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# Indicators in risk management : a fresh perspective between hazard analyses and societies' responses

Ante Ivčević

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# THÈSE DE DOCTORAT

Soutenue à Aix-Marseille Université  
le 11 décembre 2020 par

## Ante Ivčević

### Indicators in Risk Management : a Fresh Perspective between Hazard Analyses and Societies' Responses

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#### Composition du jury

Maria Luísa LIMA	Rapporteuse
ISCTE-IUL, PT	
Barbara LUCINI	Rapporteuse
Catholic University of Sacred Heart, IT	
Caroline MICHELLIER	Examinatrice
Royal Museum for Central Africa, BE	
Raquel BOHN BERTOLDO	Examinatrice
LPS - AMU, FR	
Abdelkhalak BEN MOUSSA	Examineur
Université Abdelmalek Essaâdi, MA	
Mossadek TALBY	Invité
Collège Doctoral d'AMU, FR	
Emmanuel TRIC	Président du jury
Université Côte d'Azur, GeoAzur, FR	
Lionel SIAME	Directeur de thèse
CEREGE - AMU, FR	
Hubert MAZUREK	Directeur de thèse
LPED - AMU - IRD, FR	

# Affidavit

I, undersigned, Ante Ivčević, hereby declare that the work presented in this manuscript is my own work, carried out under the scientific direction of Hubert Mazurek and Lionel Siame, in accordance with the principles of honesty, integrity and responsibility inherent to the research mission. The research work and the writing of this manuscript have been carried out in compliance with both the French national charter for Research Integrity and the Aix-Marseille University charter on the fight against plagiarism.

This work has not been submitted previously either in this country or in another country in the same or in a similar version to any other examination body.

Marseille, 11 December 2020.

*Ante Ivčević*



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# Abstract

Risk management indicators are used to mitigate the potentially dramatic effects of natural hazards. Local authorities and managers use them in elaborating rescue and urbanism plans, which do not always work, highlighting society's vulnerability in the particular context of global environmental and climate changes. Within this context, the United Nations (Sendai, 2015) advised constructing a series of indicators to better cope with human losses and economic disasters. In fact, the question is whether or not such indicators do constitute successful decision-making tools. This interdisciplinary PhD thesis aims at identifying reliable risk indicators and societal responses related to multiple risks (natural risks and climate change impacts) to provide a governance framework for disaster risk reduction. The recent literature was critically reviewed to assess how indicators are currently being constructed in risk management. Since different societies face diverse risks and do not necessarily have the same level of local perception confronting them, two sites were selected from the Mediterranean basin, one chosen from the South coast (North Morocco), other from the North coast (the Italian island of Sardinia). North Morocco, the region of multi-risks, is characterized by high demographic and economic pressures; West Sardinia counts for remarkable biodiversity of wetlands and is characterized by high environmental and agricultural pressures, which in both cases intensify the vulnerability of the coastal areas. Testing for the local population's preparedness to change allowed discussing the spatial and temporal scale at which indicators of risk management can be applied. Based on these findings, further ideas on a new series of less descriptive, more dynamic, and more user-friendly indicators are suggested. The obtained results could serve in future governance frameworks for the mitigation of natural hazards in the Mediterranean region and wider. Finally, the dire need for continuous work to overcome the communication gap between the scientific community, risk administrators, and the general population is encouraged.

Keywords: indicators, vulnerability, risk, hazard, management, climate change

# Résumé

Les indicateurs de gestion des risques sont utilisés pour atténuer les effets potentiellement dramatiques des aléas naturels. Les autorités locales et les gestionnaires les utilisent pour élaborer des plans de sauvetage et d'urbanisme, qui ne fonctionnent pas toujours, mettant en évidence la vulnérabilité de la société dans le contexte particulier des changements environnementaux et climatiques mondiaux. Dans ce contexte, les Nations Unies (Sendai, 2015) ont conseillé de construire une série d'indicateurs pour mieux faire face aux pertes humaines et aux catastrophes économiques. En fait, la question est de savoir si ces indicateurs constituent ou non des outils décisionnels efficaces. Ce doctorat interdisciplinaire vise à identifier des indicateurs de risque fiables et des réponses sociétales liées aux risques multiples (risques naturels et impacts du changement climatique) afin de fournir un cadre de gouvernance pour la réduction des risques de catastrophe. La littérature récente a fait l'objet d'un examen critique pour évaluer la manière dont les indicateurs sont actuellement construits dans la gestion des risques. Étant donné que différentes sociétés sont confrontées à des risques divers et n'ont pas nécessairement le même niveau de perception locale, deux sites ont été sélectionnés dans le bassin méditerranéen, l'un choisi sur la côte sud (le nord du Maroc), l'autre sur la côte nord (l'île italienne de Sardaigne). Le nord du Maroc, région à risques multiples, se caractérise par de fortes pressions démographiques et économiques; la Sardaigne occidentale compte une biodiversité remarquable des zones humides et se caractérise par de fortes pressions environnementales et agricoles, qui intensifient la vulnérabilité des zones côtières. Tester la préparation de la population locale au changement a permis de discuter de l'échelle spatiale et temporelle à laquelle les indicateurs de gestion des risques peuvent être appliqués. Sur la base de ces résultats, d'autres idées sur une nouvelle série d'indicateurs moins descriptifs, plus dynamiques et plus conviviaux sont suggérées. Les résultats obtenus pourraient servir dans les futurs cadres de gouvernance pour l'atténuation des risques naturels dans la région méditerranéenne et au-delà. Enfin, le besoin urgent d'un travail continu pour combler le fossé de communication entre la communauté scientifique, les administrateurs des risques et la population générale est encouragé.

Mots clés : indicateurs, vulnérabilité, risque, aléa, gestion, changement climatique

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“There is need of much organisation, and where there must be so much, there is almost sure to be more than there ought to be. The harm that this will do will be the diminution of opportunities for individual effort. Vast organisations produce a sense of impotence in the individual, leading to a decay of effort. The danger can be averted if it is realised by administrators, but it is of a kind which most administrators are constitutionally incapable of realising. Into every tidy scheme for arranging the pattern of human life it is necessary to inject a certain dose of anarchism, enough to prevent immobility leading to decay, but not enough to bring about disruption. This is a delicate problem, not theoretically insoluble, but hardly likely to be solved in the rough-and-tumble of practical affairs.”

*Bertrand Russell: Sceptical Essays*

“Imati srce i zvjezdan let  
Pa bježat šumom noći,  
Običi tako čitavi svijet  
I nikad nigdje ne doći.”

*Josip Pupačić: Nemirno srce*

“En route, le mieux c’est de se perdre. Lorsqu’on s’égaré, les projets font place aux surprises et c’est alors, mais alors seulement, que le voyage commence.”

*Nicolas Bouvier : L’usage du monde*

“Se vogliamo che tutto rimanga com’è, bisogna che tutto cambi.”

*Giuseppe Tomasi di Lampedusa: Il Gattopardo*



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# List of Abbreviations

CMED	Centre Méditerranéen pour l'Environnement et le Développement
CNRST	Centre National pour la Recherche Scientifique et Technique
CV	Contingent Valuation
IPCC AR	Intergovernmental Panel on Climate Change Assessment Report
MEDSEA	Mediterranean Sea and Coast Foundation
ORSEC	Organisation de la Réponse de Sécurité Civile
SPSS	Statistical Package for the Social Sciences
UN	United Nations
UNCHS	United Nations Centre for Human Settlements
UNDRR	United Nations Office for Disaster Risk Reduction
UNHCR	United Nations High Commissioner for Refugees
WTP	Willingness to Pay

# 1. Prologue

Every year, the human and economic losses due to natural catastrophes are dramatic. In the year 2018, the human losses were 11,804 fatalities and economic damage was 132 billion USD, when compared to 2017, when there were less casualties (9,697), but higher economic losses (335 billion USD). Although the loss is lower, when compared to the previous decade, the devastating hazardous events in these two years did not occur. From the official data it could also be concluded that the main human losses are always in developing countries (Sierra Leone, Indonesia, India), and the main economic damages always in developed countries (USA, Japan) (CRED, 2018; CRED, 2019). Based on this data, it is evidently important to continue the global struggle to improve the risk management in order to reduce the disaster risk.

For decades, it has broadly been acknowledged that disasters that cause human and economic losses are not only natural, but depend on the social conditions of the areas where natural hazards occur (Alexander, 1992). To make the society's response more efficient, and to tackle the increasing losses, the United Nations (UN) developed disaster risk management plans to set goals and objectives for reducing risks associated with natural hazards. With time, disaster risk management attracted more attention worldwide, with the first global framework for disaster risk reduction (the *Hyogo Framework for Action 2005-2015*) and with the actual plan, i.e., the *Sendai Framework for Disaster Risk Reduction 2015-2030* (UN, 2015), which aimed at achieving a significant reduction of disaster risk and losses during a 15-year-period.

But is it efficient? Although we have a global program of addressing risk reduction from 2005 onwards, did we manage to reduce both the casualties and the economic damage? Or does the sum of damage depend exclusively on how strong is the earthquake that hits Haiti or Indonesia (Figure 1), the hurricane that destroys the USA, or typhoon that ravages the Japanese coasts?



Figure 1: Palu, Indonesia, after a 7.5 Magnitude earthquake on 28 September 2018 (Syamsidik et al., 2019)

The key tools of risk management are the indicators. With many definitions, the main characteristics of an indicator are to ‘make the information intelligible’, to make it more compact, and to allow a better understanding of the phenomenon to be measured, especially for a non-specialist audience. The indicator is also a replicable element that can be used to track the phenomenon in time and space. One of the Sendai’s flaws is related to indicators since the proposed indicators mainly apply to the monitoring of national policies and carrying out the Sendai policy, rather than the implementation of local strategies (Beccari, 2016). The key objective of adapting the framework for local contexts has recently been addressed (Klein et al., 2019, Ivčević et al., 2019).

To start with, since the risk is a cross-sectoral domain between natural and social sciences, there is indeed a dire need to integrate different parameters into a global approach that should be comprehensive for all the actors involved, and allowing identifying reliable indicators related to multiple risks (Birkmann et al., 2013), which are not just the sum of single hazards (Kappes et al., 2012). It is, thus, important to clearly define which risk components are used in the analysis (Fuchs et al., 2011).

Secondly, different societies face different risks and, although they sometimes face the same hazard, they do not necessarily have the same level of local perception confronting them. Besides this horizontal scale, there is also a need to address vertical scale of using indicators, to see whether the global Sendai’s policy monitoring the national policies, technicians from the field, and the local population, manage to converge in their discourse?

Finally, the question is whether or not the indicators respond to the societal need of serving as decision tools, that is to say, to reduce impacts and to facilitate the resilience of societies. Do they remain useful to policymakers to inform and attend the well-being of the general population, as they are meant to?

These are the main questions that will hopefully be responded to in this thesis.

## 2. Introduction

### 2.1. The research topic

How come the Sendai Framework implementation does not result in disaster risk reduction? Why, after more than 30 years of risk management policies, the vulnerability of populations remains so significant? Is it because the policy is not implemented properly by the concerned countries? Is it because not a great thing can be done facing tremendous, catastrophic events? Is it because it is an administrative and political tool only? Is the question of scale crucial since the Sendai Framework addresses national and international, and not local scale which is the first to manage risks? How can it be improved? Or the improvement will just occur with more time? What types of indicators are useful in risk management and are they compatible with the Sendai Framework? All important questions to ask, and hopefully to answer, relate to disaster risk reduction. Do we manage to improve our risk management, based on our experience from previous decades, with the help of the Sendai Framework implementation, and in light of ongoing global environmental, societal, and climate change?

To manage natural risks and their impact on society, broadly used tools are risk management indicators. They are supposed to be a user-friendly interface between risk analyses and societal responses. Indicators are used to facilitate taking actions and to monitor the evolution of the actions that mitigate the potentially dramatic effects of natural hazards. Local authorities and managers use them in elaborating rescue and urbanism plans, which do not always work, highlighting society's vulnerability in the particular context of global environmental and climate changes. Within this context, the United Nations (Sendai, 2015) advised reconstructing a series of indicators to tackle human losses and economic disasters. The question is whether or not such indicators constitute successful decision-making tools. It is therefore essential to assess how indicators are currently being constructed in risk management. This first step would allow discussing the spatial scale at which indicators of risk management can be applicable, to what extent they should be physically oriented, and if they can fit the needs of the governance framework. Based on these findings, further work on a new

series of less descriptive, more dynamic and more user-friendly indicators can be suggested. Finally, the dire need for continuous work to overcome the misinterpretation of used indicators and how to reduce the communication gap between the scientific community, decision-makers, managers, and the population can be encouraged. Within this context, since indicators are designed to comply with the application of the Sendai Framework, which addresses international and national scale, the question is whether or not they respond to the societal need of serving as decision tools at the local level, that is to say, to reduce impacts and to facilitate the resilience of societies. Do they remain useful to policymakers to inform and attend the well-being of the general population, as they are meant to? (Ivčević et al., 2019) Does the scientific information manage to be beneficial for the general population, in the transmission process by the local authorities and policymakers? To test this transfer, and encouraged by the Sendai Framework, local case studies are needed, to enrich the local risk perception knowledge, all for a higher goal of reducing human losses.

