ESI Preprints **Not Peer-reviewed**

Stakeholders' Perceptions of Seismic Risk and Adaptive Capacity to Earthquake: The Case of Anse-à-Veau (Haiti)

Garry Jourdan
Department of Geography
University of Namur (Unamur)
Institute of Life, Earth, and Environment (ILEE)
Michelet Clerveau
Institut Supérieur de Recherches et d'Études en Sciences Sociales (ISERSS), Port-au-Prince, Haïti
State University of Haiti (UEH)
Wisly Dieujuste
Institut Supérieur de Recherches et d'Études en Sciences Sociales (ISERSS), Port-au-Prince, Haïti
State University of Haiti (UEH)
Sabine Henry
Department of Geography
University of Namur (Unamur)
Institute of Life, Earth, and Environment (ILEE)

Doi: 10.19044/esipreprint.11.2023.p519

Approved: 20 November 2023
Posted: 23 November 2023

Cite As:
Jourdan G., Clerveau M., Dieujuste W. & Henry S. (2023). *Stakeholders' Perceptions of Seismic Risk and Adaptive Capacity to Earthquake: The Case of Anse-à-Veau (Haiti)*. ESI Preprints. https://doi.org/10.19044/esipreprint.11.2023.p519

Abstract

Earthquakes were responsible for more than half of all natural disaster deaths worldwide between 2000 and 2019. Populations in developing countries are the most affected. What can help stakeholders to increase people adaptive capacity to earthquake in a context of very limited financial resources?The perception of seismic risk by the stakeholders and the perception of their adaptive capacity seemed to be able to influence the stakeholder's adaptive capacity to earthquakes as well as that of the population. Haiti, a country at risk of earthquakes and ranked among the poorest in the world, is a relevant place to explore the potential people

adaptive capacity to earthquake. Face-to-face interviews were conducted with 21 stakeholders in the Town of Anse-à-Veau, in 2020 to focus on their perceptions of risk and adaptive capacity, just one year before an earthquake in the region.Results show that stakeholders were mostly aware of earthquake risk. This was identified by their perception of seismic risk related to the zone and the perception of their adaptative capacity to deal with earthquakes. Respondents perceived some drivers such as self-capacity, motivation and self-responsibility can increase their adaptive capacity. Some temporal and physical factors have been highlighted as constraints to stakeholders' adaptive capacity to earthquake.As expected, training, awareness, and appropriate constructions were identified as effective ways to increase the adaptive capacity of stakeholders and the one of the local populations to earthquakes. Surprisingly, earthquake unpredictability was seen as a barrier but also as a motivation for preparedness. Thus, this observation must be examined to find in which way it can facilitate adaptive capacity or not.Human resources are targeted as the main resource to cope with an earthquake. Also, training and awareness were recognized as means to increase stakeholders' adaptive capacity and the one of the local populations to deal with such an event despite the limited financial resources.

Keywords: Risk perception, adaptive capacity perception, stakeholders, earthquake, Haiti

Introduction

Over the past two decades, over four billion people have been affected by natural disasters worldwide and more than 1.2 million people have lost their lives. Among the 10 deadliest disasters in the world, the earthquakes associated with tsunamis caused 58% of deaths during 2000-2019 (UNDRR 2019). The 2004 Indian Ocean earthquake and tsunami (226,408 deaths) and the 2010 Haiti earthquake (220,000 deaths) significantly increased the number of deaths from these hazards during this period (IFR and RCS 2012). It is important to note that the loss of life is greater in poor countries. Poverty, as an indicator of lack of access to resources and income opportunities, adds to other aspects that determine the vulnerability of the poor such as place, age, gender, community structure, and political issues (Ncube, Mangwaya, and Ogundeji 2018).

Low income is often identified as an important component that limits people's ability to cope with natural disasters (Borderon and Oliveau 2016) and the poorest are more likely to die (Yohe and Tol 2002). This consideration is a reality for all vulnerable people, especially in developing countries, and seems to place these people in a state of fatality, where the increase in their income appears to be the sole condition to reduce their

vulnerability. However, it is possible to put the weight of income into perspective by considering the resources available to the population to adapt to an earthquake. A study conducted in Utah (USA) showed that income is not considered a key determinant of earthquake adaptation (Nicoll and Cova 2016). A comparative study in Seattle (USA), Osaka (Japan), and Izmir (Turkey) showed that the least costly adaptation measures (knowing the location of nearby medical emergency centers, having a first aid kit, and having a 4-day supply of dehydrated or canned food) are preferred by people (Lindell and Perry 2000; Solberg, Rossetto, and Joffe 2010). A study conducted in Germany and Zimbabwe compared economic resources and perceived adaptive capacity at the household level. It showed that past experiences, perceived risk of future impacts, and perceived adaptive capacity are likely to be more important determinants of adaptation than economic resources (Grothmann and Patt 2005).

These studies appear to support the humanities and social sciences perspective that implementing adaptation measures can reduce vulnerability and improve personal safety (Nicoll and Cova 2016). A social approach to risk management (bottom-up), based on participatory management that values local knowledge, may be less costly and more effective in reducing risk at the community level (Bétard and Fort 2014). Gaillard mentioned many cases (Australia, New Zealand, Philippines) where people used their passive prevention skills to avoid negative impacts on their lives and livelihoods (Gaillard, Cadag, and Rampengan 2019). Such an approach requires a prior good knowledge of the population's risk behavior in their area.

Within a society where the citizens protection is not a priority, the inhabitants are generally poor and the culture of risk is absent, it is important to find the way that can lead people to be prepared for uncertainty. Given that the zone is earthquake-prone, it was question to investigate the best placed people to influence the risk culture in the zone. That is why this study focuses on stakeholders' perception. There is many definition of this term but the most appropriate definition for this study is this one *"any group or individual that can be influenced by, or can itself influence, the activities of the organization"* (Gray, Owen, and Adams cited by Friedman and Miles 2006:9). This definition considers argued that stakeholders are concerned by the issue at two levels like influenced and influencer in an area. In this sense, the perception of stakeholders seems important to be studied to determine their capacity to act.

1.1. Stakeholders' perception of seismic risk

The human population can amplify or reduce risk depending on how they perceive it (Deng et al. 2019). The perception of risk varies based on

people's level of education and experience (Lopez-Ramirez et al. 2019). A study of earthquake risk perception conducted in the United States of America, Italy, and Turkey showed that people with higher levels of education as well as those who already have experienced an earthquake have a better perception of risk. Joffe et al. (2013) argued that there is a fundamental difference between experts and public knowledge. The first is considered objective, correct, and authoritative, and the latter is seen as subjective, irrational, and wrong.

A review of the literature on household adaptation to earthquakes involving 23 studies, 20 of which were conducted in California, found that there is generally, but not always, a significant correlation between risk perception and seismic hazard adaptation measures on one hand (Lindell and Perry 2000). This means that people who have a high level of risk perception are more likely to implement adaptation measures. Negative correlations were found between earthquake perception and likelihood, potential damage, and predictability in the implementation of seismic hazard adjustments on the other hand (Joffe et al. 2013).

Renn (1990) used four elements considered to be intuitive biases in risk perception. The first element is "availability", i.e. events that come immediately to people's minds are considered more likely than those that take longer to come to memory. The second is the "anchoring effect", whereby the probabilities of an event are adjusted according to the information available or the perceived importance of that information. The easier it is to imagine a disaster or another negative effect, the more likely people are to perceive it. The third element is "representativeness", which shows that unique, personally experienced events are considered more important than frequency-based information. The fourth element is "cognitive dissonance": information that challenges perceived probabilities already embedded in a belief system will either be ignored or minimized (Renn 1990).

Furthermore, authors have argued that risk perception is shaped by experience, optimism, and demographic factors, including gender and age (Solberg, Rossetto, and Joffe 2010). Lindell and Perry refer to personal consequences, including death, injury, loss of property, work interference, and social dysfunction (Lindell and Perry 2000).

Many studies showed some factors such as education, experience, and psychological aspects contribute to influence risk perception by stakeholders. In the next section, stakeholders 'perception of adaptive capacity' will be reviewed to understand their strategy to deal with an event.

