 6.1.1 Detection of the US as a key stakeholder

According to the White House the "United States has made available over 5.1 billion USD for assistance to Haiti to support life-saving post-disaster relief as well as longer-term recovery, reconstruction, and development programs" (The White House, 2021). The US' influence on Haiti has been strong throughout the history. The United States occupied Haiti twice in the 20th century, for the first time from 1915 until 1934 and for the second time from 1994 until 1997. The US intervened with the purpose to establish democracy and peace as they feared that otherwise Haiti would move closer to the Soviet Union and their political- and value system (Crawford-Roberts, 2023). However, the interest in Haiti was not only politically motivated. The US made use of their invasion to Haiti by increasing their export to the country which caused a socioeconomic decline in the country (MacLeod et al., 2023). The US' interest as well as influence can therefore be categorised as "high" according to Reed et al. which makes them a key player and is another reason for their significant influence in disaster management.

### 6.1.2 Detection of the EU as a key stakeholder

Another influential stakeholder in the disaster management was the EU. European countries are linked to Haiti by a long history of colonial occupation. The Spanish arrived in Haiti in 1492 and the French in the mid 16<sup>th</sup> century. On the one hand, France had a huge influence on Haiti's prosperity in the 16<sup>th</sup> century by bringing African slaves to the country that worked in agriculture and therefore contributed to Haiti's high exports in cotton, cocoa, and coffee (MacLeod et al., 2023). On the other hand, France contributed to Haiti's economic decline by making Haiti's recognition as an independent state conditional on a large compensation payment, which left Haiti heavily in debt (MacLeod et al., 2023). Today, the European Union is one of Haiti's biggest donors of development aid. The EU describes its partnership with Haiti as having two components. The political component has the purpose "to enable the country to consolidate a democratic transition [...]" (Delegation of the European Union to Haiti, 2021). The development dimension aims to support NGOs, the Haitian state, and the civil society in achieving the Sustainable Development Goals. The key sectors of cooperation between the EU and Haiti are sustainable territorial development, infrastructures, and urban development and social, economic and governance (Delegation of the European Union to Haiti, 2021). From 2007 until 2008 the European Commission (EC) spent 103 million USD on average for development assistance in Haiti, which is less than half as much as the US. However, this only comprises the development assistance of the European Commission. The member states on their behalf make their own contribution in giving aid to Haiti, as development politics is a shared responsibility between the EC and the EU member states (Hergaden, 2023). Overall, the EU, as one of Haiti's largest providers of development aid has a strong influence on Haiti and its development. The interest in pursuing development policy in Haiti may be greater for the US due to its geographical proximity, but the EU is also pursuing development projects in Latin America and the Caribbean. On the one hand the EU wants to strengthen democracy in the countries there, on the other hand the EU wants to be part of the important market of resources including oil and agricultural products. The reestablishment of Haiti's agricultural prosperity could have benefits for the EU as the EU could increase their import from the country and therefore could create supply security at a time when agricultural crops are increasingly threatened by climate change (bpb, 2007). Interest as well as Influence of Haiti are therefore high, which also makes them a key player according to Reed et al. (2009).

### 6.2 Involvement of the US and EU in phases of disaster management

In the following the focus will lie on the United States and the European Union and their role in the different phases of disaster management. The results of the analysis are summarised in Tables 1 and 2. To get an overview over the role of the two actors an Atlas.ti analysis was conducted (see Appendix C). For the US, policy documents of the Congress and the Congressional Research Service, the Department

of Homeland Security (DHS), the US Agency for International Development (USAID) and the US government were analysed. USAID is an international development agency and has been detected as a key actor coordinating disaster management in Haiti. The agency played a significant role in the aftermath of the earthquake and was part of all phases of disaster management from prediction to reconstruction as the analysis has shown (USAID, 2023). The Federal Emergency Management Agency FEMA which is part of the Department of Homeland security is another actor playing an important role for disaster management. The agency is responsible for the preparation for, coordination during and response to a disaster. Normally the agency concentrates on disaster such as Hurricanes, or the Covid-19 pandemic in the US, but it also provided emergency relief after the earthquake in Haiti.