## **2.2. The key research questions**

The importance of indicators in risk management and disaster risk reduction is the key topic of this thesis; their definition, construction, time and space scales. Based on an extensive bibliography synthesis and two case studies from the Mediterranean region, the answers to these key research questions will follow:

- 1) What kind of indicators could be useful in risk management and how to construct them both naturally and socially?

To test for the type of indicators used in the scientific papers related to risk management, an extensive literature review will be carried out. Since risk is the product of hazard and vulnerability, the main assumption is that both hazard and vulnerability indicators have to be used and valued in a balanced, interdisciplinary way. Thanks to this literature analysis, the way how indicators are constructed and used will be evaluated. The focus will be on frequently chosen indicators in natural hazard assessment concerning large catastrophic events and some methodological issues arising from this assessment regarding the scale and nature of used indicators will be



addressed. Additionally, studies that followed the UN Sendai objectives for disaster risk reduction will be looked for, and the main goals of analysed indicators used in risk management will be registered. Finally, some encountered shortcomings and ideas for future elaboration of risk management indicators will be discussed.

2) What is an indicator on a spatial scale, both related to horizontal variability and vertical hierarchy?

Two Mediterranean case studies will be chosen to test the local risk awareness and precautionary behaviour of the local, general population. This experiment is chosen since vulnerability is considered as a dynamic process, that can be influenced by local knowledge, practices and cultural particularities. Two questionnaire-based case studies will be compared, in order to see if the indicators of their risk awareness indicate horizontal variability, and if that awareness results with concrete precautionary measures. Furthermore, the policy literature will be analysed and, if not accessible, the interviews with the administrators, scientists and associations will be held, to examine the information transfer between the key actors of the risk management process. Moreover, the general population is hoped to reveal some indicators for measuring local resilience through the risk awareness studies, and those indicators will be compared with other actors of risk management process. This exchange of information through vertical hierarchy could indicate success or failure of risk management policy.

3) How to create more dynamic indicators, how to build them on the temporal scale?

It is assumed that successful risk management is based on indicators collected in every phase of the disaster management cycle. It would be useful to develop indicators to be followed up for each phase of the temporal scale: pre-disaster, response, and recovery (post-disaster). Based on the lessons learned from the literature review and two case studies, indicators will be described as bridging the pre- and post-disastrous events. The conceptual possibility to create those indicators will be theorised. Some ideas to overcome the possible obstacles will be offered, particularly the possible obstacle of the rupture of information transfer between the interlocutors included in the risk management process.

The answer to the first question will be offered based on an extensive literature review, methodologically introduced in section 4.1. and with results in section 5.1., which will serve as a theoretical reference. Two chosen Mediterranean case studies will serve as a support in discussing the concept and usage of indicators on spatial scale, by analysing the local risk perception and by comparing the discourse of three groups of actors in the region of study, described in the following section. Based on both aspects, some advice for the theoretical elaboration of the third research question on a dynamic temporal scale will be introduced.

## **2.3. The choice of the terrain**

The chosen fieldwork is the Mediterranean basin, a region prone to many natural hazards. It is one of the cradles of civilisation that has always been an attractive migration hub. More than 500 million people are estimated to live nowadays in the bordering countries (Karadirek et al., 2019) and the Mediterranean coasts represent the most visited tourist spot in the world, with more than 330 million visitors in 2016 (Tovar-Sánchez et al., 2019). Since the projections for the Mediterranean region are to experience the highest raise in the frequency of occurrence of extreme events due to climate and environmental change (Vousdoukas et al., 2017), the concern raises with the regional increase of population.

Bearing this in mind, two Mediterranean sites were chosen, the regions of North Morocco and the Italian island of Sardinia (Figure 2).



Figure 2: The chosen case studies from the Mediterranean basin: North Morocco and Sardinia, Italy

North Morocco is a region of multi-risks, which is enriching to study due to the increased complexity of social and natural processes. The region's coasts are also of decreased resilience to climate change due to the heavy urbanization of the coastline, leaving no space for the beaches and wetlands to adapt to a new state (Snoussi et al., 2010). There, the fieldwork was facilitated with the support of the association for the popularization of science and risk awareness '*Centre Méditerranéen pour l'Environnement et le Développement*' (CMED) from Tetouan, Morocco, which was the intersectoral partner of the project. The team of students from the Faculty of Science, Abdelmalek Essaâdi University, also from Tetouan, greatly helped logistically with the questionnaires. They translated them from French to the local variation of Arabic (*darija*), helped logistically with the organization of the trip, and with reaching the contacts in different municipalities, and they finally submitted the questionnaires to the local population (Figure 3).



Figure 3: This survey could not have been done without the kind help from Fatimazohra, Hajar, Ali and CMED students Kamal, Zakaria, Otman and Abdelhak (Xago)

The other study site, Sardinia, and the Gulf of Oristano in particular, is highly sensitive to sea-level rise, with a maximum relative sea-level for the year 2100 at about 949 mm based on the report of Intergovernmental Panel on Climate Change (IPCC AR5 8.5 scenario), which will imply partial flooding (Antonioli et al., 2017). Since our Sardinian zone of study consists of wetlands precisely, which are a nature-based solution to mitigate the impacts of climate change on the coast, it could be inspiring to test whether the society is aware of these wetlands' ecosystem services and does it give them a value.

There the majority of the research activities were undertaken under the framework of the 'Maristanis' project and coordinated by the Mediterranean Sea and Coast Foundation (MEDSEA) from Cagliari, Sardinia. The local stakeholders provided useful information while elaborating and adapting the questionnaires, and two environmental economists from the MEDSEA helped with the questionnaires and supported the survey administration activity (Figure 4).



Figure 4: This survey could not have been done without huge help and support from the whole MEDSEA team, particularly from Vania, Vanessa, Giorgio and Alessio.

In addition, within this study, there is an opportunity to compare the developing and developed countries of the same region, one belonging to Arabic and other to European

cultural circle, and the perception that the global, climate, and environmental change leave on citizens.

### **2.3.1. North Morocco**

In the European suburbs, just on the other side of the Strait of Gibraltar, lies Morocco, a country that seems to offer a perfect example of the Mediterranean essence. The country is praised since the medieval times, like Ibn Battūtah describing it as “the best of countries, for in it fruits are plentiful, and running water and nourishing food are never exhausted” (Encyclopaedia Britannica). These beauties of Morocco attracted more than 10 million arrivals in 2017 (Fernández & Hertz, 2019).

North Morocco is the region which faces the Strait of Gibraltar and Europe, situated between the Atlantic Ocean and the Mediterranean Sea. The region’s vulnerability has its roots in the Rif Mountain, one of the most vulnerable Mediterranean domains when it comes to natural disasters (Pateau, 2014), located on a seismically active zone (Neres et al., 2016), prone to landslides (Chalouan et al., 2006; Dugonjic et al., 2008), and soil erosion (Pateau, 2014b); with the interior prone to drought, floods and flash floods (Pateau, 2014), whereas Moroccan coastlines are highly exposed to climate change and sea-level rise consequences (Satta et al., 2016; Cramer et al., 2018). The region’s vulnerability has however increased since the region became a big economic hub at the end of the 20th century, with the project of Tanger-Med port and the development of tourism. Due to this context of multiple risks, the region of North Morocco can be called a multi-risks zone.

Local communities were seen to creatively integrate scientific elements to their cultural understanding of risks, in ways that might either contribute to their protection or increase vulnerability. Since scientific information is transmitted from scientific to common-sense knowledge, it integrates culturally available elements so that individuals make active use of historical and cultural ideas when collectively responding to risks (Moscovici, 1984; Joffe, 1999). More specifically the cultural specificities of North Morocco, where a strong government is allied with the omnipresence of the Muslim

culture, compose a singular cultural setting (Paradise, 2008) where vulnerability and risk preparedness are to this day ill-understood.

Morocco is partly geographically and entirely culturally immersed in the Mediterranean. Even though it has experienced natural hazards for centuries, its inhabitants have still managed to successfully occupy the area. Morocco maintains, in its modernity, very strong traditional components, with the traditional forms of appropriation of space and the forms of its usage (Figure 5). People live and survive thanks to this territory, they are attached economically to it, and that is also the case for the region of North Morocco (El Abdellaoui et al., 2008).



Figure 5: Morocco maintains traditional forms of appropriation of space and the forms of its usage (here a traditional tannery in Tetouan’s old town medina)

Among the total population of 33.8 million, 50.2% are women, and 60.4% live in urban areas. 28.2% of the population is younger than 15 years old, and 9.4% older than 60 years old. The illiteracy rate is 32.2%, with 4.3% of the population having a university degree. 99.2% of inhabitants read and write in Arabic, 2.9% in Amazigh, 67.2% in French. Only 34.3% of population is active, and among them 16% unemployed. The region of North Morocco counts for 10.5% of a total population of Kingdom (3 556 729 inhabitants) and is one of the regions that experienced relatively higher growth than the national average, with the population growth rate around 1.5% (2014 census).

Besides, Morocco is a Muslim society. In the study on perception of earthquake risk in Agadir, South Morocco, it was showed that both opinions and perceptions of seismic risk are less influenced by personal experience than by Muslim education, rituals, and culture (Paradise, 2005). In the seismically active western Maghreb, it has been found that religious elements have prevented the assessment and implementation of risk management solutions (Paradise, 2008).

Although the region of North Morocco, also named 'Tangier-Tétouan-Al Hoceima', was territorially depicted just in 2015 (Bulletin Officiel n° 6340, 2015), it is a consistently religious and traditional region, where many local heterogeneities can be spotted. It is composed of three areas with different geographical and physical characteristics, whereby the East zone has a different cultural and historical background. Rif Mountains are inhabited by the ethnic group Amazigh, and still today there are sometimes frictions between the Arabic majority and the Amazigh minority in the region (Figure 6).



Tetouan, November 2018



Figure 6: Still today there are sometimes frictions between Arabic majority and Amazigh minority in the region, particularly in Al Hoceima, or like here on a protest banner at Faculty of Science in Tetouan.

These areas also experienced different historical hazard events. It is precisely these natural particularities that are the base of this trial, considering at the same time other local variations in the analysis, as well. Physically, the geography of North Morocco is composed of three main domains: the Atlantic coast, the Mediterranean coast and river valleys (among others the most important Martil River), and the Rif Mountains.

The Atlantic coast, including provinces of Tangier and Larache, suffered from a large tsunami resulting from a M8.5+ earthquake, the so-called Lisbon earthquake (1<sup>st</sup> November 1755). Other tsunamis were also observed in 1941 and 1969 but without such disastrous consequences. This coastline is highly vulnerable to such natural hazards since Tangier is the second economic centre and the third biggest city of Morocco with approximately 950.000 residents (2014 census), whose coastal infrastructure is undergoing a significant economic (harbour) and tourism (marina,

beach, hotels, resorts) development (Benchekroun et al., 2015) (Figure 7). One example of the Moroccan economic growth is the harbour project of Tanger-Med, which brought not only construction work and increased employment, but also informal settlements and brand-new environmental issues arising from the rubble freshly excavated from the port, as well as landslides and water pollution issues (Pateau, 2014b).



Figure 7: The harbour development of Tangier, with hotels, restaurants and the marina.

The Mediterranean coast of Tetouan is one of the coastal areas that have rapidly been urbanized in Morocco. Because of an erosive shoreline, the direct exposure of coastal infrastructure to waves, sea-level rise, and marine storms, the Mediterranean coast with its high population density is strongly exposed to climate change and the consequences of natural hazards (Satta et al., 2016; Cramer et al., 2018). The area is little fed with fluvial inputs. With a catchment area of 1220 km<sup>2</sup>, the seasonal Martil River is the most important sedimentary source, whose hydrological regime is that of recurrent flash floods (Snoussi et al., 2010; Satta et al., 2016) (Figure 8).

Tétouan, April 2018  
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Figure 8: Construction site of Martil River floodplain in Tetouan.

The Rif Mountains are also very vulnerable to natural hazards. Due to the natural predispositions of the relief, a barely consolidated flysch lithology is prone to landslides (Chalouan et al., 2006). In addition, many forest surfaces of the region were converted to agricultural parcels, leading to amplified soil erosion (Pateau, 2014b). Since it is located at the transition between a Mediterranean climate with oceanic influence to the North, and a more arid climate to the South, the interior of Morocco is also prone to drought, floods and flash floods, where periods of rain and drought alternate (Pateau, 2014). These are not the only worrying hazards, as the region is also located in a seismically active zone (Neres et al., 2016), where most of Moroccan seismicity is concentrated (Sébrier et al., 2006). It experienced three earthquakes in 22 years, with the 2004 notorious disaster of Al Hoceima (M6.4 earthquake). Together with the adjacent Gulf of Cadiz and the Alboran Sea, this region hosts most of the Moroccan seismicity and belongs to the diffuse plate boundary between the Nubian and Eurasian plate (Neres et al., 2016). Indeed, the relatively superficial nature of the seismicity combined with weak

ground mechanical properties led to significant damages on constructions that do not always respect building standards (Mourabit et al., 2014) (Figure 9).



Figure 9: The construction sites in Al Hoceima, exposed to landslides, flash floods and seismic risk.

### 2.3.2. West Sardinia, Italy

Water is one of the key natural resources at stake in the present and future world, having a crucial role for both societal and economic component of sustainable development. One of the solutions in preserving the healthy water cycle are wetlands, “areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres”, as defined by the intergovernmental Ramsar Convention (Russi et al., 2013). The Ramsar Convention

aims at conservation and wise use of wetlands in the widest sense, where wetlands may include even coastal zones, islands and the adjacent sea (Matthews, 1993) (Figure 10).