1.2. Stakeholders' perception of adaptive capacity

In addition to the stakeholders' perception of risk, it is important to explore how actors perceive their capacity to adapt to earthquakes. *"The adaptive capacity of a human system represents the potential of the system to reduce its social vulnerability and thus minimize the risk associated with a given hazard"* (Brooks 2003). In reference to earthquake risk, adaptive capacity can be defined as the ability of people to prepare for, cope with, and recover from an earthquake. Adaptive capacity affects vulnerability by reducing sensitivity (Engle 2011). Even if a hazard level is constant over time, adaptation will allow a system to reduce the risk associated with this hazard by reducing its social vulnerability (Brooks 2003). As explained by Morin (2008), exposure represents the situation whereby a potential hazard and the exposed elements are brought into relationship in a given environment; whereas sensitivity is seen as the susceptibility that an exposed element, community or organization will be affected by the manifestation of a hazard (Morin 2008:10). It is important to note that sensitivity can be seen as the equivalent of social vulnerability when it concerns a human system (Brooks, 2003). To reduce the human vulnerability to earthquakes, it is thus important to increase their adaptive capacity by reducing their susceptibility and their exposure if possible (Martins and Gasalla 2020).

Regarding earthquakes, it is impossible to act on the hazard related to the exposure. However, human actions may affect susceptibility. Reducing the susceptibility of houses by strengthening structures can be costly and is often beyond most individuals' or even the government's financial capacity in developing countries (Shapira, Aharonson-Daniel, and Bar-Dayan 2018). When financial resources are limited, enhancing the adaptive capacity in order to promote adaptative behavior may be a real way to reduce the people susceptibility (Thomas and Gagnon 2019). Less costly adaptation measures are already promising in reducing earthquake damage in the United States (Lindell, Arlikatti, and Prater 2009).

Stakeholders' perception of their adaptive capacity can play a crucial role in expecting actions to reduce their vulnerability to earthquakes. Perceived adaptive capacity is related to what actors think they can do, while motivation is related to what the actors want to do to cope with a situation (Grothmann and Patt 2005). These authors gave three subcomponents of perceived adaptive capacity: perceived adaptation efficacy, perceived self-efficacy, and perceived adaptation costs (Grothmann and Patt 2005). Other factors such as education (Lopez-Ramirez et al. 2019), motivation (Bandura 1982), drivers, barriers such as denial, fatalism, or delusional optimism (Joffe et al. 2013), and personal responsibility (Mulilis and Lippa 1990) seem important to consider in understanding stakeholders' perceptions of their coping skills.

1.3. Research questions

The objective of this paper is to explore how stakeholders' perception of seismic risk and adaptive capacity can influence their own adaptive capacity and that of the local populations to earthquakes. The conceptual framework (figure 1) simulates two situations: 1) the initial situation shows the situation of a population with high vulnerability to earthquakes, as the product of its exposure, its susceptibility, and its adaptive capacity; (2) the expected situation simulates a reduced vulnerability, as the product of a constant exposure, and reduced susceptibility through increased adaptive capacity.

Three research questions have been identified. The first question (Q1) aims to target the stakeholders seismic risk perception, the second question (Q2) addresses the stakeholder's adaptive capacity perception, and the third question (Q3) focuses to explore the ways and means that the seismic risk and adaptive capacity by stakeholders may influence people adaptive capacity to earthquake.

Haiti, a country at high seismic risk, is the targeted place to study the adaptive capacity of populations to earthquakes.

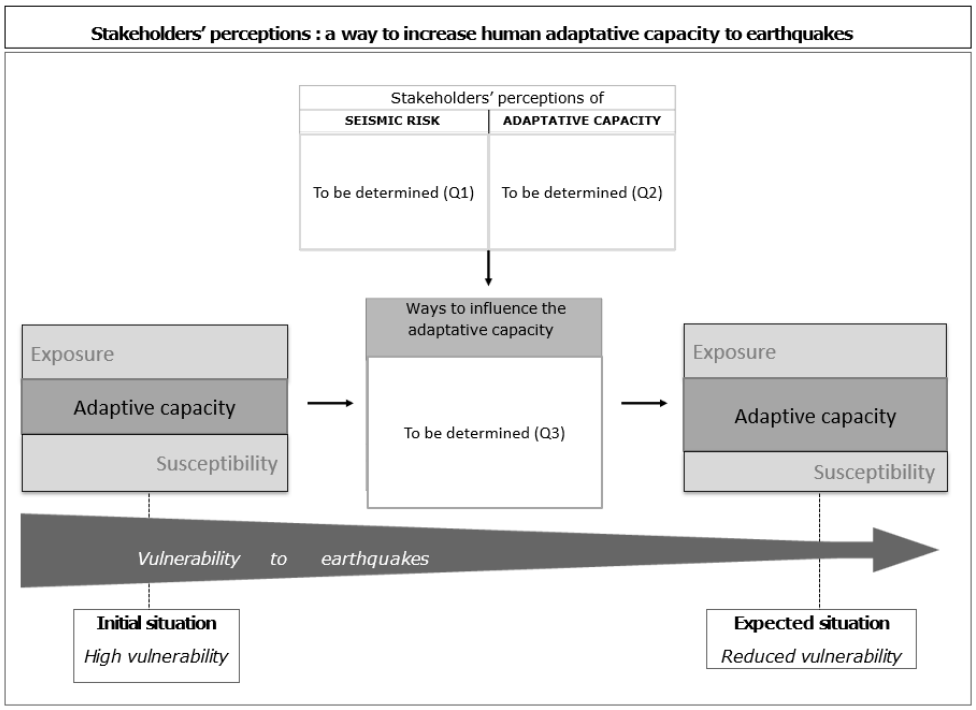

Fig 1. Stakeholders' perception of risk and adaptive capacity to earthquakes (not filled in)

2. Study area

Haiti: a relevant case study for estimating earthquake people adaptive capacity

Haiti is a Greater Antilles country among the Caribbean islands, of more than 10 million inhabitants, living in an area of 27,000 km² (IHSI 2015). The country is subject to seismic risk because it is located on the Caribbean plate with two main faults: the Enriquillo-Planten-Garden and the Septentrional. The high population density, the poor quality of construction, political instability, and poverty make the population vulnerable to a range of natural and man-made hazards. The 2010 earthquake of 7.0 magnitude, which killed 220,000 people, is evidence of the country's high level of vulnerability (PDNA-Haiti 2010).

The town of Anse-à-Veau is located 125 kilometers from the capital Port-au-Prince. It is a coastal town, bathed by the Gulf of Gonâve (Fig 2). This municipality in the department of Nippes was chosen as the study area because of its history of earthquakes and recently recorded tremors. Lately, Anse-à-Veau has benefited from some interventions on seismic risk, notably by an American organization called Geohazard International, and from seismic monitoring by the technical seismology unit of the *Bureau des Mines et de l'Energie* (Mining and Energy Office) of Haiti.

Demographically, the municipality of Anse-à-Veau has a population of about 35,000 people concentrated in an area of approximately a hundred square kilometers. Our study area focuses on the center of the town which counts more than 4,000 inhabitants distributed in 1,160 households over an area of 1.34 km^2 (IHSI 2015).

Tectonically, the Enriquillo-Plantain-Garden Fault zone (EPGF), which cuts across the entire southern peninsula, crosses the municipality of Anse-à-Veau. The main fault caused major earthquakes in 1860 and 1952 (USGS 2012), while the most recent earthquakes in 2010 and 2021 occurred on associated faults.

This study focuses on the Town Center Anse-à-Veau which is geomorphologically divided into two main parts: the Lower Town (Basse-Ville) and the Upper Town (Haute-Ville). The lower part is the historic town built on the seashore at the mouth of the Usine River. This part is made up of alluvial soils that can experience increased accelerations during an earthquake. The Haute-Ville is largely located on bedrock, which makes it more resistant to earthquakes.

Culturally, the belief in God is dominant in the town of Anse-à-Veau. Christianity is present through the Catholic Church and various denominations of Protestantism such as Baptists, Adventists, Pentecostals, and Jehovah's Witnesses. No Vodou temple is found in the Center of the

Town. Belief is seen as an element that influences the perception of risk and the ability to cope with it (ISDR 2008).