For the EU mainly Documents of the European Commission have been analysed. The European Commission is the international representation of the EU in development policy matters and in the negotiation of conventions on international development issues (European Commission, 2023). Its' department the Directorate-General for European Civil Protection and Humanitarian Aid Operations is responsible for overseas humanitarian aid and civil protection and was also active during the disaster management (European Civil Protection and Humanitarian Aid Operations, 2019)

The Atlas.ti analysis shows that for the phases of disaster management, the code "Reconstruction" was detected most often throughout the documents of both stakeholders. For the US the analysis shows an occurrence of 18, and for the EU of 28. The second-most used code for the US was "Emergency relief" with an occurrence of 15 and for the EU "Rehabilitation" with an occurrence of 12. Before taking a deeper look at the documents, the results suggest that the focus of both actors lies more on a reactive approach to disaster management. The phases following the disaster seem to receive more attention than the phases preparing for a disaster. "Prediction" and "Warning" and their synonyms occurred less often. However, as already mentioned the reason might be that mostly documents were used that were shortly published after the earthquake, which is why "prediction" and "warning" are also analysed separately.

Table 1.

*US involvement in phases of disaster management*

	Actors	Amount in USD & timeframe	Actions	Challenges
Prediction	<ul style="list-style-type: none"> <li>USAID</li> <li>OFDA</li> </ul>		<ul style="list-style-type: none"> <li>Training and technical assistance</li> <li>Comprehensive country strategy</li> <li>Deployment of regional advisor and local disaster risk management specialist</li> <li>Search and rescue training</li> </ul>	
Warning (after 2010)	<ul style="list-style-type: none"> <li>IDB</li> <li>USAID</li> </ul>	180.000 (143.000 by IDB Lab, 2021)	<ul style="list-style-type: none"> <li>Application of EEW network system as a multi-actor project after the earthquake</li> </ul>	<ul style="list-style-type: none"> <li>No warning systems before earthquake</li> <li>Missing of expertise</li> </ul>
Emergency relief	<ul style="list-style-type: none"> <li>FEMA</li> <li>Coast guards</li> <li>Rescue teams from city departments</li> <li>US Air Force</li> <li>US navy</li> </ul>	100 million (15/01/10)	<ul style="list-style-type: none"> <li>Urban Search and Rescue Task Forces</li> <li>Provision of transport and Marines</li> <li>Restoration of Port-au-Prince airport</li> <li>Reparation of infrastructure</li> <li>Provision of Health and Medical Professionals</li> <li>Emergency food assistance</li> <li>Provision of shelter materials</li> </ul>	<ul style="list-style-type: none"> <li>Dead UN officials</li> <li>Lack of leadership</li> <li>Destroyed infrastructure</li> </ul>
Rehabilitation	<ul style="list-style-type: none"> <li>USAID</li> </ul>		<ul style="list-style-type: none"> <li>Employment of Haitians in short-term jobs</li> <li>Removement of rubble</li> <li>Further provision of shelter</li> <li>Construction of semi-permanent classrooms</li> <li>Support of Interim Haiti Recovery Commission</li> </ul>	<ul style="list-style-type: none"> <li>Hygiene conditions</li> <li>Upcoming rainy season</li> <li>Much infrastructure still destroyed</li> <li>Orphans</li> </ul>
Reconstruction	<ul style="list-style-type: none"> <li>USAID</li> </ul>	2.3 billion (2010-2014)	<ul style="list-style-type: none"> <li>Construction of power plant and port</li> <li>Building permanent housing</li> <li>Support for creation of full-time employment</li> <li>Introduction of new technologies</li> <li>Support education</li> </ul>	<ul style="list-style-type: none"> <li>Insufficient planning of USAID</li> <li>Hurricane</li> <li>Cholera outbreak</li> <li>Corruption</li> <li>Unemployment</li> </ul>