Figure 10: Wetlands are one of the solutions in preserving the healthy water cycle.

Wetlands are globally significant carbon reservoirs, with the organic carbon stored per unit area similarly as in forests (Fourqurean et al., 2012). In addition, wetlands mitigate the effects of natural hazards: they provide sediment stabilisation and soil maintenance (Sathirathai & Barbier, 2001), they regulate water flow and control floods (Brouwer & Van Ek, 2004) and they scatter sea waves, buffer winds and protect coasts (Bayas et al., 2011). However, the importance of wetlands is underestimated, and their significant flood regulation and climate change mitigation capacity are generally overlooked (Dehnhardt et al., 2019). Only in the Mediterranean region wetlands reduced in area by 48% between 1970 and 2013 (Klauschen, 2019), which is against our common interest in mitigating climate change.

The Mediterranean Sea has been detected as fragile and sensitive to climate change and its ecosystems are among the most concerned by global climate change (Mediterranean Action Plan, 2016). Likewise, the second biggest Mediterranean island of Sardinia is prone to a high level of hazards, particularly its West coast, which is among one-third of the Mediterranean coastal areas exposed to the highest level of hazard. That is particularly due to extremely high values of wave heights, as shown in the study in which the research focus were sea-level rise, storms and droughts (Satta et al., 2017). The area of the Gulf of Oristano was hit by extreme weather events, above all flash floods

as a consequence of high rainfall, like in November 2013. Coastal storms (*mareggiate*) are frequent during the cold season in the area, with the projections of sea-level rise during the upcoming decades due to climate change. Furthermore, the area of the Gulf of Oristano is a wetland zone. Wetlands do contribute to disaster risk reduction, but is the local population aware of those benefits?

Sardinia is located in the Mediterranean region, a 'hotspot' within climate change context. In the region, the average temperatures recently rose to 1.6 °C over pre-industrial levels and an additional increase of 2-3 °C is expected by 2050 (Klauschen, 2019). This change will be accompanied by enhanced extreme weather events, storm-related precipitation and the likely increase of frequency and intensity of drought (Stocker, 2014). The area is severely affected by climate change, both in terms of sea-level rise (Marsico et al., 2017) and climate-related extreme weather events (droughts and floods). In addition, although floods did affect this area in the past century, they are now more frequent. A set of nature-based solutions was then proposed to tackle global change; among them wetlands, which have a role of shock absorbers against various natural hazards such as regulating floods and droughts, heatwaves, sea-level rise and scattering coastal storms (Klauschen, 2019). Sea-level rise will be a serious problem in the future decades and some of the current areas (including archaeological sites) will be flooded in the future. As estimated by the IPCC, wetlands as a nature-based solution, along with forests, grasslands and agricultural lands, could provide 37% of the CO<sub>2</sub> mitigation needed by the Mediterranean region by 2030 to succeed in holding global warming below 2°C (IPCC, 2018).

Moreover, by focusing this research on the wetlands' benefits as a natural risk mitigation solution for coastal hazards, it is built on the conclusions by Antonioli et al. (2017). In this research, a maximum relative sea-level for the year 2100 at about 949 mm above sea level based on the IPCC AR5 8.5 scenario is expected for the Gulf of Oristano. The assumption is that some sites in the gulf will be partly flooded, notably the Mistras lagoon, unless drainage systems will effectively be installed (Antonioni et al., 2017). However, wetlands also create a conflict between urban areas that are preserved and fishing and farming activities that are affected by floods. While inhabitants in the area are aware of how floods impact the region, they are less aware of how floods are also expected to increase with climate change.

Sardinia hosts eight Ramsar sites, six of them in the Gulf of Oristano, with a surface of 77 km<sup>2</sup> and with 140 km of coastline (Figure 17). The 'Maristanis' project aims at promoting integrated governance for that area. The wetlands of the Gulf of Oristano, stretching from Capu Mannu to the Marceddì lagoon represent an ecosystem of priceless value. The area is politically in the province of Oristano, where the main city Oristano also borders the pond of Santa Giusta, a rather industrialised and polluted lagoon that is connected to another small Ramsar pond of Pauli Maiori, the only freshwater pond in the area that could be considered a testimony to the original native biodiversity.

Among Ramsar sites, the pond of Cabras is the biggest one. It is important for numerous species of water birds. In its direct proximity is the wetland of Mistras, which borders the coastal plain of the Gulf of Oristano, rich in bivalve molluscs and fish, making the municipality of Cabras a famous fishing site in the zone. Both of them are saltwater lagoons, located close to the mouth of Sardinia's main river Tirso. More to the South, a freshwater pond of S'Ena Arrubia is the last remnant of a once broad complex of swamps and lagoons, converted into a fertile land in the 1930s. In three lagoons, traditional fishing activities are allowed. Several traditional food and handcraft activities are still maintained in the area and they strictly relate to the presence of wetlands, accompanied by tourism activities (Figure 11).

Beside weakness in governance due to an overlapping of competences and constraints of different actors, several issues affect these areas: pollution coming from wastewater treatment plants, former mining activities and agricultural activities (the reclaimed area in Arborea has been declared a Nitrate Vulnerable Area according to the Nitrate Directive). There are also anthropic disturbances (including illegal waste disposal) related to uncontrolled access to the area, as well as the problem of invasive and alien species diffusion.



S'Ena Arrubia, March 2019  
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Sinis peninsula, May 2019  
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Figure 11: The conflict of activities in the Gulf of Oristano wetlands : traditional way of fishing, bird-watching, tourism, and dairy production (here two Jersey cows kissing)

Sardinia is a Mediterranean island with rich historical and cultural influences that shaped its present existence. A comprehensive disaster resilience index combining indicators for social vulnerability, accessibility, environment and institutions was recently developed at the Italian municipality level. The index, which is based on the Sendai's Framework for Disaster Risk Reduction, displays results for the Gulf of Oristano that indicate higher resilience against future disasters (Marzi et al., 2019).

Sardinians autonomously govern their island and are proud of the long history of their legislation, as well as of the natural beauties of their 'endless' island (tourist



slogan). An important medieval Sardinian legislative act, *Carta de Logu*, introduced by *juighissa de Arboree*, lady judge Eleonora of Arborea in the 14<sup>th</sup> century (Figure 12), regulated all sorts of juridical and administrative questions, stating that all men are equal before the law. Some environmental questions were addressed as well, such as the burning of stubble, which was regulated to avoid wildfire, and the protection of hawks and falcons against illegal bird hunters (The Riverside Dictionary of Bibliography, 2005; Enciclopedia delle Donne).



Figure 12: Lady judge Eleonora of Arborea introduced an important legislative act in the 14<sup>th</sup> century, addressing even some environmental issues.

This area turned famous in the 20<sup>th</sup> century, between world wars, in which a huge land reclamation work was carried out by the fascist government (the area of 18,000 ha), by drying up the coastal pond of Sassu and other smaller ones, with the deviation of stream Mogoro and the creation of a moderator basin to contain floods and to provide water for irrigation (Figure 13). The village of Mussolinia, later named Arborea, was constructed and inhabited with Italians mostly from northern regions (Enciclopedia Treccani). Even today, the terrain administrated by the municipality of Arborea is a site of extensive agricultural production. This fertile area is home to the main agricultural sector and the agro-food in Sardinia, including one of the main national dairy sector companies and one of the main national aquaculture companies.



Figure 13: Reclamation work in Arborean plain is crucial for agricultural production and for controlling floods (Sassu dewatering pump (Idrovora di Sassu) from 1934, the postcard ©Pro Loco di Arborea, Sagra della Polenta).

Today, among the total population of 1.64 million people on the island, 51.1% are women. 44 years old is the average age on the island, 11.3% of the population is younger than 15 years old, and 22.7% older than 65 years old. The illiteracy rate is 1.3%, with 9.5% of the population having a university degree. 49.9% of population is active, and among them 18.6% unemployed. The province of Oristano counts for 10% of a total population of the autonomous region (163 916 inhabitants), which is lower population density than it is the case for whole island (53.9 compared to 68.1 inhabitants per km<sup>2</sup>), with a loss of 2.4% of population compared to 2001 census (2011 census).

Wetlands, omnipresent in the province of Oristano, have long been depreciated as sources of diseases or wastelands, even though they are found to have a global value mean of 6,923 USD/ha/year for flood control service in agricultural landscapes (Brander et al., 2013; Rogers et al., 2019). Considering their paramount importance for disaster risk management it remains to be studied how Sardinians think about these areas.

Besides, the question of environmental protection of Sardinian coasts is more than actual today. The autonomous, centre-right regional government proposed a new law *Piano Casa*, approved on 12 February 2020, to ‘develop sustainably’ the island and ‘to restart the sector of construction’. However, the environmental associations fear that this could lead to beach privatization in Sardinia, allowing more square meters for the coastal structures, as well as new tourist accommodation facilities that could be located even within the mandatory 300 m coastal strip (La Repubblica; Gruppo d’Intervento Giuridico onlus, 2020).

Finally, Sardinians experienced some disastrous events that strongly marked their local memory, shaped how they approach environmental risks and contributed to building local solidarity between municipalities. That was the case in the devastating flood from November 2013, when citizens from Terralba and Arborea worked together to manage the crisis (Sardinia Post) and where the residents of Terralba dedicated a letter of thanks to Arborea for their generosity and help during and after the flood (Figure 14).



Figure 14: Residents of Terralba contribute a thank-you note to Arborea for generosity and sacrifice that their neighbours showed while defending their village from the devastating effects of flood on 18 November 2013.

## 3. State of the art

### 3.1. Risk

In everyday life, humans encounter the term 'risk', as something that accompanies negative or unwanted events (although not exclusively), in statistics, business, crime or in medicine. The term developed from Latin word *resecum*, kept similar meaning in European languages, relating to a future negative event. It is mainly related to *damage* in French (possibility, probability of an event considered to be bad or damage, *Dictionnaire Larousse*) and in Italian (possibility of experiencing damage connected to more or less foreseeable circumstances, *Dizionario Treccani*), and to *danger* in English (the possibility of something bad happening sometime in the future; a situation that could be dangerous or have a bad result, *Oxford Dictionary*) and in Croatian (danger, exposure to danger, daring feat, *Rječnik stranih riječi*).

Risk related to natural or technological events is a negative consequence of probabilities that is necessarily to be reduced. In risk research, it is defined in many ways, and the polysemy of the term, as well as the multitude of applications, is above the scope of this work. However, the concept of risk is closely related to the notion of the future that can be impacted by natural processes, but that can be modified by some human activities (Zinn, 2009).

In the second half of the 20th century, with technological development and economic growth, the scientists started questioning about the rate that our society was willing to pay for safety, as related to nuclear energy in a seminal paper 'Social Benefit versus Technological Risk' by C. Starr (1969). The momentum was increased by the United Nations, whose Commission for Human Settlements (UNCHS – HABITAT) defined risk in 1981 as "related directly to the concept of disaster, given that it includes the total losses and damages that can be suffered after a natural hazard: dead and injured people, damage to property and interruption of activities. Risk implies a future potential condition, a function of the magnitude of the natural hazard and the vulnerability of all the exposed elements in a determined moment", or shortly: "There is a high risk of

disaster when one or more natural hazards occur in a vulnerable situation: *RISK = VULNERABILITY + HAZARD*" (Maskrey, 1989).

Risk is indeed a central topic in the management of many events and technologies. In an article *'Defining Risk'*, the authors call for an explicit definition of the term 'risk', considering its creation as a political act. The distinction of 'objective' risk, as a product of scientific research, and of 'subjective' risk, as non-expert perceptions of that research, is criticized: "When public and experts disagree, it is a clash between two sets of differently informed opinions. Sciences, scientists, and definitions of risk differ greatly in how explicitly they acknowledge the role of judgement" (Fischhoff et al., 1984). This is considered as a key factor in managing risks, the understanding of how experts and non-experts think and make decisions about risks (Covello, 1983), since risk communication efforts are bound to fail unless are structured as a two-way process of exchange between experts and general public (Slovic, 1987). In addition, although claiming that there is no standardized notion of risk, which is widely used in many different disciplines, B. Rohrmann (1998) defined risk as "the possibility of physical or social or financial harm/detriment/loss due to a hazard within a particular time frame" where hazard "refers to a situation, event or substance that can become harmful for people, nature or human-made facilities". Considering risk as a social and cultural construct, the epistemological distinction between objective and subjective risk does not stand, since all information about risk is only a representation of the reality (Rohrmann, 1998).

Those years, a far-reaching publication *'Risk society: towards a new modernity'* by U. Beck was published, where the author reflected about globalization and states that "Risk may be defined as a systematic way of dealing with hazards and insecurities induced and introduced by modernization itself" (Beck, 1992). As elaborated by O. Renn (1992): "There is no commonly accepted definition for the term risk – either in the sciences or in public understanding. All risk concepts have one element in common, however: the distinction between reality and possibility", subsequently defining risk as "the possibility that human actions or events lead to consequences that have an impact on what humans value" (Renn, 1998), and concluding that "the definition of risk, therefore, contains three elements: outcomes that have an impact upon what humans value; the likelihood of occurrence (uncertainty); and a specific context in which the risk may materialize" (Renn, 2008).