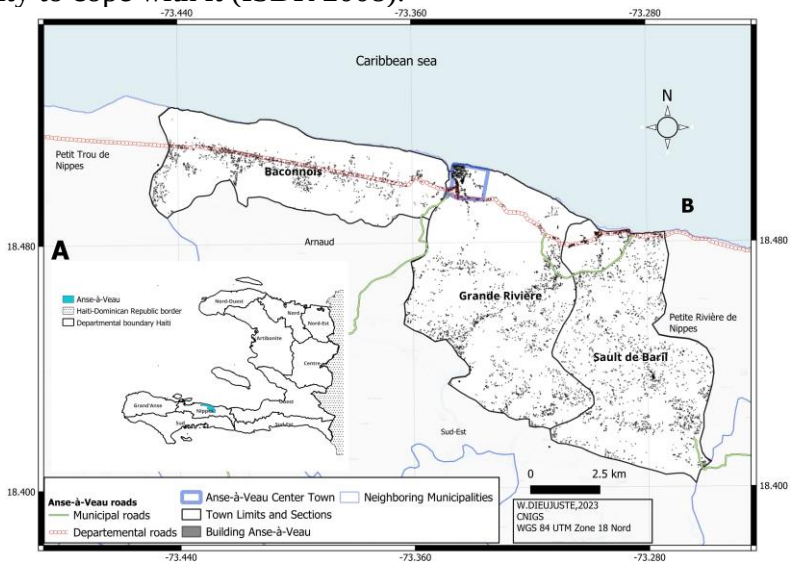

Fig 2. A) Map of Haiti B) Map of Anse-à-Veau

3. Data and method

Semi-structured interviews were conducted with 21 stakeholders in the town using an interview guide with 16 questions. In this study, the stakeholders are individuals who are concerned by seismic risk in the town of Anse-à-Veau. Thus, dominant risk stakeholders including the Departmental Coordination of Civil Protection of Nippes, the municipality, Red Cross of Anse-à-Veau, Geohazard, and Women's Organization, were chosen for the interviews because of the role they play in risk reduction in the municipality. Other dormant stakeholders, such as school principals, religious leaders, radio directors, hospital management staff, hotel owner and manager, and police station chief (Table 1), were selected because of their potential to influence people's ability to prepare for earthquakes, starting with their own capacity. The function of the stakeholders, actual or potential influence were the main criteria of interviewees selection. This section includes the interviewing process, interviewee characteristics, interview guide, and discourse analysis.

3.1. The interviewing process

Potential participants were approached by a colleague who gave us their telephone number. By contacting them, most of them readily agreed to take part in the interviews. Data were collected during three phases in 2020 (19-22/08, 6-9/10, 15-21/11). Not any earthquake occurred in the region during this period. The August 2021 earthquake occurred long after all

interviews were conducted. Although the interview guide was bilingual (French and Creole), the interviews were conducted in Creole to allow informants to share their views on the subject without any language constraints. The informants' quotations have been translated from Creole to English to the purpose of this paper.

To safeguard the data, all interviewees voluntarily agreed to be recorded. All participants were interviewed on site, except for the Nippes departmental civil protection coordinator, who was interviewed in his office at Miragoâne. For each participant, a form with his profile, contact information, and the date interview date, place, and time was recorded.

3.2. The interview guide

The information was collected about four main themes of the interview guide: (i) perception of risk, (ii) perception of stakeholders' adaptive capacity to earthquakes, (iii) existing and mobilizable resources, and (iv) protective actions to be undertaken.

Stakeholders' perception of seismic risk was explored through five questions regarding the *likelihood of seismic risk, mental associations related to earthquakes, the perceived consequences of an earthquake, the town's level of exposure, and stakeholders' sources of information.*

Stakeholders' perceptions of their adaptive capacity were explored through seven questions addressing *personal and family capacity, motivation, barriers, facilitators, responsibility, and effectiveness of earthquake preparedness*.

Resource themes are measured by questions that seek to determine *the resources that stakeholders or even households can rely on to undertake actions to increase the capacity of populations to cope with earthquakes.*

The action themes aimed to explore the actions that stakeholders intend to take *to increase their adaptive capacity and thereby reduce their own and the local population's sensitivity to earthquakes.*

3.3. Discourse analysis

A thematic analysis was conducted to identify recurrences, groupings, and contradictions in all the responses obtained (Paillé and Mucchielli 2008). The analysis of the discourse is based on the manifest content, i.e. what the respondents said explicitly (Henry et al. 2022). To better identify recurrences, groupings, and contradictions, all relevant answers found verbatim was inserted into a table. In this matrix, all the elements of the answers appear in the same line, making it easier to compare the units of meaning relating to each question separately.

4. Results

This section presents the stakeholders' characteristics (Table 1), stakeholders' seismic risk perception of risk, the stakeholder's perception of their adaptive capacity, and the stakeholders' perceived ways (resources and actions) to influence their adaptive capacity, and the one of local populations to earthquakes.

4.1 Stakeholders' characteristics

Stakeholders interviewed were people with professional, educational, religious, economic, and politic functions or activities in the area. The following attributes were considered to characterize them: education level, gender, age, occupation, place of birth, place and years of their residence, and function (Table 1).

Table 1. *Profile of interviewed stakeholders (Survey conducted by Jourdan, 2020)*

Variables	Numbers	Variables	Numbers
Education	**21**	**Gender**	**21**
University	20	Men	18
Primary	1	Women	3
Age	**21**	**Profession**	**21**
30-39	3	Teachers	7
40-49	7	Lawyers	5
50-59	8	Accountants	3
60-69	2	Administrators	2
70-79	1	Other	4
Place of birth	**21**	**Residence**	**21**
Anse-à-Veau	14	Haute-Ville	13
L'Asile	3	Basse-Ville	6
Cayes	2	Other	2
Port-au-Prince	1		
Paillant	1		
Function	**21**	**Years of the residence**	**21**
School Principals	4	Less than 6	4
Risk actors	4	Between 6 and 25	3
Religious leaders	4	More than 25	14
Radio Directors	2		
Hospital Director	1		
Director of the municipality	1		
Police Station Chief	1		
Owner of the Hotel	1		
Hotel Manager	1		
President of the association	1		
Technical coordinator of the departmental risk disaster	1		

Most of the stakeholders were male (18/21) and only one had left the school at primary level. The 40-49 and 50-59 age groups are best represented among all respondents. Two-thirds of stakeholders were born in the town and

have lived there for more than 25 years, giving them a sense of the place attachment. Nearly two-thirds of the interviewees reside in the Haute-Ville (Table 1).

4.2. Perception of seismic risk by stakeholders

The results concerning the perception of seismic risk are related to five sub-themes which are the perception of earthquake probability, mental associations related to earthquakes, perceived consequences, exposure of the town, and the stakeholders' source of information about earthquakes (Fig 3, Q1).

4.2.1. Perception of earthquake probability

Stakeholders unanimously recognized that an earthquake could strike the town of Anse-à-Veau (all responses were received well in advance of the 2021 earthquake). The three reasons evoked for this probability were historical seismicity, recent tremors, and the existence of faults. The 1952 earthquake was often mentioned by the interviewees. Many participants further talked about tremors in the town in recent years. To justify his response, one participant said: *"But when you do the history, you know that there was an earthquake in 1952 that devastated Anse-à-Veau and, in 2015, there were several small earthquakes of which about 37 hit the town" (Actor of risk, 30-39 years old, Translated from creole).*

For others, the presence of faults that cross the municipality increases the likelihood of earthquakes hitting the town. Thus, one participant stated, *"We have a lot of faults, on the Miragoâne side when you take the Haute-Ville it is the whole fault, since it's a fault site, you're subject to an earthquake, and it's going to hit" (School Principal, 50-59 years old, Translated from creole).* This response gave an idea about the interviewee's knowledge of the earthquake cause and emphasized the imminence of an earthquake due to the presence of faults in the area.

4.2.2. Mental associations related to earthquakes

Stakeholders were asked about the images they associate with earthquakes. Two main trends emerged. On the one hand, most stakeholders emphasized the negative catastrophic aspects. The words mentioned were: "*natural disaster, destruction of houses, damage, disasters, material losses, loss of human life, even the destruction of the area by a tsunami"*. On the other hand, positive associations were related to protective measures. The terms used were *taking shelter, do not leave the house, get out of the house, if possible, do not cross the street, and warn the population. Some* psychological considerations can be added to this tendency, such as *remaining calm, do not panic, do not get upset*. It should be noted that the

second tendency was much less dispersed among the stakeholders. These measures are consistent with drop cover and hold on (DCH) required in case of earthquake.

4.2.3. Perceived consequences of an earthquake

Participants' responses to the possible consequences of an earthquake on the town of Anse-à-Veau can be grouped into four categories of consequences. (1) human consequences referred to the loss of human life for almost all respondents. The expression *moun ka mouri (risk of death)* was often used in the interviews. (2) Material consequences related to houses' collapse. Some informants mentioned the possible impact on roads and bridges and stores 'collapse. Recurring terms were: *dega (damage), katastwòf (disaster).* (3) Environment consequences could be *landslides, and problems with springs, and even animal deaths*. (4) Finally, psychological consequences were phrased as follow: *the earthquake can cause trauma for people who have lost loved ones.* Non-standard construction and lack of earthquake-resistant standards were mentioned to increase the fragility of the Basse-Ville. Concrete slab houses were cited as an element that can significantly increase earthquake damage.