*Note:* own representation that summarizes the results of the analysis

Table 2

*EU involvement in phases of disaster management*

	Actors	Amount in EUR & timeframe	Actions	Challenges
Prediction	<ul style="list-style-type: none"> <li>European Civil Protection and Humanitarian Aid Operations</li> </ul>	38 million for disaster preparedness programme) & additional 3.4 million for general preparedness (1998-2023)	<ul style="list-style-type: none"> <li>Disaster preparedness programme (Early warning, response capacities, shelter, water, hygiene)</li> </ul>	
Warning (after 2010)	<ul style="list-style-type: none"> <li>European Civil Protection and Humanitarian Aid Operations</li> </ul>		<ul style="list-style-type: none"> <li>Development of an Early Warning Systems toolkit together with other actors <u>after</u> the earthquake</li> </ul>	<ul style="list-style-type: none"> <li>No warning systems before earthquake</li> <li>Missing of expertise</li> </ul>
Emergency relief	<ul style="list-style-type: none"> <li>EC</li> <li>Member states</li> <li>Military</li> </ul>	320 million (22/03/10)	<ul style="list-style-type: none"> <li>Emergency food assistance</li> <li>Water &amp; sanitation</li> <li>Access to health care &amp; disease control</li> <li>Distribution non-food items</li> <li>Emergency telecommunication</li> <li>Military assistance</li> </ul>	<ul style="list-style-type: none"> <li>Dead UN officials</li> <li>Lack of leadership</li> <li>Destroyed infrastructure</li> </ul>
Rehabilitation	<ul style="list-style-type: none"> <li>EC</li> </ul>	100 million (22/03/10)	<ul style="list-style-type: none"> <li>Team of experts: reconstruction for government buildings, support for education &amp; governance, support for disaster preparedness mechanism</li> </ul>	<ul style="list-style-type: none"> <li>Hygiene conditions</li> <li>Upcoming rainy season</li> <li>Much infrastructure still destroyed</li> <li>Orphans</li> </ul>
Reconstruction	<ul style="list-style-type: none"> <li>EC</li> <li>Member states</li> <li>EIB</li> </ul>	1.235 billion (01/11)	<ul style="list-style-type: none"> <li>Infrastructure</li> <li>Water &amp; sanitation</li> <li>Individual projects of member states</li> </ul>	<ul style="list-style-type: none"> <li>Hurricane</li> <li>Cholera outbreak</li> <li>Corruption</li> <li>Unemployment</li> </ul>

*Note:* own representation that summarizes the results of the analysis

### 6.2.1 Prediction

The Phase of Prediction is mainly about mitigating risks and preparing for possible upcoming natural disasters (Lin-Moe & Pathranarakul, 2006).

USAID and the Office of US Foreign Disaster Assistance (OFDA) provided training and technical assistance to Haitians since 2006 in order to improve their ability to prepare for and respond to disasters (USAID, 2009). USAID and OFDA also created a comprehensive country strategy to coordinate the response to natural disasters that also involves early recovery projects. USAID and OFDA deployed a regional advisor and a local disaster risk management specialist to Haiti. These staff members have assessed disaster response needs and worked on programs focusing on education, justice, democracy, governance, the environment, food security, and humanitarian assistance. USAID and OFDA also provided search and rescue training to local disaster response personnel in major urban centres in Haiti. Moreover, USAID and OFDA have established a mechanism for requesting assets of the US Department of Defense should the UN, the Haitian Government, or the UN Stabilization Mission in Haiti (MINUSTAH) signal the need for support in disaster response. Together with the American Red Cross, Save the Children and the Pan American Development Foundation, USAID and OFDA also implemented community-based disaster risk reduction activities to make Haitian communities and Haitian children prepared for and resilient to disaster situations. From 2006 until 2008 USAID and OFDA preparedness and mitigation programs mainly focused on technical assistance and training for GoH officials, NGO staff and members of local communities. Technical assistance consisted of damage evaluation and needs analysis of equipment and materials (USAID, 2009).

Information on the EU's efforts in assisting Haiti preparing for and mitigating disaster risks is limited compared to information on emergency relief, rehabilitation and reconstruction. The European Civil Protection and Humanitarian Aid Operations states that from 1998 until 2023 the EU has invested 38 million EUR in a disaster preparedness programme which aims to establish Early Warning Systems and Rapid Response Capacities by strengthening shelters and infrastructure against natural disaster (European Commission, 2022).

### 6.2.2 Warning

Warning means the timely and effective distribution of necessary information to sufficiently prepare for an upcoming natural disaster.

Haiti has a high vulnerability towards earthquakes because of its location on the intersection of the North American and the Caribbean plates. The fault line between these two tectonic plates is called the Enriquillo-Plantain Garden fault zone. The two plates move laterally at a rate about a quarter of an inch a year (Fountain, 2021). Due to its high vulnerability towards earthquakes, EEW's are of great



importance to timely evacuate people, shut down facilities, and take measures to mitigate the damages before an earthquake occurs in Haiti.

However, many factors contributed to a general unpreparedness of Haiti for the earthquake 2010. On the one hand there are the socioeconomic factors like the lack of resources to invest in earthquake preparedness in the same manner as countries that are similarly vulnerable to earthquakes like Japan. On the other hand, missing expertise contributed to the earthquake having such devastating consequences. Haiti only had a few seismologists and no seismic network (DesRoches, 2011). The most recent geological map was from 1987 and was therefore missing important details. According to DesRoches et al. (2011) Haiti did neither have an earthquake preparedness program nor a university curriculum including studies such as seismic design, seismology or geosciences. Missing expertise for seismology also contributed to the lack of EEW systems prior to the earthquake. The research on the application of EEW's in Haiti showed that only recently there have been some developments in establishing EEW's in Haiti. However, no information could be found on EEW systems that have been in use before the earthquake 2010. The lack of EEW is therefore another factor that contributed to the huge number of victims after the earthquake, as timely and effective evacuation can save many lives. It is important to underline that the two following projects investigated to establish EEW's in Haiti were established after the earthquake 2010. No information could be found on the financing of EEW's of neither the US, nor the EU before the earthquake.