This multi-faceted concept and complex meanings of risk can be introduced by the following quote by J. Zinn (2009): “[...] it might sometimes be confusing that the term ‘risk’ in interdisciplinary risk discourse is used in at least three different, albeit connected ways. Often, risk is understood as similar to *hazard*, *loss*, *damage*, or *threat*. Then it is just an indication of unwanted events. At the same time, the term is used for *risk calculation*. In a technical perspective, risk is then about the probability and extent of an (undesired) event. However, in a less formalized perspective of everyday life, risk is often calculated by intuitive or pre-rational techniques”, or concisely by Y. Haimes (2009): “Risk is a measure of the probability and severity of consequences.”

This research draws heavily on here introduced work, with key words probability, perception and interdisciplinarity. Probability symbolises the natural, perception the social component, and interdisciplinarity what risks truly are, on the interface between natural and social sciences. The definition of risk taken in this dissertation is in line with the concise and widespread definition by Maskrey (1989):

“There is a high risk of disaster when one or more natural hazards occur in a vulnerable situation:  $RISK = VULNERABILITY + HAZARD$ .”

This definition is chosen due to the interdisciplinarity that is explicitly stated, vulnerability standing for social science, hazard representing natural science, and for its simplicity of expression, which is essential for the efficient management. It is important to note that this equation is just a theoretical description of risk. Risk is sometimes referred as sum of vulnerability and hazard (Maskrey, 1989), sometimes as their product (Blaikie et al., 1994). For me, the intersection of hazard and vulnerability represents the best the notion of risk.

The indicators used to characterise hazard and vulnerability will be discussed, as this is one of the key objectives of this thesis. However, there is a need to underline the importance of human exposure to hazards, and here exposure is considered as a consisting part of vulnerability. If there is no exposure of human beings or human-made facilities, there cannot be discussion of risks. Further in the thesis it is considered that there is always a vulnerable situation, with human beings dwelling in an area of research. Moreover, the hazards considered here are natural, not technological or social, due to personal interest and scientific background. Furthermore, risk is considered as a

social and cultural construct, and cross-cultural differences, efficient risk communication, and actual risk behaviour are discussed, in line with Rohrman (1998). Risk can be efficiently communicated only in a mutual exchange between different interlocutors included: scientists, risk managers, local authorities and the general population (Slovic, 1987, Renn, 1992a). Constituting parts of risk, hazard and vulnerability are two concepts that need to be introduced.

### **3.1.1. Hazard**

The research on natural hazards was scientifically initiated in the 1960s by G. White and his students who promoted a research paradigm based on assessing risks from natural events (Thouret, 1990, Gares et al. 1994). Natural hazards are defined in the paper by I. Burton and R. Kates (1964) as “elements in the physical environment, harmful to man and caused by forces extraneous to him”. The authors underlined that the wide disparity of definitions of different hazards was due to extensive scientific knowledge that lies behind, followed by the change in both knowledge and technology. However, they highlighted that precise definability is “a more sophisticated form of perceiving a hazard, [...] more than mere awareness” and they affirmed that the differences in human attitude towards natural hazards failed to be described precisely in terms of magnitude and frequency. It is so because of the existing differences in hazard perception between managers opposed to scientists and technicians, as well as differences among scientists (Burton & Kates, 1964).

Defined by the UNCHS – HABITAT, “hazard is the probability that in a given period in a given area, an extreme potentially damaging natural phenomena occurs that induces air, earth or water movements, which affect a given zone. The magnitude of the phenomenon, the probability of its occurrence and the extent of its impact can vary and, in some cases, be determined” (Maskrey, 1989). Hazards are characterised by their location, intensity or magnitude, frequency and probability (Assembly, U.G., 2016).

The role of natural sciences in risk analysis is crucial. D. Alexander (1993) emphasized the trigger role of natural factors, where a hazard is “a physical event which makes an impact on human beings and their environment and, unless this conjunction occurs, there will be no hazard or disaster”, referring to the period before disasters.

Likewise, P. Gares and co-authors (1994) questioned the role of physical science in research on natural hazards and judged it as rather undefined. They called for geomorphologists to recognise how the natural systems get affected by human systems, by understanding the geomorphologic responses emerging from the interaction of physical and human systems (Gares et al., 1994).

The role of natural science is even more straightforward for V. Baker, in a paper on the geomorphological understanding of floods from 1994, who argued that grand part of modern environmental science became increasingly mathematical and oriented towards modelling, whereas geomorphology can offer way more. When geomorphologically understanding the floods, real past processes are described, and that builds on concrete, particular natural experience. Since science cannot be expected to be only thoughtlessly followed but has to be truly understood, the author claimed that if human perception of risks derives from reality, then geomorphology can provide evidence for it, boosting human experience with hazards and perception of risks. As the author underlined it: “it is an irony of modern science that its conceptual emphasis, born of a need to bring rigor to explanations, has served to distance science from the great societal goal toward which many believe it aspires: to serve as the basis for societal action. [...] People’s perceptions, on which they are prepared to act, are open to what they can see and touch. Geomorphological flood evidence is as accessible to their senses, including their common sense, as it is to those of the hydrologist” (Baker, 1994).

Similarly, I. Alcántara-Ayala (2002) defined natural hazards as “occurrence of a natural condition or phenomenon, which threatens or acts hazardously in a defined space and time. [...] Natural hazards are considered with a geological and hydrometeorological conception [...]” they “are strongly related to geomorphology since they are important ingredients of the Earth’s surface dynamics”. The author underlined that “magnitude and frequency, as well as temporal and spatial scale, are key geomorphic concepts strongly correlated to natural hazards”.

Furthermore, an influential work *‘At Risk: natural hazards, people’s vulnerability and disasters’* by P. Blaikie and co-authors (1994, 2014) defined: “Hazard refers to the natural events that may affect different places singly or in combination [...] at different times [...]. The hazard has varying degrees of intensity and severity. Although our knowledge of physical causal mechanisms is incomplete, some long accumulations of



records (for example of hurricanes, earthquakes, snow avalanches or droughts) allows us to specify the statistical likelihood of many hazards in time and space.”

Although precisely and correctly defined by the UNCHS – HABITAT, as probability of an extreme potentially damaging natural phenomena affecting a given zone (Maskrey, 1989), natural hazards are here defined based on the definition of the UN (Assembly, U.G., 2016):

Natural hazards are processes with natural origins that may negatively affect humans physically, socially and economically or through an environmental degradation. They are either climate-related (floods, droughts, cyclones, heat waves) or telluric (earthquakes, landslides, volcanoes).

Although flood is a flood and earthquake an earthquake, regardless of the impact on population, hazards are here considered through a risk paradigm, where there is no interest for risk science if there is no human exposure. However, it is impossible to advance in risk research if hazards are not continuously and consistently studied, their characteristics such as magnitude or frequency that could indicate change. The active faults need constant monitoring, the maximum intensity of the rainfall could change in years, coastal erosion could be impacted by climate change processes. Due to climate and global change, all types of hazards need constant further research, and the role of natural sciences cannot ever be neglected in risk analysis. However, branches of science dealing with the multitude of hazards are fragmented, which requires an interdisciplinary research. The base of knowledge is immense and it calls for large human expertise, in order to successfully produce multitude of indicators used in risk management, on temporal and spatial scale (Blaikie et al., 1994, Alcántara-Ayala, 2002). Understanding of hazards contributes to direct and concrete natural experience, and provides evidence for risk perception (Baker, 1994).

However, to discuss the risk of disaster, natural hazards need to occur in an area where there are people or their property. We are dealing with the vulnerable situation.

### 3.1.2. Vulnerability

The switch towards the societal coupling with hazards happened with the American geographers of the so-called Chicago school around G. White, who considered physical processes through their social dimension within the concept of vulnerability (White & Hass, 1975), sometimes even characterizing natural hazards as resulting from the interaction of the natural and human-use systems (Cochrane, 1975). Similarly, until the 1970s, French geography was exclusively natural, when the focus on connections between nature and society arose. The switch of paradigm occurred in 1990s with the concept of vulnerability, when geography incorporated risk in its main concepts of space and territory. The coupling of nature and society is what makes geography, and could be exclusively an interdisciplinary science that relies on both natural and social sciences, but that works on hybrids with elements from both branches of science (Veyret & Reghezza, 2005). R. d'Ercole (1993) highlighted that hazard only concerns the physical phenomenon and is often confused with risk and called for taking vulnerability into account for efficient management of natural hazards, and A.-C. Chardon (1994) adopted the widespread risk equation where a natural component is a geodynamical phenomenon that constitutes a hazard or a threat, and where being vulnerable to natural risks means to be exposed physically to hazard. In addition, although praised the role of geomorphologists in undertaking natural hazards research, Alcántara-Ayala (2002) acknowledged vulnerability as a “key factor in understanding the occurrence of natural disasters”, and distinguished natural vulnerability, which depends on natural hazards, and human vulnerability, which is based on social, economic, political and cultural systems. There, he acclaimed the role of geomorphologists in the reduction of natural vulnerability, not only through the theoretical and applied knowledge of the discipline, but concluded that geomorphology “must play a role in the interdisciplinary efforts to develop adequate strategies for prevention and mitigation of natural disasters. Nonetheless, contributions of geomorphology would be even more significant if research applications were directed towards the understanding and coupling of human and natural vulnerabilities.” Similarly, although Blaikie et al. (1994, 2014) did acknowledge the significance of natural hazards as events that trigger disasters, they considered it insufficient for calculating the real level of risk. They, therefore, mainly emphasized how social systems function to engender disasters by making humans vulnerable, schematising risk in a pseudo-equation previously mentioned,  $RISK = HAZARD \times$

*VULNERABILITY* (Blaikie et al., 1994). This paradigm, in explicit or slightly modified form, is still nowadays largely used in risk modelling, like for example in assessing global vulnerability towards natural hazards by the United Nations (Peduzzi et al., 2009, United Nations, 2015).

Conversely to hazard, vulnerability is slightly more complex to define, since it is a dynamic process, and since it is not always clear what is the vulnerable situation or group, based on a multitude of world societies. As defined in the same document as risk and hazard, “Vulnerability of any physical, structural or socioeconomic element to a natural hazard is its probability of being damaged, destroyed or lost. Vulnerability is not static but must be considered as a dynamic process, integrating changes and developments that alter and affect the probability of loss and damage of all the exposed elements.” (Maskrey, 1989)

T. Cannon (1994) argued what is nowadays widely accepted, that “hazards are natural, but that in general disasters are not” since “disasters happen when a natural hazard strikes vulnerable people.” He defined vulnerability as “a characteristic of individuals and groups of people who inhabit a given natural, social and economic space, within which they are differentiated according to their varying position in society into more or less vulnerable individuals and groups.” He also stated that the “conflict of economic interests is one of the most intractable barriers to the mitigation of disasters.” Although it has a lot to do with poverty, vulnerability and poverty are not synonymous, as highlighted when the consequences of the cyclones in the USA, or droughts and floods in Europe are assessed.

In addition, according to findings of a group of French physical geographers, “vulnerability is articulated around a large number of variables, natural and human, whose dynamics in time and space can generate more or less dangerous situations for an exposed society” (d’Ercole et al., 1994). The classical approach consists in measuring the potential damage of the exposed elements, evaluating spatial-temporal, socio-economic and cultural consequences (Thouret & d’Ercole, 1996, d’Ercole, 1998).

The multitude of the term ‘vulnerability’ is remarkable, and J. Birkmann (2006) listed twenty-five different definitions (Becerra, 2012), but more about definitions and theoretical background is above the scope of this research. However, at least ever since the development of the sociology of catastrophes in the 1970s the role of society in assessing vulnerability is acknowledged. Both sociology and geography share the idea

that the occurrence of disasters depends on the interaction between the environment and the social systems, on the social response of the communities facing them. However, the challenge is to operationally evaluate and measure vulnerability, integrating different approaches (quantitative and qualitative, traditional and participatory) to different scales, from local to global (Becerra, 2012). The scale problematics was elaborated by M. Reghezza-Zitt (2017), who argued that, although the meaning for global is worldwide, the clear meaning of the term local is non-existent and could go from precise places to regions, countries or even continent, with a need of thinking about vulnerability scales to capture the particularities of certain risks (Reghezza-Zitt, 2017).

In this work vulnerability is considered on the grounds of the definition by the UNCHS – HABITAT (Maskrey, 1989) and by Cannon (1994):

Vulnerability is a characteristic of people who inhabit a given space, within which they are differentiated according to their varying position in society into more or less vulnerable individuals and groups. Vulnerability must be considered as a dynamic process, always relative to a certain situation or action, integrating changes that affect the probability of human loss and damage of all the exposed elements.

The fact that vulnerability is dynamic, varying over time, and relative to specific situation, varying over space, adds to complexity and challenge in operationally evaluating and measuring it. Indicators evaluating vulnerability must, therefore, meet both of these characteristics to reach their utility in efficient risk management, and this is one of the key objectives of this thesis. Different scales and different approaches need to be integrated (Becerra, 2012). Flood, earthquake or coastal storm are hazards that are always measured in the same way, using magnitudes, frequencies, probabilities. However, it is not the same if flood, earthquake or coastal storm hit an area belonging to one society or another, a wealthier or poorer region of the same society, separately or simultaneously, hitting a young or experienced society, land that is less or more densely covered, and so forth. In addition, a further contribution to vulnerability assessment is the ‘intangible’ damage that disasters cause, such as the loss of meaning, values or social cohesion, as well as the feeling of vulnerability, the risk perception and its impact on human behaviour (Gilbert, 2009). But before discussing the risk perception and societal

input in risk management, another concept closely related to vulnerability needs to be introduced: resilience.