4.2.4. The town's exposure

Most stakeholders agreed that the Basse-Ville (Lower Town) is the most earthquake prone. They proposed several reasons for this high exposure, such as its proximity to the sea leading to the risk of tsunami, the loose nature of the soil, the shallow water table, and anarchic constructions. Some stakeholders believed this part of the town can be destroyed by a tsunami following an earthquake. Only a minority of interviewees considered the Haute-Ville (Upper Town) to be more exposed. These people mentioned landslides and solid constructions (masonry, concrete slab) that do not always respect standards, as well as old and sensitive buildings, such as the catholic church, the high school, and the prison. Some stakeholders declared that the whole town is exposed to earthquakes. To illustrate the situation of the Haute-Ville and the Basse-Ville, one participant reported an opinion commonly shared by most of respondents, he said *"the upper area of the town is less exposed than the lower part, like here, because this part [Haute-Ville] lies on a large rock. In the lower part of the town, even when a big truck passes by, houses shake"* (Civil protection member, 40-49 years old, Translated from creole).

4.2.5. Sources of information

The stakeholders highlighted risk training via workshops organized by Geohazard and Civil protection to raise awareness of the population about earthquake. This form of training and radio have emerged stakeholders'

primary sources of information. Television, school, and social networks were cited as less frequently used sources of information. The internet, books, newsletters, telephone, experience, grandparents, and church were considered rather marginal sources of information about earthquakes. Additional comments suggested that they have a clear perception and awareness of the seismic threat to the town. The perceived human and material consequences will probably depend on the exposure of each part of the town. However, risk perception does not drive necessarily to decision to take protectives measures. For this reason, it is important to target the stakeholder's adaptive capacity perception.

4.3. Stakeholders' perception of their adaptive capacity to earthquake

To determine the stakeholders' perception of their adaptive capacity, six topics: institutional capacity, individual and family capacity, sources of motivation, barriers to preparedness, facilitating factors, and responsibility - were explored (Fig 3, Q2).

4.3.1. Institutional capacity

Stakeholders mentioned training, awareness, information, prevention, education, and precaution, in order of recurrence. All these terms are closely related to training and risk education, as tools for preparedness. Most stakeholders believed they can support the people by training them via their institutions (Red Cross, schools, churches, hotels…) to be prepared for earthquakes. Half of two religious leaders denied any responsibility by assigning it to the government, which they regard as having the necessary resources. Nevertheless, they acknowledged their responsibility to secure their own homes.

4.3.2. Personal and family capacity

In terms of survival skills when an earthquake occurs, the most recurring item for self-capacity was to *"protect yourself in a safe place in the house".* The first perceived actions included all that they must be done indoors such as "*get under a solid table or desk", and "stay under a lintel, under the beams, or in a corner".* The second set of expressions that appeared most often was related to the right state of mind such as *"pa fè tèt cho" (stay calm)*. It is also important to have a good attitude such as: "*not to hurry without watching for falling objects", "don't jump downstairs if you are on the second floor",* and *"don't take the stairs".* Moreover, they mentioned the best thing to do is to stay in a safety place in the house during the first tremor. The third phrase evoked was to "*get out of the house, if*

possible", which is considered a possible way to protect oneself after the first tremor. The fourth phrase was *"build stronger".* A quarter of the respondents recognized the importance of building houses that can withstand earthquakes.

In terms of family adaptive capacity, most respondents answered that training their family members on how to behave before, during, and after an earthquake is an effective way family protection. Other responses expressed inability to take precautionary measures. Some expressions such as "*only God has the answer*", "*I don*'t know", *and* "*construction is so uncontrolled*" showed the impossibility of respondents to act to protect themselves and their households from earthquakes. As a synthesis, participants' responses can be classified into one of the three stages of adaptive capacity which are anticipation, coping, and recovery (Table 3).

Table 2. Summary of perception actions among stakeholders, Jourdan 2023

Capacity to		
Anticipate (before)	**Coping with (during)**	**Recover (after)**
Training/ simulation	Keeping calm	Solidarity
Education	Stay in a safe place	Psycho-sociological support
Preparation	Do not panic	Temporary shelter
Awareness	Do not run without control	
Information	Open space	
Precaution	Saving lives	
Prevention	Do not take stairs	
Building Safe Homes	Get out of the house if possible	

4.3.3. Motivation for preparation

According to the stakeholders, three main reasons could be explained their motivation to deal with earthquake which are the protection of human life, the consequences of an earthquake, and its characteristics. The first source of motivation refers to survival and includes the love of life, its protection, and consequently, avoiding the loss of human life. One respondent expressed the priority of staying alive very well, as the source of his motivation to prepare: "*The first thing is your life, you will have to be saved with others, this could also be the source of my motivation to prepare for an earthquake*" *(Organization member, 40-49 years old, Translated from creole).* Secondly, the consequences of earthquakes are an important source of motivation. Many interviewees emphasized the drama of earthquakes, such as "*the brutal deaths, the problems of the survivors, and the suffering*". In this regard, one interviewee stated, "*when you look at the number of dead people, it's not nice, it's not nice. When you count the dead. When you look at the collapsed houses. When you count the dead, you see the efforts to get people out of the rubble. It deserves to be prepared*" *(Assistant Principal of*

School, 50-59 years old, Translated from creole). The third source focused on the characteristics of an earthquake such as unpredictability and imminence. To justify the unpredictability, one participant said: "*since we don't know the day nor the time, we have to be prepared all time*". Another participant said something that could be compared to an impending earthquake. He said: "*The earthquake is like we are waiting for the return of Jesus Christ, we don't know when it will happen or when it won't happen*" *(Actor of radio, 50-59 years old).* Surprisingly, unpredictability, which is considered as the primary barrier to protection for most interviewees, was found to be a motivating factor here. However, the argument supports that the only way to deal with unpredictability is to prepare for it.

4.3.4. Constraints to earthquake preparedness

The constraints identified by the participants to protect themselves can be categorized into four points. The first one groups spatial-temporal constraints such as time, people location when the earthquake occurs, and its unpredictability. Most of these terms were mentioned as factors limiting the application survival skills. For example, if an earthquake occurs at night while people are sleeping, their reaction time may be considerably longer. The same is true for persons inside an earthquake-sensitive house whose ability to protect themselves may be greatly reduced despite good knowledge of saving-life techniques. Secondly, physical constraint concerns people with illnesses or disabilities that prevent them from protecting themselves during an earthquake. Thirdly, inappropriate behavior is considered a psychological limitation reported by a minority of participants who referred to dispositions such as "*low morale"*, "*rebellion*", "*negligence*", "*personal problems*", *or* "*reluctance to leave a cherished item*" that could be an obstacle to their protection. Lastly, financial constraint was reported by many stakeholders as a limiting factor in the construction of earthquake-resistant homes. However, two of the interviewees did not see any difficulties in protecting themselves if an earthquake occurs.

4.3.5. Factors facilitating preparation

The interviews highlighted some factors that facilitate earthquake preparedness. Firstly, the physical factor related to earthquake-resistant construction, appropriate construction, and lightweight construction were target as important for safe construction. In this vein, one participant said: "*I would live in air-conditioned containers if I had more money*". But he insisted that it was more important to him is "*to have a house that does not serve as a tomb in case of an earthquake*".

The second factor is risk education (awareness) expressed as "*training*" and *"information*" in equal parts by the stakeholders. It concerns

the precautions to take and the survival skills during an earthquake, the knowledge about the earthquake, its characteristics, and its impact on both human and material levels. Stakeholders think that such training and information can help them to better cope with earthquakes.
Finally, a psychological factor refers to terms such as "*being aware of the exposure of the area*", "*being vigilant*", "*having a good morale*", and "*having peace of mind*". All these terms describe attitudes that can drive stakeholders to behave appropriately in the event of an earthquake.

4.3.6. Responsibility for preparation

According to stakeholder responses, four responsibility levels can be identified as adaptive capacity to earthquake: the national, local, personal, and institutional levels.