The Inter-American Development Bank (IDB)<sup>5</sup> together with the Private company Grillo which is specialised in seismic monitoring in developing nations, the telecom company Digicel and the Cloud Computing Service of Amazon (AWS) developed a seismic sensor network and cloud-based detection system for the south of Haiti in 2021 (IDB Lab 2021; Grillo, 2023). The construction of the original technology was funded partly by USAID. The IDB financed 80 % of the 180000 USD required for the pilot phase of the project. The EEW network system makes use of the technology of Geodetic networks described above. It works by firstly deploying a network of seismic sensors which are installed by Digicel then transmitting the data to AWS, analysing the seismic data with algorithms to then generate alerts which can be sent to authorities and the public once an earthquake event is detected. The IDB underlines the importance of such EEW's for mitigating loss of life and injury from earthquakes by alarming people seconds or minutes before shaking and therefore giving sufficient time to prepare. Grillo states that the project has already been successfully deployed in a magnitude 5.9 earthquake in 2018 (Grillo, 2023).

The Caribbean Disaster Emergency Management Agency, the International Federation for the Red Cross and Red Crescent Societies and the United National Development Programme launched an Early

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<sup>5</sup> The Inter-American Development Bank is an international financial institution owned by 48 member states, including the US and 12 EU member states financing development in Latin America and the Caribbean (IDB, 2023)

Warning Systems Toolkit in 2018 (reliefweb, 2018). The toolkit is an information resource for developing warnings systems for hydro-meteorological and coastal hazards. The goal of the project is to “strengthen disaster preparedness and risk reduction”. The project has been funded by the General Directorate of Civil Protection and Humanitarian Aid of the European Union.

### 6.2.3 Emergency Relief

The emergency relief phase begins immediately after a natural disaster happens. In this phase basic human needs, like water, shelter and medicines need to be provided to keep people alive. In a parallel effort the search and rescue phase for survivors takes place which can last for hours or days depending on the magnitude of the disaster (Crutchfield, 2013).

The US Federal Emergency Management Agency of the DHS activated eight Urban Search and Rescue task forces, which were, together with two task forces of USAID, responsible for 47 of 134 live rescues in Haiti (US Department of Homeland Security, 2010). Additionally, the US sent rescue teams from various cities, for example from LA county or Miami and coast guards to Haiti to pull survivors from the rubble. As of the 15<sup>th</sup> January 2010, the US has made available \$ 100 million for search-and-rescue teams, transport, planes, helicopters, and the arrival of marines. According to the US government, the focus in the immediate aftermath of the earthquake was on “response is search and rescue, logistics and infrastructure support, provision of assistance where possible, and conducting needs assessments” (Taft-Morales, Margesson, 2010, p. 6). During the emergency relief phase, the US Air Force restored flight operations of the Port-au-Prince airport, which was severely damaged due to the earthquake. The Coast Guard and the Navy repaired ports which made it possible to double the capacity from pre-earthquake standards according to the White House (2010). Regarding Health and Medical, Disaster Medical Assistance teams, Surgical Response teams, and US military, medical professionals treated patients and performed operations. Emergency food assistance could be provided to 2.9 million people with the help of US food aid contributions and the Joint task Force Haiti (JFT-H). The US government together with NGOs, the UN, and other organisations provided shelter materials to more than 1.5 million Haitians and the Defense Department distributed 68000 self-powered radios to Haitians so that they could receive information on emergency assistance (The White House, 2010).

The EU’s humanitarian assistance in emergency relief after the earthquake in Haiti amounted to over 320 million Euro, from which 201 million was spent by 18 member states of the EU and 120 million by the EC (European Commission, 2010a). Humanitarian aid was mainly channelled through NGOs, and International Organisation (European Commission, 2010b). The EC’s objectives immediately after the earthquake were to save and preserve lives and to provide multi-sector emergency assistance. Humanitarian aid according to the EC should be provided to people in need through NGOs, IOs and UN agencies. Components of the EU’s assistance in emergency relief were mainly emergency food

assistance, water and sanitation, access to primary health care and disease control, distribution of non-food items, emergency telecommunication and emergency rehabilitation of shelter and logistics (European Commission, 2010b). Moreover, the Haitian prime minister René Préval appealed to the EU for urgent military assistance. The EU followed his appeal and provided police units, helicopters, military personnel and military police, an engineering task force and an aircraft carrier, as well as a landing platform dock ship each with hospitals on board (European Commission, 2010a).