### **3.1.3. Resilience**

Although previously used in physics, psychology and ecology, the resilience of societies to climate change was discussed by P. Timmerman in 1981, but became central concept in risk management in the beginning of the 2000s (Reghezza-Zitt et al., 2015). Resilience relates to reversibility or elasticity. “The relationships that underpin vulnerability often generate disturbances that can modify the characteristics of the elements, sometimes irreversibly; this reversibility is part of the measure of vulnerability: the resilience of the system.” (Dauphiné, 2003, Mazurek, 2012). Resilience is a process that does not seek to reduce an impact, but that enables to anticipate the impacts of hazards. It is, therefore, an opposite concept of resistance, which can have troublesome effects when the system’s behaviour is not linear nor predictable (Dauphiné & Provitolo, 2007). It has been a long time since human action was seen as a possible strong perturbation of physical and biological equilibriums that could lead the Earth’s destiny towards unknown directions (Dauphiné, 1991b). Sometimes it is considered as a complementary and novel approach to vulnerability, that aims at identifying conditions favourable to damage or affecting the ability to respond to a crisis. It is thus turned towards the operational research and development (Thouret & d’Ercole, 1996, d’Ercole, 1998). Similarly, while comparing vulnerability and resilience, Y. Haimes focused on the research of societal response to terrorism, and vulnerability there indicates the physical, organizational, or technical states of a given system that can be exploited by an enemy to damage it (Haimes, 2006). On the other hand, resilience is the ability of the system to endure a large disturbance within tolerable degradation level and to recover within a tolerable time. The main difference is that “vulnerability addresses only a system’s protection, whereas resilience focuses also on a system’s recovery following an adverse event” (Haimes, 2009).

Resilience is likewise, related to natural hazards, defined in the paper by S. Cutter and co-authors (2008): “Resilience is the ability of a social system to respond and recover from disasters and includes those inherent conditions that allow the system to absorb impacts and cope with an event, as well as post-event, adaptive processes that facilitate

the ability of the social system to re-organize, change, and learn in response to a threat.” In that paper, the authors made a clear distinction between vulnerability and resilience, two concepts that, although often related, are detached. They considered vulnerability as “the pre-event, inherent characteristics or qualities of social systems that create the potential for harm”, and related it to exposure and sensitivity of the system. Their model serves to establish the relationship between the two concepts, particularly to tackle natural hazards, and with the main focus on the social resilience at the community level. As far as indicators of resilience are concerned, livelihood is often used as an indicator of resilience at the individual level, and the Gross Domestic Product at the regional or national scale. The authors also suggest some indicators of resilience related to rapid onset hazards (e.g. community evacuation plans, seismic retrofit on structures, storm shutters) and to slow ones (e.g. water conservation, drought-resistant crops species) (Cutter et al., 2008). This approach can be used to manage risks by defining indicators dynamically, bridging the concepts of vulnerability and resilience.

The relationship between vulnerability and resilience was also considerably analysed in the work of French scientists. D. Provitolo (2009) identified three temporal phases of the cycle of disasters, with the temporality of the risk before the release of the hazard, the temporality of the disaster (the hazardous event per se), and the time after the disaster and the resilience of the system. Vulnerability is thus just one of the components of the whole catastrophe (along with hazard and domino effects), and resilience is praised for opening “the possibility to study the catastrophe not any more from the point of view of the event but rather from the approach of the crisis”, considering the disaster system as a whole (Provitolo, 2009).

M. Reghezza-Zitt and co-authors (2012) evaluated resilience in details, with a critical approach in the paper entitled ‘*What resilience is not: uses and abuses*’. There they pinpointed at the vast meaning of the term, nowadays inevitable in risk management, but that leaves some political and ethical doubts while using it. As defined: “In the context of geography, resilience is thus the ability of a system (social, spatial, economic, etc.) to reproduce itself: it is not continuity without change but the ability of an element at risk to maintain itself through disruption or even to assimilate the disruption to its functioning.” By comparing the definitions and usage of terms, the negative connotation of vulnerability, and a positive and desirable of resilience is underlined. Within it, however, cities can be both vulnerable and resilient at the same time (e.g. New York,

vulnerable to terrorist attack and hurricane Sandy, nevertheless resilient as one of the global 'centres'). The problematic of the temporal scale is elaborated as well, since the authors legitimately ask themselves 'when the crisis stops' and 'the post-disaster period starts', as well as 'what is that going back to normal' that resilience has to reach to be considered as a 'post-disaster recovery' (e.g. New Orleans and hurricane Katrina). Finally, declaring a territory resilient has a political meaning and implications, the political choices are done and an agenda is pushed for to become 'more resilient' and the individual participation of a broad number of local stakeholders is called for, to list only some of the remaining issues related to resilience. The uncertainties related to a shift from vulnerability to resilience, particularly the substitution of protection with adaptation, along with the following political agenda, were elaborated by C. Gilbert (2013).

To sum up this 'vulnerability vs. resilience' discussion, the concepts are indeed partly dependent, but still distinct. The concept of 'resiliency vulnerability' that goes beyond opposition is proposed (Provitolo et al., 2015), and it is argued that resilience is shared by two excluding concepts: hazard research (where resilience and vulnerability are synonyms) and risk analysis (where resilience and vulnerability differ, with indicators used in analytical approach) (Reghezza-Zitt et al., 2015). However, in this work resilience will be considered as a different, complementary concept to vulnerability. The definition is in line with the one proposed by S. Cutter et al. (2008):

Resilience is the ability of a social system to respond and recover from disasters, that does not seek to reduce an impact, but that enables to anticipate the impacts of hazards. Contrary to vulnerability, pre-event, inherent characteristics of system, resilience is considered as post-event process that facilitates the ability of the system to re-organize, change, and learn in response to a threat.

When considering and discussing vulnerability and resilience as concepts bridged together, the dynamic features of indicators in risk management will be proposed. Although resilience is an omnipresent concept in risk management nowadays, it casts some political or ethical doubts. The questions on who and how decides when the crisis stops, and what does it mean to go back to normal are legitimate and should be asked (Reghezza-Zitt et al., 2012) and they are actually questioned in light of the covid-19 pandemics. Resilience as a concept, therefore, is to be used complementary with

vulnerability to manage risks by defining indicators dynamically, bridging the two concepts describing pre- and post-disastrous events, which is one of the key objectives of this thesis.

## 3.2. Risk management

R. Zimmerman (1986) defined risk management as the outcome of the integration of risk analysis into the decision-making process. “Risk management is defined here as the process by which decisions about risk are made linking analytical procedure with the administrative, legal, political, organizational, and human dimensions of the decision-making process” (Zimmerman, 1986). The true interdisciplinarity of risk management, sometimes referred as geo-cindynics, was stated and elaborated by French geographers, who at the same time called for the contribution and inclusion of both scientific domains in the development of a risk management science (Faugères, 1991).

The management process is put directly into society, through the communication process. The difference between risk assessment and risk management was underlined in Haimes (2009), where the former “attempts to ‘discover’ potential future risk-based events [...] and thus to prepare for and respond to possible adverse events through risk management and risk communication.” In addition, the way how societies are ruled has an impact on risk management strategies. In that way, A. Maskrey (1989) criticized top-down, centralized disaster mitigation programs that dealt with risks of specific hazards, and not with reducing vulnerability in a community-based approach he experienced in Latin America. Later on, based on further experience, the author revised his advice, stating that many of the best community-based managements are those that were promoted by Latin American governments. The broader partnership of governments and civil society is needed, balancing top-down and bottom-up scales of action, with a switch of focus from individual communities to wider, regional areas (Maskrey, 2011). Besides, disasters are still considered as unforeseen shocks rather than the outcome of failed social processes, where real political and economic commitment for efficient disaster risk management is needed (Lavell & Maskrey, 2014).

Although building on these elements, on the societal impact on risk management, on the communication and its impact on awareness and on the need for truly interdisciplinary research for an efficient risk management, this thesis relies mainly on



the extensive work on risk evaluation and management by A. Klinke and O. Renn (2002). There the authors resumed (in line with Zimmerman, 1986):

The authors presented their three types of management, based on the characteristics of a multitude of risks and the problems of complexity, uncertainty, and ambiguity. The risk-based strategies correspond to large events of well known probability of occurrence, such as earthquakes or floods, and they call for indicators improving organizational managing structures. Precaution-based strategies are destined to events of relatively high degree of uncertainty, such as human intervention in the environment or changes in the ecosystems, and they call for more monitoring indicators and precautionary measures. Discourse-based strategies target climate change and loss of biodiversity, and call for indicators of subjective perception, awareness, trust and public participation (Klinke & Renn, 2002).

Due to lack of expertise on organizational managing structures to focus on risk-based strategies, and due to high uncertainty that calls for enhanced monitoring in precaution-based strategies, this thesis is mainly focused on indicators that can improve the discourse-based strategies. There, the public participation is needed, especially if there is a large gap in risk perception between general population and experts. Risk awareness, societal trust, information transfer and direct involvement of affected people will be tested in both of the chosen terrains of study.

### **3.2.1. Societal and cultural knowledge**

Through a long history of settlement in one place, communities become experienced in the dangers posed by their immediate surroundings. These local hazards have been continuously integrated into local cultures as a type of cultural inoculation process that is active at a collective level, enabling a better resilience of communities to naturally occurring hazards (Douglas & Wildavsky, 1982, Kasperson et al., 1988, Boyer-Villemare et al., 2014). Social memory, myths and religious beliefs are mixed into common-sense knowledge that supports local people in their practices (Nazarea, 2006), and scientific information is translated into common-sense knowledge by integrating historical and cultural ideas, as a way of making scientific aspects contextually meaningful for local populations (Moscovici, 1984, Joffe, 1999).

The social reference and the general world view of the others are important while we are constructing our theories about our space. While Dauphiné (1991a) distinguished between terrestrial and geographic space, where the latter is constructed by geographers departing from the former's reality, Mazurek (2012) questioned this distinction. He argued that space is observed through different filters, which are determined by perceptions, social classes and hierarchies constructed around those perceptions, and not by differences of disciplines that describe it (Bourdieu, 1977, Mazurek, 2012).

Knowledge about risk undergoes the same process of 'translation' of scientific knowledge to the common sense of laypeople (Moscovici, 2002). Eventually, the mismatch between scientific logic and its local appropriation for risk preparedness has been seen to contribute to the vulnerability of local populations to natural hazards (Langford, 2002, Solberg et al., 2010). Furthermore, some cultures express fatalistic attitudes towards future hazard predictions, preventing them from acting although they have direct experience with hazards (Ainuddin et al., 2014); some with genealogical or economic place attachment prepare for hazardous events (Mishra et al., 2010); sometimes the financial insurance and preparedness strengthen the sense of security, but weaken the sense of caution when it comes to encountering hazards (Lo & Cheung, 2015); sometimes the 'false sense of security' can be caused by the technological progress and protective structures, such as it was with the coastal dykes in the region of Sendai, Japan (Strusińska-Correia, 2017).

In addition, society is made of different individuals with diverse backgrounds, education and risk experience. If we want to manage risks successfully, public participation in the management of hazards needs to be promoted (Slovic et al., 1979). The dialogue and the values are two directions to be taken into account. The improved dialogue and partnership of government with public are tackled by the risk communication strategies, with an extensive review that underlines the key obstacles to efficient risk communication: gaps in knowledge, lack of trust, selective information transfer by the media, and psychological factors of how people process information related to risk, acknowledging the partnership of managers and the general public (Covello & Sandman, 2001).

However, this relationship is not enough. The cultural theory of risk indicates that social groups have their own 'risk portfolio' based on their system of values (Douglas,

1990), and are pushed to become entrepreneurs of their own risk choices, by deciding on insurance or making political choices (Peretti-Watel, 2003). Unfortunately, the local knowledge and cultural particularities are getting lost by globalisation and institutionalisation of risk, where the traditional landmarks are lost (Mazurek & Arreghini, 2004). The international community seems to be slow in learning about the local adaptive measures from the southern, less developed countries whose approaches differ (Janicot & Reinert, 2015), and where the participatory approach contributes to the improved dialogue in knowledge sharing process (Mazurek, 2016). The impact of personal participation in elaborated collective risk management opens the field of social representation, the theory of common sense, that refers to the ideology and personal positions (Moscovici, 1961, Gruev-Vintila & Rouquette, 2007).

Finally, damages caused by natural hazards and as consequences of climate change have a high economic impact (Cochrane, 1975, Tol, 2013). Economists focused on their analyses on consumers' preferences for technologies and policies that can avoid or mitigate the negative consequences of climate change. Special attention has been paid to analyse the willingness to pay (WTP) to support public policies addressing carbon dioxide emissions (Tol, 2013). For example, a recent study on an Italian nationwide survey shows that WTP ranges a lot and the heterogeneity due to proposed public policies and individual characteristics is similar (Alberini et al., 2018). While these approaches generally focus on green technologies (Bigerna et al., 2017, Streimikiene et al., 2019), very recent studies focused on stated preferences started analysing WTP for the adoption of nature-based solutions (Bockarjova et al., 2020). Moreover, in the past decades, a wide range of studies have analysed the determinants of WTP to reduce climate change risk. European studies of climate change and the insurance industry have mainly been conducted in Germany, the Netherlands, and the United Kingdom (Bellman et al., 2016).