At the national level, most stakeholders believe that the State (government) has the primary responsibility for the preparedness of the population. This includes the government's responsibility to guide and monitor construction. It covers the implementation of the building code and its revision, the control of construction, and the subsidy of appropriate materials for construction in seismic risk areas. To do so, it must take appropriate measures to raise awareness, motivate and inform the population. At the local level, preparing the population was mostly identified by stakeholders as the responsibility of the municipality often associated with civil protection. The municipal council must mobilize relevant agencies, such as the Local Emergency Operation Center (COUL), which includes the Police and the Red Cross to assist the population in the event of a disaster. Civil protection is the main institution holding the leadership in natural hazard preparedness. Some interviewees thought that this institution should have a say in every information concerning the population's preparedness that circulates in the media, especially on the radio. For others, Civil Protection should collaborate with the Bureau of Mines and Energy (BME) to have all the necessary information on earthquakes.

The individual level is cited in third position and equals with the population ones in verbatim. It mainly takes the form of " *Nou menm"* in the interviews, which translates as "*Ourselves"*, specifically referring to the respondents. This responsibility is based on the principle that it is up to everyone to take care of his or her life first. This statement rhymes very well with a Haitian proverb that says "*Se mèt kò, ki veye kò*" *(the master of the body is the bodyguard).*

The institutional level refers to institutions, some of which were rarely mentioned by the stakeholders (church and school). However, they could play an important role in sharing information on seismic risks. Churches, schools, local radio stations, and the Red Cross have resources

available to increase the adaptive capacity of the community through awareness and training. The involvement of these institutions in the preparation of the population is currently minimal but could expand in the future. Geohazard International was also mentioned as an international institution which plays an important role in raising the community's awareness.

4.4. The stakeholders' perception of means, resources, and actions to increase people adaptive capacity to earthquake

After examining stakeholders' perception of their adaptive capacity to earthquakes, it is important to consider the way that their perceptions seismic risk and adaptive capacity may influence their own adaptive capacity and the one of the local populations. To do so, responses were selected according to three perceived categories: effectiveness tools, resources, and actions (Fig 3, Q3).

4.4.1 Perceived effectiveness of preparedness tools to influence the community.

The interviews showed three means (training, awareness, simulation) that stakeholders perceived to increase their adaptive capacity and consequently the people adaptive capacity.

Firstly, ***risk training*** appeared to stakeholders as the best way to prepare the local population for earthquakes. Elements of training content were identified such as (1) inhabitants' knowledge about the seismic risk and its consequences; (2) prevention which covers actions to be taken before, during, and after an earthquake; and (3) instructing people in the construction of earthquake-resistant buildings. The interviewees said that the target audiences could be the general population and young people who, after having been trained, should share what they have learned with their entourage.

Secondly, ***awareness*** was the second most cited term by stakeholders. Channels such as the community's radio, megaphones, and sound truck were identified for outreach. Schools, churches, and soccer games were suggested as places or events to aim at the following themes that can be used to frame messages: how to behave during an earthquake, optimal building practices to minimize earthquake damage, and peer education.

Finally, ***simulation*** was mentioned only twice by stakeholders but seems to be relatively relevant to prepare people for earthquakes. Simulation sessions could show in a practical way how to protect themselves during an earthquake. One interviewee expressed her preference for simulating session about preparation for earthquake. Thus, she stated: "*It is not only theoretical training but also practical training. Because you can have training but no*

practical sessions, what do you call that? Simulation" *(Member of School Direction, 50-59 years old, Translated from French).* Simulation of protective measures against earthquakes is an important way of bringing theoretical training closer to reality.

The different terms used during the interviews allowed us to have an idea about the perceived effectiveness of means to enhance the adaptive capacity of the community of Anse-à-Veau. Stakeholders perceived the means in which they have been aware as are the best way to help people to be aware. Hence, the importance of understanding stakeholder's perceptions to better outline their involvement in enhancing the local population's adaptive capacity. The available ressouces in the area to reach this goal need to be assessed for further actions.

4.4.2. Stakeholders' perceived resources to increase local populations adaptive capacity

Despite the lack of financial resources, stakeholders were willing to adapt to earthquakes and to help the local populations to develop their adaptive capacity to earthquakes by drawing on available and potential resources for community protection.

In terms of available resources, stakeholders perceived that Anse-à-Veau has human resources to help the community to adapt to earthquakes. Human and social capital and physical capital were identified as helpful to anticipate an earthquake. Human and social capital refers to people within institutions such as churches, schools, the health center, the Police station, the Red Cross, and a women's organization who are available to learn and share knowledge, skills, and capacity to influence earthquake preparedness in the community. The physical capital corresponds to schools and churches buildings, which are often used as temporary shelters in case of disasters, including earthquakes.

Potential resources perceived by the stakeholders included human resources that could be mobilized to develop training and awareness on the appropriate behavior before, during, and after an earthquake. Churches and schools could be involved in training the population. Social networks like facebook and WhatsApp were identified as relevant tools to reach young people. Building solidarity were considered as important because it helped to save lives under the rubble during the earthquake of January 12, 2010, in Port-au-Prince.

Regarding potential physical resources, stakeholders reported that the development of local resources such as the *Sault du Baril,* a waterfall located in the third communal section of Anse-à-Veau, and the drilling of wells could supply the entire town with drinking water. Some interviewees suggested expanding the health center and improving its services to facilitate

access to health service. The construction of an equipped temporary shelter can be very useful for the population to deal with earthquake or any other disaster response.

Concerning financial resources, income-generating activities, such as investment in fishing, trade, stores, and financial services (banks and money transfer offices), could be developed to make the area more dynamic. These activities could compensate, to a certain extent, to the lack of financial resources that limit protectives measures.

In terms of institutional resources, the role of the Municipality was identified as crucial to improve the adaptive capacity of the community. According to the stakeholders, the Municipality should control the land occupation, the issuance of building permits, and the supervision of construction. To implement such measures, the municipal engineering department must be restored. The Municipal council can promote the training of earthquake-resistant construction engineers and technicians, as well as the learning of disaster response brigades.

4.4.3. Perceived actions for increasing adaptive capacity

The actions perceived by the stakeholders to adapt to earthquakes can be located at two levels: community, and household / personal levels.

At community level, two broad categories of actions are perceived by stakeholders: awareness raising / training and building safe houses. The first category appears as an effective preparation measure for stakeholders to influence the community. Several interviewees felt that it would demand only a little financial resource. Human resources, such as Red Cross volunteers, and the population itself are important in promoting actions to help people to survive an earthquake. The second category of actions identified by the stakeholders concerns safe houses (build better). The availability and enforcement of building standards, especially earthquake standards, should be ensured by the Municipality Council and the Government. A minority of respondents do not feel responsible due to the lack of resources and the unpredictability of earthquakes.

At household and personal levels, stakeholders' actions can be classified into two broad categories: information sharing and building safety. Firstly, they aim to share useful information to help their family members to protect themselves. They focused on necessary actions to survive an earthquake, such as preparing survival kits and identifying safe places in their home. Behavior during an earthquake is to practice the protective measures learned, such as "staying calm, making safety a priority, and leaving the house carefully". Secondly, building safety was highlighted as important actions to better cope with an earthquake at household and personal levels. Comments from some stakeholders seem to show that

concrete slab houses are perceived as more dangerous in the event of an earthquake than sheet metal roofing houses.

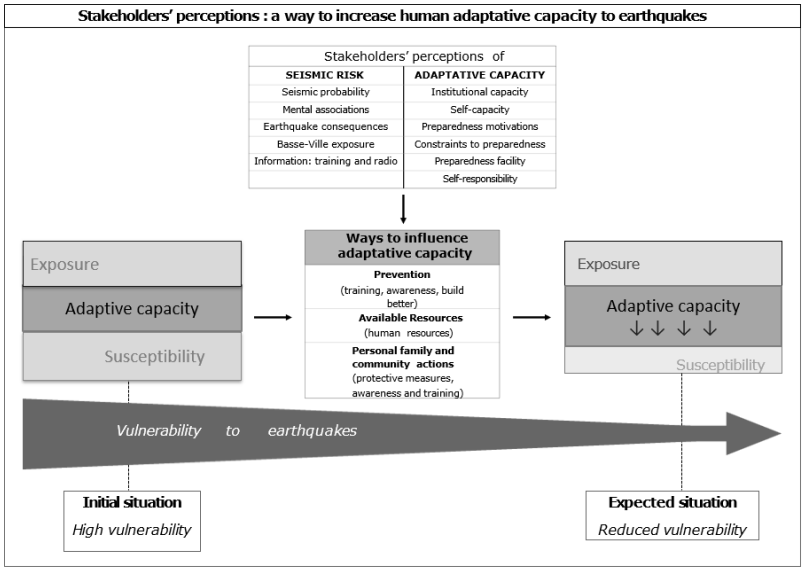

Fig 3. Stakeholders' perception of risk and adaptive capacity to earthquakes (completed)