Challenges during the emergency relief phase included the death of multiple UN officials as a consequence of the earthquake and the lack of leadership of the Haitian government which caused uncertainty over who should take charge and made coordination between the actors difficult. Destroyed infrastructure including important roads, the airport, and ports complicated the arrival of emergency relief supplies (DesRoches, 2011).

#### 6.2.4 Rehabilitation

During Rehabilitation actions are taken to go back to pre-disaster living conditions while, at the same time, taking measures to reduce disaster risks. The phase can also be described as recovery because it bridges the gap between emergency assistance and reconstruction. In this phase “the affected population is in a more stable period of transition” (Crutchfield, 2013) meaning that people have a place to get food and water, a temporary home, and can go back to their daily lives.

USAID (2023) states that they contributed to Haiti’s recovery by employing more than 350000 people in the first year after the earthquake in short-term jobs which delivered \$ 19 million into the local economy. Furthermore, they contributed to recovery by removing rubble, providing shelter, constructing over 600 semi-permanent classrooms and supported the Interim Haiti Recovery Commission (USAID, 2023).<sup>6</sup>

For the EU the main concerns during rehabilitation were the hygiene conditions in the camps, the upcoming rainy season which made finding new transitional shelters an urgent issue and priority and the distribution of shelter and sanitation in general (European Commission, 2010a). Further challenges were the lack of the Haitian government to coordinate and critical roads that needed urgent repairs. Moreover, livelihoods needed to be restored by providing cash-for-work emergency activities to Haitians for example by removing rubbles, agricultural recovery was necessary to provide food and to help the economy to recover and the number of orphans that have risen from 380000 to 1 million following the earthquake and in need for shelter, food and education. The EC provided 100 million

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<sup>6</sup> The Interim Haiti Recovery Commission (IHRC) is a planning body for Haitian recovery. It was announced at the international donors conference “Towards a New Future for Haiti” in March 2010 (US Department of State, 2011b)

EUR for short-term recovery and rehabilitation and provided a joint team of experts that would propose reconstruction of government buildings, general support for education and governance, budget support, and strengthening disaster preparedness mechanisms (European Commission, 2010a). However, a report by the European Court of Auditors found out that out of seven projects for rehabilitation supported by the EC only two were implemented in the initial timeframe. The projects included urgent rehabilitation necessities such as the removal of rubble, the construction of shelters, the construction of water supply- and sanitation systems or the creation of a geographic information centre (European Court of Auditors, 2014). Reasons for the delayed implementation were the already explained challenges such as the cholera outbreak, hurricanes, and precarious security conditions.

### 6.2.5 Reconstruction

In the phase of reconstruction, a country is still recovering from the previous disaster while already mitigating risks and preparing for upcoming disasters. In this phase life is beginning to be stable again as permanent housing is being rebuilt, children are returning to school buildings, adults can go back to their jobs, and physical as well as social structures are being rebuilt (Crutchfield, 2013).

From 2010 until 2014 the US has made available 1.3 billion USD in humanitarian relief and 2.3 billion USD for recovery, reconstruction and development assistance (Taft-Morales, Margesson, 2010). The USAID reconstruction and recovery plan included plans to construct a power plant to provide electricity in Northern Haiti, the construction of a new port nearby, and the building of permanent housing in Port-au-Prince, St-Marc and Cap-Haitian areas (Taft-Morales, Margesson, 2010). USAID states that they supported the creation of full-time employment in key industrial sectors, introduced technologies, improved seeds, fertilizers, and irrigation to Haitian Farmers so that they can increase their yields and supported Health facilities. In the education sector USAID promoted a new model to improve early grade reading and writing in Creole and French. USAID worked with national government entities to improve legal frameworks and increase resources in municipalities. To address corruption, the agency provided assistance to the Superior Judicial Council and the Integrated Financial Management System to build connectivity between Haiti's expenditures and revenues.