Lastly, the strong impact of social and cultural influences on the experts' interpretations of probabilistic information in transmitting it to laypeople is discussed in the literature, since the way the information is framed while being presented to the population directly influences the perception of risks (Johnson & Covello, 2012), with a crucial role in managing risks.

### 3.2.2. Risk perception and awareness

A leading role in efficient risk management is not only played by knowledge but equally by risk perception. In one of the first contributions of cognitive psychology to decision making under risk, the concept of risk perception depicted that non-expert people might perceive risks by resorting to different logics than experts do (Slovic et al., 1976), making the process of risk appropriation more complex. Likewise, V. T. Covello (1983) assumed that a better understanding of how experts and non-experts reflect on and decide about risks would be beneficial to both risk analysts and decision-makers.

In the later article *'Perception of risk'*, P. Slovic (1987) proposed a strategy for studying perceived risk through psychometric paradigm, which uses multivariate analysis techniques and scaling to produce a quantitative representation of risk perceptions. The main conclusion is that laypeople can be short of some information related to hazards, but have a rich perception of risk that has to be included in risk assessments by the experts.

B. Rohrman (1998) defined risk perception as a concept that “refers to people’s judgments and evaluations of hazards they are or might be exposed to” which are the “interpretations of the world, based on experiences and/or beliefs”. Since the images of risk are sometimes distorted, public perception is at least partly driven by biases, false assumptions and sensation, as argued by O. Renn (1998). He reasoned that risk perception studies help to collect different personal experiences with risks and identifying public concerns. However, they cannot state any normative legitimacy. Since scientific expertise and rational decision-making are necessary, but not sufficient, such a debate between experts and non-experts is needed.

The risk research on perception additionally accentuates the need for interdisciplinary research, particularly the need for rising above the gap between natural sciences and humanities. As argued by social anthropologist T. Ingold (2000), humans are organisms that evolved in the environment but use their imagination and social constructs in everyday life. He asked whether an ecological approach to perception could offer the relation between biological and cultural life that we are deeply involved in, considering us as organisms-in-our-environment, and not as individuals confronting the outer world.

Furthermore, another discipline that has a say in risk perception is social psychology. As argued in the paper by I. Langford (2002), social and cultural settings are the grounds

to study how anxieties relate to the ways people perceive risks. Among his case studies, one related to climate change captured a wide range of personal, social and environmental anxieties. This helped him to argue that the complexity and importance that risk perception has in forming identities demand for people's recognition and involvement. People need to be persuaded in their need to act, and only by believing in change can risk managers develop significant and far-reaching risk strategies. Moreover, in his existential approach, the author elaborated the perception and fear of death, a primal source of anxiety. This fear can lead to defence mechanisms of a belief in personal specialness and/or in some form of ultimate rescuer, which acknowledges religious values when perceiving existential risks (Langford, 2002). Recently, climate change is considered as an existential security risk and a threat to human civilisation, where the severe +3°C warming (2050 scenario) predicts world conflicts over resources, amplified religious zeal, and utter chaos (Spratt & Dunlop, 2019).

Another similar yet distinct concept is risk awareness. If risk perception can be described as related to 'conceptual understanding' of threat, risk awareness could be associated to information, knowledge and participation in risk information sessions (Papagiannaki et al., 2019, 2019b). Nevertheless, while some authors do not seem to strictly distinguish between risk perception and risk awareness in their research (AlQahtany & Abubakar, 2020), others consider awareness to be just one of the components to measure risk perception (Khan et al., 2020).

In addition, resulting from risk awareness and perception, but based on the cultural and socio-economic context, is the risk precautionary behaviour. Come what may, it is not always the case that high-risk perception provokes protective actions or precautionary behaviour (Wachinger et al., 2013). Similar appears to be true for risk awareness. A comparative study has shown that high seismic risk awareness was not translated into human behaviour in the USA, Japan and Turkey (Joffe et al., 2013). Likewise, in the Costa Rican study on climate change and floods, the impact of risk perception on risk awareness was detected but did not result in the adoption of disaster risk reduction measures (Hori & Shaw, 2012). Furthermore, it seems that taking actions based on risk awareness could be particularly critical in a multi-hazards setting (Sullivan-Wiley & Gianotti, 2017).

Risk awareness has been globally investigated concerning tsunamis, and it is confirmed to have grown after both the disastrous 2004 Indian Ocean and 2011 Tohoku earthquakes and tsunamis (Arce et al., 2017). While horizontally comparing Japan, Chile and Indonesia, the authors named the lack of awareness and cultural issues as one of the key explanations for adequate tsunami response (Esteban et al., 2013), confirming that risk awareness was related to education, local particularities and local and national policies (Esteban et al., 2017), showing the impact of the cultural context on behaviour. In a recent tsunami awareness research in the same region, the authors underlined the peculiarity of the submarine landslide tsunami (Harnantaryari et al., 2020), and the awareness in the low-risk coastal community (Valenzuela et al., 2020).

When it comes to recent studies from the Mediterranean region, risk perception and awareness included landslide perception (Antronico et al., 2020) and multi-hazards perception (Avvisati et al., 2019) in South Italy. In a recent Greek study, the authors showed that risk perception did not manage to explain the current level of preparedness, as it stated only the preparedness intentions. Nevertheless, it showed that variables describing risk awareness and confidence were indeed identified to impact flood precautionary behaviour (Papagiannaki et al., 2019). In another Greek study, testing public risk perception on multi-hazards, the authors provided results according to which risk awareness and personal experience play a key role in risk perception, and found that awareness activities relate to a higher emergency response effectiveness (Papagiannaki et al., 2019b).

Finally, some studies tried to grasp an individual's risk awareness and perception, which might influence WTP for protection, as an indicator of precautionary risk behaviour. As regards developing countries, risk perception is a leading factor related to earthquake insurance demand in China (Tian & Yao, 2015), whereas in the case of floods in Pakistan WTP is not significantly influenced by perceived risk, but by respondents' financial position (Abbas et al., 2015). Conversely, in developed countries, the effect of risk perception on WTP seems to be more apparent. One Dutch case study indicates that the perceived flood risk is a stronger predictor of WTP for flood insurance than the real risk level based on geographical information (Botzen & van den Bergh, 2012). Moreover, a recent Canadian study confirmed the influence of the ongoing climate change and storm surge perception on the WTP of the inhabitants of a coastal city of Halifax (Withey et al., 2019). However, while the perception of the consequences does not appear to be a

strong determinant of the choice of adopting mitigation measures in Germany, other socio-economic factors such as having children or being a house owner result in stronger determinants and in spending more money on flood protection measures (Kreibich, 2011).

The research presented in this thesis draws heavily on here presented work. While distinguishing the indicators in risk management, the awareness, perception and behaviour need to be distinguished. Although sometimes the concepts of risk awareness and risk perception are overlapping or confusing, in here presented research the concepts draw from the distinction made by Papagiannaki et al. (2019, 2019b). Risk awareness is, therefore, considered as the measure of information and knowledge uptake, risk perception is related to conceptual understanding of the threat, based on a personal interpretation of the knowledge arising from a cultural background, and risk precautionary behaviour is the result of awareness and perception based on the socio-economic context. Risk perception is, thus, considered as a higher and more technical term than risk awareness, calling for higher expertise in psychology and social science. Therefore, the focus here will be more on the indicator of risk awareness and its impact on precautionary behaviour, considering the cultural context for measure-taking, since risk questions are never only technical, value-free problems (Zinn, 2009). The cultural context will be tested while comparing two different societies, from different socio-economic contexts, inspired by a cultural approach that considers risk as a social and cultural construct. Cross-cultural differences between North Morocco and Sardinia will be detected, and actual risk behaviour of North Moroccans and Sardinians will be described, in line with Rohrman (1998). Since it was shown long ago that the communication and the transfer of information contribute to different risk perceptions between the experts and non-experts (Slovic et al., 1976, Covello, 1983, Renn, 1998), here the efficiency of risk communication between the general population, scientists and managers will be examined.

It is to see how the international community implements social knowledge in disaster risk reduction strategies.

### 3.2.3. Institutional response to disaster risk reduction

For decades, it has broadly been acknowledged that the disasters that cause human and economic losses are not only natural but depend on the social conditions of the areas where natural hazards occur (Alexander, 1997). Risk management has been praised for its part in resolving uncertainty and even controversy in the field of policy (Zimmerman, 1986), improving society. To make society respond more efficiently, and to tackle the increasing losses, the United Nations (UN) developed disaster risk management plans to set goals and objectives for reducing risks associated with natural hazards. After the International Decade for Natural Disaster Reduction (1990-1999), disaster risk and risk management expectedly attracted more attention worldwide. One of the frameworks developed was that from the “Program for Latin America and the Caribbean”, which, in addition to relative indicators at the national level, included a limited number of aggregate indicators to serve policymakers. Four composite indicators were used to measure each country’s progress in risk management and its proposed monitoring tool for risk management is still used in modified form on national levels (Cardona, 2003, Cardona, 2005, Neri & Magaña, 2016). On a larger, global scale, the first framework for disaster risk reduction, i.e., the *Hyogo Framework for Action 2005-2015*, was adopted. The five priorities for action were: ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation; identify, assess, and monitor disaster risks and enhance early warning; use knowledge, innovation, and education to build a culture of safety and resilience at all levels; reduce the underlying risk factors; strengthen disaster preparedness for effective responses at all levels (UNISDR, 2005). Among its identified shortcomings was the need to encourage mutual responsibility for disaster resilience at all levels (Zimmermann & Keiler, 2015), which was hopefully overcome in the most recent plan, i.e., the *Sendai Framework for Disaster Risk Reduction 2015-2030* (Assembly, U.G., 2016).

The Sendai Framework aims at achieving a significant reduction of disaster risk and losses during a 15-year-period and consists of seven global targets, which are proposed to reach the goal by using appropriate indicators. There are four priority areas for action: better disaster risk knowledge, improved risk governance and management, new research into resilience practices, and improved post-disaster and recovery phase. The missing gap on mutual responsibility from the Hyogo Framework is now addressed, but with subsisting doubts on how to implement it (Zimmermann & Keiler, 2015). The



Sendai's flaws are the lack of the targets that specify a measure of improvement in disaster risk to be made, the first five years are meant to serve as a period to put together disaster risk reduction strategies, and sometimes the objectives are expected to be attained on a global level (Mysiak et al., 2016). The proposed indicators mainly apply to the monitoring of national policies and carrying out the Sendai policy, rather than the implementation of local strategies (UN, 2015, Beccari, 2016). The key objective of adapting the framework for local contexts has recently been addressed (Zimmermann & Keiler, 2015, Klein et al., 2019), coming from the positive example of increased resilience to floods and droughts in Peru, where the teams of locals worked together with external researchers to identify vulnerabilities and possible solutions (Klein et al., 2019). Similarly, measuring societal resilience at country level (Germany) is underlined as problematic for local level assessment since demographic information cannot be profound (Fekete, 2018). These examples of governance and institutional arrangements put back on stage the bottom-up arrangements (participatory approach derived from a common work of a group of involved members of society, conversely to top-down arrangement decided from above) for management that better suits different local contexts (Klein et al., 2019). Finally, seeking for Sendai's framework to succeed, the open-source knowledge transfer of reviewed information on disaster risk reduction from researchers to practitioners has to be established (Cutter et al., 2015).

The UN also called for a better dialogue between experts and civil society (the community flow) and, since the key terms like *disaster risk*, *hazards*, *vulnerability* and *resilience* used in the literature are sometimes differently defined, it recommended the use of a defined terminology related to disaster risk reduction as it follows. The UN defines *hazards* as processes that may negatively affect humans physically, socially and economically or through environmental degradation, with either natural, anthropogenic or socio-natural origins. *Vulnerability* is the condition that increases the human susceptibility to the impacts of hazards. *Disaster risk* is determined probabilistically as a function of hazard, vulnerability, exposure and capacity. Complimentary to vulnerability, *resilience* is the ability to recover from and adapt to the impacts of a hazard in a timely and efficient manner (Assembly, U.G., 2016).

However, among the previously mentioned 38 defined terms in the United Nations Office for Disaster Risk Reduction (UNDRR) report on indicators and terminology

relating to disaster risk reduction, the term *indicator*, widely understood and used by the risk managers, is not among them (Assembly, U.G., 2016)<sup>a</sup>.

### 3.2.4. Indicators in risk management

The term ‘indicator’ is widely used in different branches of science, from mathematics and economics to natural sciences, but also in engineering or policy-making. For example, indicators are common in territorial and environmental planning, where they stand for a measure of environmental properties (Hein & Kowarik, 2010). For instance, vulnerable species are an indicator that allows evaluating the quality of a marine environment (Boubekri & Djebar, 2016). To use indicators as a clear basis for decision-making, it is needed to precisely define what the term ‘*indicator*’ means in our specific context of research (Heink & Kowarik, 2010). As stated in the book edited by Jörn Birkmann (2007), different authors would define indicators differently. Birkmann defines the vulnerability indicator for hazards of natural origin as “a variable which is an operational representation of a characteristic or quality of a system able to provide information regarding the susceptibility, coping capacity and resilience of a system to an impact of an albeit ill-defined event linked with a hazard of natural origin” (Birkmann, 2007). Additionally, in risk management, every measure of environmental, social or economic phenomena used to evaluate or to set environmental, social or economic changes and goals could be considered as an indicator (Cardona, 2005, Heink & Kowarik, 2010).