5. Discussion

5.1 Relation between education level, age and place of residence and risk perception

Among the socio-demographic characteristics, the stakeholders' level of education, age and place of living need to be discussed in relation to the seismic risk perception. Firstly, Despite the stakeholder's education level was currently high, it seemed difficult to assign the stakeholder's risk perception to their education level because school was seldom cited as their source of information. In addition, interview data revealed that stakeholders may have a high seismic risk perception without real knowledge about earthquakes. For example, a school principal, university level, thought that earthquakes are caused by the heat. Such explanation is hardly surprising because of the education of risks has been neglected in school curriculum in Haiti. Moreover, the only participant who had a very low education level had also a high perception of the seismic risk in the area. Secondly, age groups most representative of interviewees were 40-60 years old (Table 1). It is not surprising that this generation had never heard the word risk at school. Several studies found that education level influences risk perception (Tekeli-Yeşil et al. 2010). However, other finding showed that high education level did not lead necessarily to high-risk perception. For example, a study at Dhaka (Bangladesh) showed that people with high education level had low risk perception because they lived in modern apartment perceived as

earthquake-resistant (Paul and Bhuiyan 2010). Thirdly, the place can influence stakeholders risk perception they lived in the town long enough to have enough knowledge about the risks associated with the place. More than half of participants lived in the town twenty-five (25) years ago. The 2010 earthquake hit the country only 11 years ago, at the time of the interviews. Finally, each of these elements can contribute to influence stakeholders' seismic risk perception, but it is still difficult to assign to their seismic risk perception to one element specifically.

5.2. Influence of reality of earthquake, awareness, and radio on seismic risk perception

Most of stakeholders were aware sufficiently of earthquake. The stakeholders' judgment revealed that they have a high perception seismic risk in their community. Their perception of earthquake associated with Basse-Ville have been confirmed by the history that the 1860 earthquake destroyed the Basse-Ville, and the Haute-Ville served to refuge for people (Scherer 1912). The stakeholder's seismic perception seemed to be influenced by the reality of earthquake, awareness, and radio as information sources. The earthquake reality to extent that stakeholders have a vivid memory about the seismicity of the zone, especially the 1952 earthquake and the little tremors that hit the town recently. Their perception seems to be influenced by the awareness (risk training) conducted largely by an international institution (Geohazard). Radio was presented as the second source of information by the stakeholders. This information reported by Benjamen that radio is seen as the media most popular in Haiti (Benjamin et al. 2021). However, their risk perception can influence positively or negatively their capacity to act when an earthquake occurs. For example, in reference to earthquake consequence, respondents who believe that the Basse-Ville could be destroyed by a tsunami after an earthquake may feel powerless to take protective action. This trend may lead to fatalism because the consequence is perceived as beyond the capacity of stakeholders to act (Tekeli-Yeşil et al. 2010, Solberg, Rossetto, et Joffe 2010). Contrary to this perception of tsunami, the is no study that mentioned a tsunami on the town level at Anse-à-Veau.

Although school is less cited as a source of information, stakeholders still recognized the importance of developing risk education at school. Education could be reinforced to play an important role in promoting the culture of risk. Nepal is already engaged in such awareness program to prepare his population to face risks through school (Tuladhar et al. 2015). In the long term, this measure may be less costly to the country than any other pathway. Moreover, countries that are well-prepared for earthquakes, such as

Japan, New Zealand, and the United States, have all promoted risk education from an early age.

This way of perceiving the risk can be a driver to stimulate them to take protectives measures. Some findings showed that risk perception can influence people to take decisions to protect themselves (Yu et al. 2015). Other authors showed that the risk perception does not determine the willingness to take precautions (Tekeli-Yeşil et al. 2010). However, the recognition of the risk is important to expect to see people to take some protective measures. It is difficult to ask someone to do something to protect himself if he does not feel to be at risk.

If the stakeholders seismic risk perception is necessary to make them aware of the risk, it is not sufficient to lead them to take protective measures to survive an earthquake. Therefore, it will be helpful to explore the stakeholder's adaptive capacity perception to better understand the way that they will act in case of earthquake.

5.3. Influence of motivation, enabling factors and self-responsibility on adaptive capacity

The interviews revealed that stakeholder's adaptive capacity perception is significant to lead them to take protective measures for earthquake. Thus, three fundamental elements need to be discussed: motivation, enabling factors and self-responsibility. The stakeholder's motivation is clearly expressed in their willingness to protect their life. A motivation that finds his root in the human life is great, because a man can give anything just to save his life. For enabling factors, most of stakeholders felt sufficiently aware about the protective measures or survival skills to protect themselves and their families in case of earthquake. There are confidents to be able to do take actions to survive an earthquake. This perception of the stakeholders adaptive capacity is consistent with a study in rural China about respondents perceived capacity (Yu et al. 2019). The self-responsibility is important to help people to act fort their protection. Arlikatti and colleagues suggested that responsibility for protection is highest at the personal and family level (Arlikatti, Lindell, and Prater 2007). Montreux et al showed that people can adapt well despite the lack of financial resource when they feel their responsibility to protect themselves (Montreux and Barnett 2017). Conversely, people tend to stay inactive when they think that their protection depends on government responsibility or other entities.

The self-capacity, as an element of stakeholder's adaptive capacity, could contribute to a good performance in real-life situations. This has been confirmed by different tests in health assessments (Bandura 1982). Another study carried out in Mexico on seismic, industrial, and anthropological risk showed that the people's internal control of a situation is positively

associated with active strategies to face the seismic risk in particular (López-Vázquez and Marván 2003). Indeed, people's perception of their own adaptive capacity to a stressful situation determines their decision to act in real life.

Construction safety was emerged as crucial factor for earthquake prevention. The quality of construction is central for reducing earthquake damage. The statement about the danger of houses that are not properly built to withstand an earthquake was taken up in a study in Italy (Massazza, Brewin, and Joffe 2019). However, earthquake-resistant construction as practiced in developed countries may be difficult to implement in Haiti where most of the population is lacking the financial resources. Nevertheless, one could design locally appropriate solutions to build better. Indeed, the concrete slab considered as a visible sign of wealth in Haiti is recognized as dangerous because this type of house caused many human deaths in the 2010 earthquake at Port-au-Prince. Thus, the perception of concrete constructions could start changing in favor of lighter constructions.

Some constraints have been underlined such as the time of occurrence (at night), people's location (fragile houses), level of responsibility (who does what) and financial resources (low income). If the time of occurrence cannot be controlled because the unpredictability of earthquake, nevertheless, some elements such as human settlements, local authorities' responsibility and access to income could be considered in case of eventual actions to enhance people adaptive capacity. However, it is important to underline that these actions cannot be undertaken only with the local populations because of the lack of financial resources. What's worse is such things received a low priority for most Haitian leaders where gaining and maintaining power were the priority of the majority of politics during several decades in Haiti (Corbet et al. 2023).

5.4. Perceived means, resources, and actions to increase adaptive capacity

Stakeholders tried to target means, resources (available and potential) and actions to increase the local population's adaptive capacity. The means identified by stakeholders are very important to make people aware of the risk. However, several years of research showed that awareness did not lead automatically to the decision to take protective measures. It would be interesting to find some alternative means to involve the local populations more actively in their preparedness. It is to note that financial resources are very limited in a poor municipality in a pour country (Llorente-Marrón et al. 2020). However, a study in rural China found that income and various sources of income did not affect respondents' intention to adapt to earthquakes (Yu et al. 2019). Thus, making the effort to identify the

available and potential resources can be helpful to allow stakeholders to find possible ways to increase people adaptive capacity. Hence, some elements were found like human/social capital and physical capital. These available forms of capital could be used by stakeholders to enhance their adaptive capacity as well as the one of the local populations. These potential forms of capital could be explored to translate them to actions for increasing people adaptive capacity. Thus, the stakeholders' leadership is crucial to mobilize these resources around a project to make the town safety. It is possible for stakeholders to find external resources to realize a project which is beyond the local financial resource.