However, the US and especially its agency USAID experienced massive challenges in the reconstruction phase. The port project in Northern Haiti in combination with the construction of the power plant was financed by USAID with \$ 170.3 million. However, the port construction was 2 years behind schedule and the funding to build the port was insufficient according to the US Government Accountability Office (2013). USAID lacked expertise in port planning in Haiti. Generally, cultural differences between the US and Haiti seem to have been underestimated. The Federal Emergency Management Agency (FEMA) task forces said that they encountered a range of challenges regarding foreign disaster deployment as they were not prepared for the cultural dimension (US Department of

Homeland Security, 2010). Furthermore, for the housing project supported by USAID, the number of houses to be built was decreased from 15000 to 2649 and the costs were increased from \$ 59 million to \$ 97 million. In the report, conducted by the Joint Task Force Haiti (JFT-H) the lack of responsiveness and effectiveness by USAID is reasoned by USAID's limited personnel, insufficient resources, bureaucratic hurdles, and diverse political agendas (DiOrio, 2010).

The EU's medium and long-term reconstruction efforts for Haiti comprised 1.235 billion EUR as of 10<sup>th</sup> January 2011, one year after the earthquake and provided for by the EC, 18 member states, and the European Investment Bank (European Commission, 2011). The focus of the reconstruction efforts was mainly put on reactive measures including infrastructure, water and sanitation, education, health, governance, agriculture, and rural development. Multiple EU member states contributed to Haiti's reconstruction. Spain for example provided water and sanitation in Port-au-Prince while France focussed on reconstructing the State University Hospital of Port-au-Prince. Germany financed the construction of the Hydropower Plant "peligre" which was established for energy generation (European Commission, 2011). Regarding proactive measures taken by the EU in the reconstruction phase the EU invested 3.4 million EUR in disaster preparedness for water, sanitation, hygiene, and drought and in response capacities and shelter techniques (European Civil Protection and Humanitarian Aid Operations, 2019). Similarly to the US, the EU also faced cultural challenges during reconstruction including the lack of country expertise and missing linguistic skills of the implementing partners. Therefore, a programme which was supposed to strengthen Haiti's disaster preparedness, financed by the EU with 14.5 million EUR was several delayed and could not fully adapt to local Haitian conditions (European Court of Auditors, 2014).

Again, there were some challenges the US and the EU faced during the reconstruction phase. Hurricane Tomas brought additional damage to Haiti in October 2010 worsening the cholera outbreak in the country (Ocasio et al., 2023). 10 months after the earthquake the first outbreak of cholera ever was confirmed in Haiti and caused nearly 10000 deaths. Poor water and sanitation conditions after the earthquake caused the outbreak and made reconstruction efforts even more difficult. Additionally, the US underlined that corruption, high unemployment rates, an unfavourable business climate and weak government capacities would make reconstruction even more difficult (US Congress, 2014). The EU calls the environment in which post-earthquake aid is needed to be delivered as "characterised by numerous logistical, infrastructure, social and political challenges" (European Commission, 2011, p.1). Many risk factors such as poor administrative capacities or low community participation hampered reconstruction efforts (European Court of Auditors, 2014). Therefore, for reconstruction to be efficient the US expects from the Haitian government to be transparent and to be committed to a market economy, rule of law and democracy (US Congress, 2014).

## 7. Discussion

After analysing the role of the EU and US as key international stakeholders in the disaster management of the earthquake, in the following their involvement will be critically discussed.

It can be summarised that the US as well as the EU had a huge influence on the disaster management in general. However, differences between their involvement in the different phases can be detected. Especially during emergency relief both stakeholders channelled a lot of development aid to Haiti.<sup>7</sup> Due to their contributions in rebuilding infrastructure including roads, ports and the capitals' airport, aid supplies could make their way to Haiti. Search and Rescue teams were able to pull out survivors of the rubble and shelters were built to provide those who lost their houses with a temporary home. This case study shows that the US and the EU focussed their assistance on the timeframe immediately after the earthquake. During emergency relief the stakeholders had a positive effect on the disaster management while during other phases their influence was either smaller or can be evaluated critically. In the phases of prediction and warning, both actors lack assistance. Compared to 320 million EUR spent for emergency relief, the EU only spent 38 million EUR for disaster preparedness programmes (European Commission, 2010a; European Commission, 2023) which is why the involvement of the EU in the Prediction phase can be described as insufficient. Disaster preparedness and mitigation as part of prediction are important elements in disaster management. When preparing effectively for natural disasters, numbers of victims are lower and assistance needed in all following phases is smaller. The same accounts for the application of EEW's during the warning phase of disaster management. For the earthquake 2010 no EEW's have been in use and therefore timely evacuation and shutting down of facilities was not possible leading to many trapped and dead people in the rubble. There were no seismologists and only one working seismometer. Since then, there have been some improvements. A network of volunteer citizen seismologists for instance analysed the seismic circumstances of the 2021 earthquake and could gain new insight about a new fault line near the Enriquillo Zone in Haiti (Gramling, 2021). The EU has financed the construction of a geographical research centre and the US and EU member states were part of the financing of the seismic network project described before. The EU additionally helped establish an Early Warning Systems toolkit (European Court of Auditors, 2014, IDB Lab, 2021, Grillo, 2022).