But an indicator is not only a variable; it is also often a combination of variables. An indicator is above all the quantitative or qualitative translation of the state of a concept or a phenomenon. The main characteristic of an indicator is to ‘shorten’ the information, to make it more compact to allow a better understanding of the phenomenon, especially for a non-specialist audience. The indicator is also a replicable element that can be used to track a phenomenon in time and space. In the field of natural hazards, the composite characteristic is of special importance, since it makes it possible to combine physical, social and economic variables to evaluate a state, like for example the level of risk, and the recovery after the risk. It thus allows better preparing systems for much more

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<sup>a</sup> Clear, additional outline on Sendai indicators <https://www.undrr.org/news/sendai-indicators-only-beginning> (online access: 2 June 2020)

effective surveillance and warning. Nowadays, managers need control instruments. Since indicators somewhat guarantee decisions' fairness and rationality, thus allowing negotiation, their control constitutes one of the main stakes of risk management (Dale & Beyeler, 2001, Kitchin et al., 2015).

Indicators are an important component of disaster risk management, since they detect flaws or failures of societal development. To take into account human welfare, disaster risk management should, however, "be defined primarily in terms of positive development benefits, measured with sensitive and sensible indicators, rather than strictly and uniquely in terms of the avoidance of negative consequences" (Lavell & Maskrey, 2014). The authors fear that the disaster risk reduction paradigm is turned towards strengthening resilience only in the discourse, and that it "continues to be driven by the increasingly outdated notion that disasters are exogenous and unforeseen shocks that affect supposedly normally functioning economic systems and societies rather than endogenous indicators of failed or skewed development, of unsustainable and insane economic and social processes and of ill-adapted societies."

According to the authors, disasters are indicators of failed development and of insane economic and social processes, therefore, it could be debatable that the ongoing covid-19 pandemic is an indicator of unsustainable development, of biodiversity loss and of nature sending an alarming message to quit on our business as usual. Flaws or failures of the usage of indicators in risk management will be discussed in this thesis.

### **3.3. Summary**

There has been a large scientific corpus on managing risks, with an ongoing debate on the definitions and usage of concepts. Based on this state of the art, the following stand is taken. Risk is considered as an interplay of natural hazards and societal vulnerabilities (Maskrey, 1989, Blaikie et al., 1994, 2014). Hazards are potentially extreme damaging phenomena occurring regardless of human exposure or built environment, taking place in space and time based on the laws of nature. However, they are here considered through a risk concept, as processes that may negatively affect humans, since there is no risk without human exposure. The considered natural hazards are numerous and call for constant measurement and follow-up of their frequencies, magnitudes, intensities and for broad scientific research on their interactions and change. Vulnerabilities,

characteristics of people inhabiting a given space differentiated according to their varying positions in societies (Cannon, 1994), are dynamic over time, and relative to specific spatial situation, which increases the complexity and challenges for operational measurements (Becerra, 2012). Resilience is the ability of a social system that seeks to anticipate the impacts of hazards. It is a concept here used complementary with vulnerability to manage risks by defining indicators dynamically, bridging the two concepts describing pre- and post-disastrous events (Cutter et al., 2008). All this effort is to improve risk management, the process of reducing the risks to a level deemed acceptable by society and to assure control, monitoring, and public communication (Klinke & Renn, 2002). Societal knowledge and local particularities of territories are a crucial part of risk management research since the process of integrating cultural ideas contributes to making scientific aspects contextually meaningful for local populations (Moscovici, 1984, Joffe, 1999). They are important in constructing risk perception and awareness, that can, if based on favourable socio-economic context, result with precautionary risk behaviour.

Although the international community broadly acknowledges the need to tackle dramatic human and economic losses, the question is, why after more than 30 years of risk management policies, the vulnerability of populations remains so significant? Is it because the proposed risk indicators mainly apply to the monitoring of national policies, instead of the learning about the local adaptive measures and the implementation of local strategies (Janicot & Reinert, 2015, Beccari, 2016)? An indicator is a quantitative or qualitative translation of the state of a concept or a phenomenon, that can be used to track phenomenon in time and space, and that 'shortens' the information, making it more compact and comprehensive, especially for non-expert population. How to improve its construction, to consequently improve risk management?

The indicators are approached as follows. Since risk is a cross-sectoral domain between natural and social sciences, interdisciplinary research is called for, in order to integrate different parameters into a global approach that should be comprehensive for all the actors involved, to allow identifying reliable indicators related to multiple risks (Birkmann et al., 2013). Branches of science dealing with the multitude of hazards are fragmented and the base of knowledge calls for large human expertise. In this thesis, the indicators of hazard will be looked for and analysed based on an extensive literature review on indicators used in risk management. The same will be done for the indicators

of vulnerability. The fact that vulnerability is dynamic and relative to a specific situation is challenging for operational measuring since different scales and approaches need to be integrated. Different spatial scales will be examined by comparing North Morocco and Sardinia, and by testing for the efficiency of risk communication between the general population, scientists and managers, integrating both quantitative and qualitative approach. Resilience as a concept will be used complementary with vulnerability to manage risks by offering ideas for dynamic indicators, where vulnerability stands for pre- and resilience for post-disastrous events.

This thesis is mainly focused on risk management indicators that can improve the discourse-based strategies. There, indicators of subjective awareness, trust and public participation are called for, especially if there is a large gap in risk perception between general population and experts. Risk awareness, societal trust, information transfer and direct involvement of affected people will be tested in both of the chosen terrains of study. Inspired by a cultural approach that considers risk as a social and cultural construct, the cultural context will be tested and cross-cultural differences in actual risk behaviour described while comparing two different socio-economic contexts of North Morocco and Sardinia. Besides, the efficiency of risk communication between the general population, scientists and managers will be examined.

Within this context, since indicators are designed to comply with the application of the Sendai Framework, the question is whether or not they respond to the societal need of serving as decision tools to reduce impacts and to facilitate the resilience of societies, taking human welfare into account. Could they be more dynamic and permit more bottom-up processes, uploading more of the locally gathered information worldwide towards the official international community working in a disaster risk reduction? Finally, how large is the gap between micro and macro scale in managing risks? The way of building dynamic indicators in this thesis will contribute to improved usage of indicators in risk management.

## 4. Methodology

Firstly, the extensive literature on indicators used in risk management was analysed. Moreover, to gain the answer on possibly useful risk indicators the questionnaires and interviews were used for the Moroccan case study. Finally, in the Italian case study, the questionnaires were used for data collection, which was later crossed with the existing secondary literature on risk management on a national and regional level.

### 4.1. Bibliographic research on risk management indicators

For the selection of papers to be included in our bibliographic analysis, the multidisciplinary science catalogue Web of Science database was used. To obtain as many papers as possible in line with this survey, the following keyword searches were performed based on the topic: 'vulnerability' OR 'resilience' AND 'indicator', with the third alternating entry 'natural' AND 'risk', 'natural' AND 'hazard', 'natural' AND 'disaster'. Furthermore, research with the keyword 'indicator', this time based on the article's title, was carried out, to particularly analyse papers that critically evaluate indicators. To limit the results to peer-reviewed, published works, the search was restricted to scientific articles and reviews. Finally, to evaluate any impact of the UN Sendai conference, the focus was only on two years before and after the conference, collecting papers from 2013 to 2017. Actually, I consider that this five-year-interval is the most relevant since the majority of all papers found were published during this period (Table 1).

Table 1: Articles dealing with indicators and vulnerability or resilience, and additional alternating entries (Ivčević et al., 2019)

		<i>Natural hazard</i>	<i>Natural risk</i>	<i>Natural disaster</i>
<i>Number of papers</i>	All years (1975-2018)	224	326	220
	2013-2017 (% of papers from the chosen interval)	172 (76.8%)	237 (72.7%)	176 (80%)
<i>Number of papers with the term 'indicator' in the title</i>	All years (1975-2018)	32	46	29
	2013-2017 (% of papers from the chosen interval)	27 (84.4%)	39 (84.8%)	25 (86.2%)

Since the amount of sampled papers is unlikely to be the sum of the three searched terms due to overlapping, the next step was therefore to identify those that belong to the three different sets, representing an intermediate set of articles.

The papers were studied bearing in mind the local or global orientation of the constructed indicators, the reference to UNDRR recommendations and the indicators' usage for different time scales.

## 4.2. The methodological approach in the first case study of North Morocco

### *Hypotheses and specific goals*

Risks are socially constructed and depend on the physical and cultural uniqueness of territories. To improve risk assessment and to strengthen the societal resilience, mitigation plans must focus on the individual experience of local dwellers at some point. The social knowledge about their territory and the local appropriation of the natural hazards are of utmost importance for the citizens' preparedness to future changes. Since

local populations have coped with different natural hazards for many centuries, we must better explore and understand what the key variables that impact local risk awareness and precautionary behaviour are.

Although a lot is already known about the situation in Europe or North America, there is a lack of studies on precautionary risk behaviour in developing countries. North Africa, and particularly North Morocco, presents a perfect region for a study of local awareness of multi-hazards in a particular social and cultural setting. Taking everything into consideration, I analysed what sort of elements pertaining to individuals' risk awareness is associated with individual and collective action for risk preparedness. To determine which variables contribute to the awareness of risk and its local distribution within the region, this study was undertaken with the following research questions:

a) What are the variables explaining the existing *readiness to protect themselves and their belonging facing natural hazards* in the social and cultural setting of North Morocco?

b) What are the variables explaining the future *willingness to invest for protection* and to implement *protection measures*?

c) Are these characteristics associated with specific social profiles among the respondents of the region?

The fieldwork procedure was both quantitative and qualitative, organized around both questionnaires and interviews. The first part of the work, the questionnaire for the general public, resulted with responses of three-hundred-and-ninety-one inhabitants of the region North Morocco from eight different communes, responded in a public setting. The chosen municipalities belong to three areas of study (Figure 15) with different geographical, cultural and social characteristics, and with a different historical hazards record. Data were collected face-to-face, by targeting general population. Four native speakers were randomly approaching possible participants, paying attention to the equal gender representation (Figure 16).

The only criterion asked before starting the questionnaire was if the respondents had been living in the municipality for at least the last five years. Additionally, only those over the age of eighteen years (age of majority) were asked to proceed with the questionnaire. Moreover, one constraint was the fact that women were not open to



participating in the survey, although there was a girl in our team who was precisely targeting women and convincing them to take part. Finally, more educated people were more likely to dedicate their time to answer the survey, although our pollsters were coming from and were mainly targeting the working-class area. The working class seemed to be less attracted by responding to the questionnaire during their working hours possibly because it was rather time-consuming (around 20 min needed to complete the survey), so there some withdrawal was encountered.

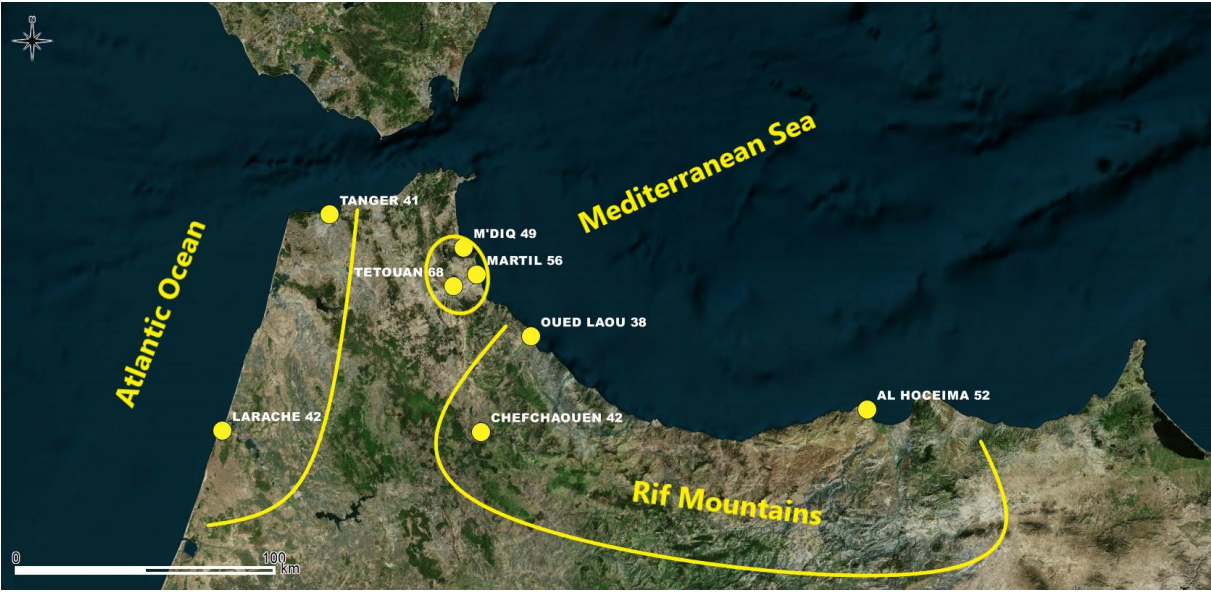


Figure 15: North Morocco with three main sub zones of the Atlantic coast (Tanger /41/ and Larache /42/), Mediterranean-Martil (Tetouan /68/, Martil /56/, M'Diq /49/) and Rif(Al Hoceima /52/, Chefchaouen /42/, Oued Laou /38/). Numbers in brackets indicate the number of questionnaires per municipality.