Awareness raising/information sharing and building better were mentioned as possible actions both at community and household level. Effectively, not much money is needed to aware people about earthquakes or another risk. The essential is to be able to mobilize the necessary means and institutions available to do it. Some authors argue that non-structural measures can be taken at individual level with limited resources (Tekeli-Yeşil et al. 2010). However, it is important to note that awareness is not sufficient to make people more likely to take decisions to take protective measures. This is consistent with a study in Dhaka City (Bangladesh) which showed that earthquake awareness and education program initiated by the government was not completely successful (Paul and Bhuiyan 2010). It seemed necessary to review the current campaign of awareness by emphasizing the active ways of learning that lead to decision. In this case, the serious game may be one of the more active ways to train the local populations to increase their adaptive capacity.

In contrast, building safe houses needs not only some financial resources but also the involvement of local authorities in controlling safe construction in the community. At a personal level, it is always possible to build a suitable home with the means at your disposal. It would be prudent for someone to undertake concrete slab construction if they have sufficient financial resources to build well. The best solution is to find some alternative ways to build a safe house with limited resources. The traditional house has already showed their capacity to resist to earthquake, it would be important to capitalize on this technology to build house better despite limited resource. The local populations need to be aware of this innovative way to cope with earthquake.

Unfortunately, women were only poorly represented among the stakeholders, this prevents a more accurate picture of women's perceptions in this study. Women's perceptions are often different from men's, both in terms of risk perception and adaptive capacity (Lundgren et Strandh 2022). These authors highlighted the role of women in drought management in local communities in rural Mozambique. Their low representation must be taken

into account in possible actions to increase the community capacity, even more so since women are a very dynamic category at the household level in Haiti (Mathieu et al. 2003).

Limitations

These findings of this study suggest a clear perception of stakeholders of seismic risk and adaptive capacity. This is an important insight when considering the role than stakeholders can play to influence local population attitude. However, the stakeholders selected constituted a privileged category in the community and their perception could be very different from the one to the public. Therefore, their perception of seismic risk and adaptive capacity are not representative for the community. Moreover, the findings are more representative for male because they constituted most interviewees. Despite these considerations, it seemed important to explore stakeholders' perception adaptive capacity to verify the way they can involve in increasing local populations adaptive capacity. Future research will focus to assess perception and adaptive capacity of local populations at household level to find the component to reinforce for increasing people adaptive capacity.

Conclusion

The objective of this study was to explore how stakeholders' perception of seismic risk and adaptive capacity can influence their own adaptive capacity and the one of the local populations to earthquakes. This study suggests that the stakeholders' level of perception of seismic risk is relatively high to influence a priori their perception of adaptive capacity to the risk. All components identified in the perception showed a tendency to acknowledge the seismic risk and the consequences an earthquake could have on the local community. Stakeholders' perception of their adaptive capacity to an earthquake suggests that they can play an important role in increasing their own and the local populations' adaptive capacity to an earthquake.

However, good intentions are not enough to change people's attitudes. It is necessary to move from words to deeds to increase the capacity of a population to adapt to earthquakes. This is critical because people generally act according to their perception of a situation. Since human resources have already been identified as the most important for the municipality, this study provided insights into ways how to prepare the population to cope with earthquakes. Human and socio-cultural capital seems to be a determining factor in increasing the adaptive capacity of a population with limited financial resources. The humanist stream of geography asserts that *"geographic agents were not only economic actors seeking to improve*

their material well-being, but also moral and cultural beings" (Entrikin et Tepple 2006:31). Exploring the latter two elements seems to be an important avenue for understanding stakeholders" behavior in the face of risk and for increasing their adaptive capacity. The household level seems to the most appropriate for a better understanding people's adaptive capacity to earthquakes.

Acknowledgments

The authors would like to thank the Academy of Research and Higher Education (ARES) for the financial support of Earthquake-Haiti Project. All stakeholders in the town of Anse-à-Veau shall be thanked for kindly according to us some of their time for the interviews. The authors would like to extend special thanks to all the people who contributed to the realization of this article especially Florence De Longueville, Hans-Balder Havenith, Caroline Michellier, and Carolin Mayer for their thorough reading. Finally, many to thank Lisa Thiry for her contribution to the conceptual design.

Conflict of interests: The authors have no relevant financial or non-financial interests to disclose.

Data Availability: All of the data are included in the content of the paper.

Funding Statement : The research is financed by Academy of Research and Higher Education (ARES) in Belgium via Earthquake-Haiti Project.

Note about General Data Protection Regulation (GDPR)

The university of the first author ethics committee has been consulted about the steps to be taken to ensure the protection of interviewees. Given that no personal data allowing identification of individual was collected, and this was given spontaneously, the recording and transcriptions were anonymised. In this context, by guarantying the anonymity of the participants, no further steps were necessary. However, oral consent was asked and all necessary information about the research and the rights of the participants was communicated before starting the interviews. Thus, the General Data Protection Regulation (GDPR) was not necessary to conduct the interviews.

References:

1. Arlikatti, Sudha, Michael K. Lindell, and Carla S. Prater. 2007. "Perceived Stakeholder Role Relationships and Adoption of Seismic

Hazard Adjustments." *International Journal of Mass Emergencies and Disasters* Vol. 25 (3): 218–56.
2. Bandura, Albert. 1982. "Self-Efficacy Mechanism in Human Agency," 26.
3. Benjamin, Francklin, Katiana Jean, Renando Antoine, Marc Prou, Max Millien, Ketty Balthazard-Accou, and Evens Emmanuel. 2021. "COVID-19: Perception of the Pandemic and the Importance of Barrier Measures by the Fruit and Vegetable Sellers of Port-Au-Prince." *European Scientific Journal ESJ* 17 (5). https://doi.org/10.19044/esj.2021.v17n5p165.
4. Bétard, François, and Monique Fort. 2014. "Les risques liés à la nature et leur gestion dans les Suds." *Bulletin de l'Association de géographes français* 91 (3): 231–40. https://doi.org/10.4000/bagf.1571.
5. Brooks, Nick. 2003a. "Vulnerability, Risk and Adaptation: A Conceptual Framework," 20.
6. Corbet, Alice, Laure Fallou, Nixon Calixte, Laennec Hurbon, and Eric Calais. 2023. "From a Seismological Network to a Socio-Seismological One: A Citizen Science Experiment in Haïti to Reduce Seismic Risk: Analysis of a 'Small Box' That Can Do a Lot." *Citizen Science: Theory and Practice* 8 (1): 2. https://doi.org/10.5334/cstp.481.
7. Deng, Yan, Guiwu Su, Na Gao, and Lei Sun. 2019. "Perceptions of Earthquake Emergency Response and Rescue in China: A Comparison between Experts and Local Practitioners." *Natural Hazards* 97 (2): 643–64. https://doi.org/10.1007/s11069-019-03663-8.
8. Engle, Nathan L. 2011. "Adaptive Capacity and Its Assessment." *Global Environmental Change* 21 (2): 647–56. https://doi.org/10.1016/j.gloenvcha.2011.01.019.
9. Entrikin, J. Nicholas, and John H. Tepple. 2006. "Humanism and Democratic Place-Making," Approaches to human geography, 30–41.
10. Friedman, Andrew L., and Samantha Miles. 2006. *Stakeholders: Theory and Practice*. Oxford; New York: Oxford University Press.
11. Gaillard, J. C., Jake Rom D. Cadag, and Mercy M. F. Rampengan. 2019. "People's Capacities in Facing Hazards and Disasters: An Overview." *Natural Hazards* 95 (3): 863–76. https://doi.org/10.1007/s11069-018-3519-1.
12. Grothmann, Torsten, and Anthony Patt. 2005. "Adaptive Capacity and Human Cognition: The Process of Individual Adaptation to Climate Change." *Global Environmental Change* 15 (3): 199–213. https://doi.org/10.1016/j.gloenvcha.2005.01.002.