Moreover, extern circumstances and mistakes that have been made led to reconstruction difficulties. The cholera outbreak, another hurricane destroying infrastructure that has just been rebuilt, and violence amongst the population are some of the factors that hampered reconstruction efforts (Ocasio et al., 2023). Since the earthquake 2010 the economy could not recover. In 2011, GDP growth amounted to

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<sup>7</sup> The EU 320 million EUR, and the US \$100 million as of 15<sup>th</sup> January 2010

5.1 %, this changed in the following years and in 2014 the growth rate decreased to just 1.7 % (International Monetary Fund, 2023). Much of the aid promised by international stakeholders was not spent in the end and projects that were funded showed problems in implementation. The infrastructure and housing project established by USAID had to be reduced due to missing expertise and increase in costs (US Government Accountability Office, 2013). Additionally, most USAID contracts were given to non-Haitian companies even though supporting local companies would have had the opportunity to give Haitians jobs and would have contributed to economic growth in the country. Especially the US has put much emphasis on development, growth and long term-/sustainability efforts as the Atlas.ti analysis shows with a high occurrence of these terms (see Appendix C). However, the socioeconomic and political decline of Haiti after the earthquake suggests that development efforts taken by the US and EU in the aftermath of the earthquake have not been sustainable. They have made it possible to provide humanitarian aid immediately after the earthquake and helped the population temporarily recover through various measures such as providing for food, water, sanitation and medicine; however a long-term effect of the measures is not evident.

## 8. Conclusion

All in all, it can be said that both, intern as well as extern factors led to the earthquake having such devastating consequences including around 230000 victims. One factor that contributed to the high number of casualties was the geographical location of the epicentre near Haiti's largest city, Port-au-Prince. In addition, Haiti's unstable political situation and inadequate resources contributed to the country's unpreparedness for the earthquake. Lack of building codes, broken infrastructure, the absence of seismological experts and EEWs led to many buildings being destroyed and people buried underneath them, as timely evacuation was not possible.

To answer the research question *What role did the European Union and the United States play in different phases of the disaster management of the earthquake 2010 in Haiti?* it can be said, on the one hand, that the US and the EU contributed with numerous disaster relief measures to the rescue and care of people shortly after the earthquake, but on the other hand, both actors contributed to Haiti's unstable political and economic situation through their past occupation in the first place. France's colonial occupation in Haiti causing Haiti's indebtedness from which the country could not recover ever since and repeated military occupation and interference in Haiti's internal market of the US contributed to Haiti's weak governments lacking leadership and the country's socioeconomic decline making it unable to prepare accordingly for upcoming natural disasters. Therefore, the promise the US made and followed especially in the middle of the 19<sup>th</sup> century under president Truman to achieve growth, prosperity, peace and democracy in underdeveloped countries such as Haiti could not be fulfilled, even though these efforts were emphasised in the documents analysed for the evaluation of disaster

management as the Atlas.ti analysis shows with a high occurrence of the codes “Democracy”, “Growth” and “Development” (C-SPAN, 2009).

Another far-reaching problem in disaster management after the earthquake was the lack of coordination on the part of Haiti, whose government was already weakened by numerous political upheavals beforehand and then had to deal with the loss of important politicians, the destruction of government buildings, and therefore the loss of important documents needed for coordination. Thus, Haiti asked for international assistance shortly after the earthquake. The EU and the US have been detected as two of the key stakeholders that were present during the disaster management. The insights gained in the stakeholder analysis suggest that both actors should concentrate their development efforts more on proactive measures and on improving reconstruction efforts. The earthquake showed that the need for development aid can not be neglected, however the overall approach to development needs to be changed. A country so vulnerable to earthquakes and hurricanes due to its geographical location needs more investments in projects for EEW systems to reduce the number of victims for upcoming disasters. Moreover, preparedness as well as reconstruction investments should be focussed on local Haitian companies so that it can benefit the Haitian economy and should not only concentrate on the Port-au-Prince area. Alternative approaches to development already mentioned in the Theory section of post-development could therefore be grassroot-development or community-based approaches focussing on rural development. The Port-au-Prince metropolitan area is highly populated, and another earthquake would have devastating consequences for the 2.6 million inhabitants. Rural development is an important factor that could lead to the population being more distributed throughout the country causing decreased vulnerability towards natural disasters. Another measure could be to support Haiti’s government. Of the 1.8 billion USD for emergency relief that has been sent to Haiti as of July 2010, only 2.9 % was distributed to the Haitian government (DesRoches et al., 2011). The European Commission underlined that development relief should be distributed to NGOs and International Organisations which indicates that the Haitian government should not receive the money. The US also had “an explicit policy of funneling money away from the Haitian government” (Svistova, 2018, p. 35). The strategy of both stakeholders of channelling aid through NGOs instead of the government contributes to its lack of leadership and coordination and shows that efforts to build government capacities are low.