13. Henry, Sabine, Sébastien Dujardin, Elisabeth Henriet, and Sofa Costa Santos Baltazar. 2022. "Qualitative Data and Approaches to Population–Environment Inquiry," International Handbook of Population and Environment., 10: 139–63. https://doi.org/10.1007/978-3-030-76433-3.
14. IFR and RCS. 2012. "Earthquakes Guidelines on Preparing, Responding and Recovering." Genava: Koninklijke Brill NV. https://doi.org/10.1163/2210-7975_HRD-9813-2015012.
15. IHSI. 2015. "Population Totale 18 Ans et plus, Ménages et Densités En 2015." Port-au-Prince.
16. ISDR. 2008. "Indigenous Knowledge for Disaster Risk Reduction: Good Practices and Lessons Learned from Experiences in the Asia-Pacific Region."
17. Joffe, Helene, Tiziana Rossetto, Christian Solberg, and Cliodhna O'Connor. 2013. "Social Representations of Earthquakes: A Study of People Living in Three Highly Seismic Areas." *Earthquake Spectra* 29 (2): 367–97. https://doi.org/10.1193/1.4000138.
18. Lindell, Michael K., Sudha Arlikatti, and Carla S. Prater. 2009. "Why People Do What They Do to Protect Against Earthquake Risk: Perceptions of Hazard Adjustment Attributes." *Risk Analysis* 29 (8): 1072–88. https://doi.org/10.1111/j.1539-6924.2009.01243.x.
19. Lindell, Michael K., and Ronald W. Perry. 2000a. "Household Adjustment to Earthquake Hazard: A Review of Research." *Environment and Behavior* 32 (4): 461–501. https://doi.org/10.1177/00139160021972621.
20. Llorente-Marrón, Mar, Montserrat Díaz-Fernández, Paz Méndez-Rodríguez, and Rosario González Arias. 2020. "Social Vulnerability, Gender and Disasters. The Case of Haiti in 2010." *Sustainability* 12 (9): 3574. https://doi.org/10.3390/su12093574.
21. Lopez-Ramirez, Ernesto Octavio, Guadalupe Elizabeth Morales-Martinez, Yanko Norberto Mezquita-Hoyos, and Luis Rodolfo Patino-Munguia. 2019. "Perceived Self Efficacy To Cope With Earthquakes." *Advances in Social Sciences Research Journal*, no. 8: 14.
22. López-Vázquez, Esperanza, and Maria Luisa Marván. 2003. "RISK PERCEPTION, STRESS AND COPING STRATEGIES IN TWO CATASTROPHE RISK SITUATIONS." *Social Behavior and Personality: An International Journal* 31 (1): 61–70. https://doi.org/10.2224/sbp.2003.31.1.61.
23. Lundgren, Madeleine, and Veronica Strandh. 2022. "Navigating a Double Burden – Floods and Social Vulnerability in Local Communities in Rural Mozambique." *International Journal of*

Disaster Risk Reduction 77 (July): 103023. https://doi.org/10.1016/j.ijdrr.2022.103023.
24. Martins, Ivan Machado, and Maria A. Gasalla. 2020. "Adaptive Capacity Level Shapes Social Vulnerability to Climate Change of Fishing Communities in the South Brazil Bight." *Frontiers in Marine Science* 7 (July): 481. https://doi.org/10.3389/fmars.2020.00481.
25. Massazza, Alessandro, Chris R. Brewin, and Helene Joffe. 2019. "The Nature of 'Natural Disasters': Survivors' Explanations of Earthquake Damage." *International Journal of Disaster Risk Science* 10 (3): 293–305. https://doi.org/10.1007/s13753-019-0223-z.
26. Mathieu, Philippe, Jean Arsène Constant, Josué Noel, and Bobby Piard. 2003. "Cartes et Étude de Risques, de La Vulnérabilité et Des Capacités de Réponse En Haïti." Oxfam International.
27. Morin, Marc. 2008. *Concepts de base en sécurité civile*. Québec: Sécurité civile Québec.
28. Mortreux, Colette, and Jon Barnett. 2017. "Adaptive Capacity: Exploring the Research Frontier." *WIREs Climate Change* 8 (4). https://doi.org/10.1002/wcc.467.
29. Mulilis, John-Paul, and Richard Lippa. 1990. "Behavioral Change in Earthquake Preparedness Due to Negative Threat Appeals: A Test of Protection Motivation Theory." *Journal of Applied Social Psychology* 20 (8): 619–38. https://doi.org/10.1111/j.1559-1816.1990.tb00429.x.
30. Ncube, Alice, Precious T. Mangwaya, and Abiodun A. Ogundeji. 2018. "Assessing Vulnerability and Coping Capacities of Rural Women to Drought: A Case Study of Zvishavane District, Zimbabwe." *International Journal of Disaster Risk Reduction* 28 (June): 69–79. https://doi.org/10.1016/j.ijdrr.2018.02.023.
31. Nicoll, K., and TJ Cova. 2016. "Http://Www.Omicsgroup.Org/Journals/Open-Letter-to-Mr-Bill-Gates-on-Energy-Miracle-2167-0587-1000167.Php?Aid=73984." *Journal of Geography & Natural Disasters* 6 (2). https://doi.org/10.4172/2167-0587.1000168.
32. Paillé, Pierre, and Alex Mucchielli. 2008. *Analyse qualitative en sciences humaines et sociales*. 2eme edition. Collection U. Paris: Armand Colin.
33. Paul, Bimal Kanti, and Rejuan Hossain Bhuiyan. 2010. "Urban Earthquake Hazard: Perceived Seismic Risk and Preparedness in Dhaka City, Bangladesh." *Disasters* 34 (2): 337–59. https://doi.org/10.1111/j.1467-7717.2009.01132.x.
34. PDNA-Haïti. 2010. "Evaluation Des Dommages, Des Pertes et Des Besoins Généraux et Sectoriels."

35. Renn, Ortwin. 1990. “Risk Perception and Risk Management : A Review. Pt. 1, Risk Perception.” https://doi.org/10.18419/OPUS-7299.
36. Scherer, J. 1912. “Great Earthquakes in the Island of Haiti.” *Bulletin of the Seismological Society of America* 2 (3): 161–80. https://doi.org/10.1785/BSSA0020030161.
37. Shapira, Stav, Limor Aharonson-Daniel, and Yaron Bar-Dayan. 2018. “Anticipated Behavioral Response Patterns to an Earthquake: The Role of Personal and Household Characteristics, Risk Perception, Previous Experience and Preparedness.” *International Journal of Disaster Risk Reduction* 31 (October): 1–8. https://doi.org/10.1016/j.ijdrr.2018.04.001.
38. Solberg, C., T. Rossetto, and H. Joffe. 2010. “The Social Psychology of Seismic Hazard Adjustment: Re-Evaluating the International Literature.” *Natural Hazards and Earth System Science* 10 (8): 1663–77. https://doi.org/10.5194/nhess-10-1663-2010.
39. Tekeli-Yeşil, Sıdıka, Necati Dedeoğlu, Marcel Tanner, Charlotte Braun-Fahrlaender, and Birgit Obrist. 2010. “Individual Preparedness and Mitigation Actions for a Predicted Earthquake in Istanbul.” *Disasters* 34 (4): 910–30. https://doi.org/10.1111/j.1467-7717.2010.01175.x.
40. Thomas, Isabelle, and Alexandre Gagnon. 2019. “Coaticook : Analyse scientifique de la vulnérabilité intégrant l’implication des acteurs locaux et citoyens pour une ville et une communauté plus résiliente.” *Risques urbains* 3 (1). https://doi.org/10.21494/ISTE.OP.2019.0319.
41. Tuladhar, Gangalal, Ryuichi Yatabe, Ranjan Kumar Dahal, and Netra Prakash Bhandary. 2015. “Disaster Risk Reduction Knowledge of Local People in Nepal.” *Geoenvironmental Disasters* 2 (1): 5. https://doi.org/10.1186/s40677-014-0011-4.
42. UNDRR. 2019. “Human Cost of Disasters. An Overview of Last 20 Years (2010-2019).” UNDRR.
43. USGS. 2012. “Accounts of Damage from Historical Earthquakes in the Northeastern Caribbean, to Aid in the Determination of Their Location and Intensity Magnitudes.” Open-File Report. Open-File Report.
44. Yohe, Gary, and Richard S J Tol. 2002. “Indicators for Social and Economic Coping Capacity Moving toward a Working Definition of Adaptive Capacity.” *Global Environmental Change*, 16.
45. Yu, Junlei, Akihiko Hokugo, Graduate School of Engineering, Department of Architecture, Kobe University, and Research Center for Urban Safety and Security, Kobe University 1-1 Rokkodai, Nada,

Kobe 657-8501, Japan. 2015. “Understanding Household Mobilization Time During Natech Accident Evacuation.” *Journal of Disaster Research* 10 (5): 973–80. https://doi.org/10.20965/jdr.2015.p0973.

46. Yu, Junlei, Timothy Sim, Chunlan Guo, Ziqiang Han, Jocelyn Lau, and Guiwu Su. 2019. “Household Adaptation Intentions to Earthquake Risks in Rural China.” *International Journal of Disaster Risk Reduction* 40 (November): 101253. https://doi.org/10.1016/j.ijdrr.2019.101253.