For future research it would be interesting to analyse what has changed since the earthquake 2010. Another deadly earthquake hit Haiti in 2021, and the country’s political and economic crisis has worsened since 2010. It would be interesting to analyse what contributed to this crisis and what role the European Union and the United States play today. It could be investigated how disaster management changed over a timeframe of 11 years. The effectiveness of EEWs could be evaluated more efficiently because much has changed in crisis warning systems ever since. It would also be interesting to see if and how the two EEW projects funded by the Inter-American Development Bank and the General



Directorate of Civil Protection and Humanitarian Aid of the European Union had an influence in preparing more efficiently for natural disasters in Haiti. Disaster management in Haiti is an important topic that needs further insights so that the country can deal with upcoming natural disaster more efficiently.

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## Appendix

### Appendix A

#### Primary sources used for the analysis

Table A1.

*US policy documents used for the analysis*

	Organisation	Type	Description
Assessing Progress in Haiti Act of 2014	US Congress	Act	Overview earthquake, plans for reconstruction
Earthquake Overview USAID	USAID	Overview	Description of relief, recovery and long-term assistance to Haiti
Haiti Earthquake Response Quick Look Report	FEMA	Report	Incident Overview, US&R Response, Additional Response and Support Topics, Evaluation of Response and Proposals for Improvement
Haiti Earthquake: Crisis and Response	Congressional Research Service	Report	Overview earthquake, Haitian Government Response, Humanitarian Relief Operation, US Response, International Response, Response of International Financial Institutions, Regional response, Implications for Haiti, Congressional Concerns, Legislation
Operation Unified Response: Haiti Earthquake 2010	JTF-H	Report	Overview earthquake, US military response, Global response, US Interagency coordination, USSOUTHCOM, challenges in forming the JTF, organizing JTF, coordination, force flow & logistics, reflections on Haiti
The United States Government's Haiti Earthquake Response	White House	Report	Response of US government, description of efforts in areas like Search & Rescue, Airports & Ports etc.
United States Government Haiti Earthquake Disaster Response Update	White House	Fact Sheet	Update on US response in areas like airport & airspace, safety, health etc.
Haiti: Disaster Preparedness and Mitigation Programs	USAID	Fact Sheet	Background, USAID & OFDA Humanitarian funding for Haiti Disaster Response and Preparedness



Table A2.

*EU Policy Documents used for the analysis*

	Organisation	Type	Description
Commission Decision on the financing of primary emergency humanitarian Actions in Haiti from the budget of the European Union	EC	Decision	Decision on humanitarian aid for Haiti, objectives & components of the humanitarian intervention
European Parliament resolution of 10 February 2010 on the recent earthquake in Haiti	EP	Resolution	Description of demands towards EU regarding European response to the earthquake
Factsheet Haiti earthquake (22/03/2010)	EC	Fact Sheet	Priorities for Emergency Aid , Challenges for International Assistance, UN Flash Appeal, EU Response
Factsheet on Haiti Earthquake	EC	Fact Sheet	Priorities for Emergency Aid, Challenges for International Assistance, UN Flash Appeal, EU Response
Haiti One Year On: Europe's actions in Haiti	EC	Report	EU response, EC response, flagship stories, overview commission funding, Cholera epidemic

## Appendix B

### Coding scheme for interest-influence matrix

<b>Role</b>	<b>Interest</b>	<b>Influence</b>
Key player	High	High
Context Setter	Low	High
Subject	High	Low
Crowd	Low	Low

*Note:* own representation based on *Who's in and why? A typology of stakeholder analysis methods for natural resource management* 90(5) p. 1938 by Reed et al. 2009.

## Appendix C

Codes for EU and US documents used in Atlas.ti

Codes	Occurrence EU	Occurrence US
Prediction	0	0
Warning	0	4
Emergency relief	4	15
Rehabilitation	12	3
Reconstruction	28	18
Democracy	2	8
Development	14	60
Governance	1	6
Long-term	4	60
Preparedness	1	28
Mitigation	0	26
Growth	0	9
Sustainable/Sustainability	0	8