The questionnaire consisted of 39 questions divided into five sections (Appendix B.1.). The first section dealt with risk awareness. It started with an open-ended question asking respondents to name up to five natural hazards that come to their minds concerning their municipalities provided that they are acquainted with that hazard. Questions about personal risk experience, formal and informal education on risks and risk awareness sessions followed. In second section participants were asked about sources of information, with questions testing for trust the respondents have to science in general, in scientists, media, public and private research institutes that take part in risk management, and finally in the government. Next block of questions was related to

climate change, to belief and knowledge respondents have about that phenomenon. Fourthly, questions related to attachment to their municipality, adopting precautionary measures and investing money were posed, followed by the demographic section. There were no direct questions related to religion and belief, as it was not the main scope of the study, to avoid any controversy, and as considered too irrelevant or evident to ask. The types of questions asked were both open-ended (the first question) and close-ended questions (dichotomous and Likert rating scale). The original version of the full questionnaire was produced in French and later translated into local Arabic. However, it is to underline that not all questions from the questionnaire (variables) were used in this analysis.

The obtained sample is composed of 44.2% female and 55.8% male respondents and thus underestimates female population (which is represented on the regional level with 49.27%, census 2014). The respondents belong on average to a 36-41-year-old class (which overestimates the fact that Morocco is a young nation with the median age of 29.5 years, census 2014), on average they live with four other members in their household, they live mainly in a working-class area of the municipality (42.8%) and are predominantly born in the municipality of study (51.7%). Besides, our sample is too educated compared to the national level, since our respondents have mainly declared either a high school level education or a bachelor's degree (50.4%), with the enrolment rate in higher education in Morocco being that of 28.14%.

The data were first described to get an initial view of the population from the region of interest. A basic description was done in Excel and the subsequent analysis (correlations, regression models, factor analysis and multidimensional analysis) was executed using SPSS software (Version 22.0). Correlations between key variables were tested using Spearman's correlation test since the data did not follow a normal distribution. The regression models used were binary logistic models since they permit both binary and continuous data jointly, dividing variables into more blocks, which allows tracing the model's improvement by adding new variables. Finally, data were summarized using a Multiple Correspondence Analysis, using binary variables to identify social groups, to better understand how natural hazards are perceived by different social groups and to identify groups more or less vulnerable to natural hazards that the region of study is prone to experience.



Figure 16: The questionnaires (391 in total) were collected in paper form, face-to-face, travelling through the region and with help from students from Tetouan.

#### 4.2.1. Description of variables

The first set of variables used in regression models is related to demographic data, all of them used as binary variables: age (with value 1 for those above the age of 36 years old), gender (value 1 for female), education (value 1 for those with a level of education corresponding to a bachelor's degree or above), and zone of residence (three dummies for three geographical zones). The second set of variables was related to risk awareness and experience with risks, whereas the third was related to additional variables that

could have a role in the risk mitigation process: place attachment, environmental identity, social trust and willingness to move out. Those data are presented as follows.

*Risk awareness* was tested using questions relating to how much the respondents considered themselves informed about natural hazards in their region in general, and specifically for each of the natural hazards listed (on the Likert scale from 1 to 5) and whether they participated or not in the awareness sessions or environmental education campaigns organized by the municipalities or associations, as in (Domingues et al., 2018).

The items used in defining indicators that describe the risk awareness level are based on the ratings which respondents used to express their level of information about eight natural hazards (drought, flood, land movement, coastal storm, heatwave, earthquake, coastal erosion and wildfire), and about the climate change, as well as based on a question of whether the respondents considered the origin of climate change to be natural or anthropogenic. The two final questions assessed the respondents' awareness of risk sessions taking place in their municipality, and explored whether the respondents were informed about possible solutions to protect themselves against natural risks. Items were submitted to factor analysis (Kaiser-Meyer-Olkin Measure of Sampling Adequacy = .897; Bartlett's test of sphericity:  $\chi^2 = 1679$ ,  $df = 55$ ,  $p < .001$ ), and two factors were retained. One factor is about how much respondents consider themselves informed about risks, which is why it is called 'risk informed' ( $\alpha = .890$ ), and the other expresses whether the respondents took part in some risk divulgation sessions, named 'risk sessions' ( $\alpha = .381$ ). They were used as two indicators of risk awareness in the following analysis.

Additionally, the variable of *personal experience* of a natural hazard (yes/no) could be of decisive importance when it comes to deciding whether to take or not to take precautionary measures to protect in the future, as well as to evacuate during future events such as floods or storms since some territories are more prone to certain hazards than others (Goldberg et al., 2019). For example, the evidence is mixed for the case of previous experience with the hurricane and its link with future evacuation behaviour, demonstrating previous experience as unrelated (Huang et al., 2016), or related

(Rickard et al., 2017) to future behaviour. As far as floods are concerned, numerous studies show that the direct experience with a flood leaves the individual capable to better evaluate the probability that a similar event could occur in the future (Villa & Bélanger, 2012).

Although it is intuitive (Lewicka, 2011), I look at *place attachment* as an emotional tie that motivates a resident to maintain a relationship with a particular place (Hidalgo & Hernandez, 2001). There is evidence from a Portuguese study that place attachment reduces risk perception for risks perceived to be less likely (Bernardo, 2013). As argued in an extensive review (Bonaiuto et al., 2016), people tend to rate environmental problems as more severe at the global than at the local level, and that was one of the questions that I asked in the questionnaire. Moreover, the authors found only two studies that show a lack of connection between place attachment and risk perception. Place attachment was measured using a 5-point scale from 1 – *not at all* to 5 – *very much* proposed by (Hidalgo & Hernandez, 2001), using five items: ‘I am proud to live in this municipality’, ‘I think this municipality offers a good living environment’, ‘I identify with other residents of my municipality’, ‘I would regret to be obliged to move from my district’, and ‘I would regret to be obliged to move from my municipality’. These items were averaged to a single ‘place attachment’ indicator with satisfactory consistency ( $\alpha = .827^b$ ).

*Environmental identity* is measured (on Likert scale 1-5) to control the extent to which the residents recognize their environment as an important part of their personality, and to which respondents identify themselves concerning environmental worries. So far it has been demonstrated as an important predicting factor in studies related to recycling behaviour (Bertoldo & Castro, 2016) and related to willingness to buy carbon offsets (Whitmarsh & O’Neill, 2010). It was measured by two items (Bertoldo & Castro, 2016). The statements were: ‘I think of myself as someone with ecological concerns’ and ‘I think of myself as someone engaged in environmental issues’. Participants rated the extent to which they agree with them and the answers were averaged into a single indicator of ‘environmental identity’ with a good consistency ( $\alpha = .846$ ).

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<sup>b</sup> Cronbach’s alpha is a measure of internal consistency or scale reliability

*Social trust.* Citizens must trust their representatives to evaluate how much of their hazard exposure they can or cannot manage on their own (Bertoldo et al., 2019). People often include their evaluation of the credibility of the institutions involved in risk management (Engdahl & Lidskog, 2014), relying on them to provide information on many topics despite possible distrust (Langford, 2002). Given the different spheres involved in risk-related decision-making, participants attribute trust/distrust (Likert scale 1-5) to a diversity of actors (such as institutes or government). Items were then submitted to factor analysis (Kaiser-Meyer-Olkin Measure of Sampling Adequacy = .768; Bartlett's test of sphericity:  $\chi^2 = 1230$ ,  $df = 21$ ,  $p < .001$ ) (Field, 2013), which split the items into two main dimensions: (1) items related to trust in science (Achterberg et al., 2017) and scientific institutions (Bertoldo & Castro, 2016); and (2) items related to trust in media, government, private and public institutes included in risk management. Items were then averaged into two indicators: 'trust science' ( $\alpha = .887$ ) and 'trust state' ( $\alpha = .804$ ).

The final two independent variables used in regression models are the general feeling about the level of knowledge related to hazards and the assessment whether the respondents think that moving out could help them to protect themselves against natural hazards (both on Likert scale 1-5). Finally, the dependent variables that were used in the regression analysis related to precautionary behaviour are: the variable 'precautions' taken (the yes/no question if the respondents took some precautions to protect themselves), the variables 'protect future' (the yes/no question if the respondents were ready to protect their lives and belongings in the future, bearing in mind that this future protection is general and not necessarily directly financial) and 'invest money' (the yes/no question if the respondents were truly ready to invest money to protect themselves in the future). The full list of the 18 variables used in the analysis is presented in Table 2.

Table 2: The list of variables used in North Moroccan analysis.

<i>Variables</i>	<i>Description</i>	<i>Category</i>	<i>N obs.</i>	<i>Mean</i>	<i>St. Dev.</i>	<i>Min</i>	<i>Max</i>
<i>GENDER</i>	Demographic	Binary	391	.44	.497	0	1
<i>AGE</i>	Demographic	Binary	389	.509	.501	0	1
<i>EDUCATION (university degree)</i>	Demographic	Binary	378	.376	.485	0	1
<i>ZONE RIF</i>	Demographic	Binary	391	.34	.473	0	1
<i>ZONE MEDITERRANEAN MARTIL</i>	Demographic	Binary	391	.45	.498	0	1
<i>ZONE ATLANTIC</i>	Demographic	Binary	391	.21	.409	0	1
<i>PERSONAL EXPERIENCE</i>	Additional	Binary	390	.64	.482	0	1
<i>FEELING HOW</i>	Additional	Continuous	385	2.74	1.287	1	5
<i>RISK INFORMED</i>	Constructed	Binary	341	.4370	.49674	0	1
<i>RISK SESSIONS</i>	Constructed	Binary	341	.51	.50	0	1
<i>PLACE ATTACHMENT</i>	Constructed	Continuous	387	3.2729	1.14415	1	5
<i>ENVIRONMENTAL IDENTITY</i>	Constructed	Continuous	385	3.1948	1.36301	1	5
<i>TRUST SCIENCE</i>	Constructed	Continuous	388	3.7908	1.10690	1	5
<i>TRUST STATE</i>	Constructed	Continuous	388	2.5513	.96907	1	5
<i>MOVING OUT</i>	Additional	Continuous	380	2.17	1.600	1	5
<i>PRECAUTIONS</i>	Dependent	Binary	382	.17	.374	0	1
<i>PROTECT FUTURE</i>	Dependent	Binary	390	.51	.501	0	1
<i>INVEST MONEY</i>	Dependent	Binary	385	.56	.497	0	1

#### 4.2.2. The qualitative part of the North Moroccan study

The use of interviews in North Moroccan study was twofold. Firstly, they served to introduce the problematic of risk management in the region and while constructing the questionnaire. Secondly, they are a source of information to be crossed with the responses from the questionnaires, as additional information. There were 25 interviews conducted, and the interviewees were grouped in three: a) the elected or installed representatives (eight), b) the scientists and technicians that work in the risk research or management (eight), and c) the members of active society i.e. associations (nine).

During the interviews, the indicators, risk management policy and personal memory of risks in the region of study were discussed. Sometimes first two groups overlap, when a scientist is installed on an administrative or political function (i.e. a chemist installed

as director of the city's office of the environment or an architect that is in charge of projects in direction of urbanism by the ministry). In those cases the questions were focused on their actual tasks in the recent activity. The interviews were held in the region on three occasions: April 2018, October-November 2018 and November 2019.

In Table 3 they are listed, along with their age, sex and municipality. The discourse analysis was effectuated by the software Iramuteq in original language (French, can be found in Verbatim record) and here presented are the representative parts translated into English.

Table 3: The list of interviewees in North Morocco.

<i>Nb</i>	<i>Group</i>	<i>Age</i>	<i>Sex</i>	<i>Municipality</i>	<i>Nb</i>	<i>Group</i>	<i>Age</i>	<i>Sex</i>	<i>Municipality</i>
1	Administrator	55	M	Oued Laou	13	Scientist	35	M	Tangier
2	Administrator	40	M	Martil	14	Scientist	30	M	Al Hoceima
3	Administrator	60	M	M'Diq	15	Scientist	45	M	Tetouan
4	Administrator	60	F	Al Hoceima	16	Scientist	65	M	Tetouan
5	Administrator	45	M	Rabat (national)	17	Associate	60	M	Tangier
6	Administrator	55	M	Tetouan	18	Associate	25	M	Tetouan
7	Administrator	35	F	Al Hoceima	19	Associate	35	F	Tetouan
8	Administrator	40	F	Rabat (national)	20	Associate	50	M	Al Hoceima
9	Scientist	50	M	Martil	21	Associate	50	F	Tetouan
10	Scientist	50	M	Tetouan	22	Associate	55	M	Chefchaouen
11	Scientist	30	M	Tetouan	23	Associate	50	M	Larache
12	Scientist	50	F	Tangier	24	Associate	30	F	Tangier
					25	Associate	55	M	Tetouan



## 4.3. The methodological approach in the second case study of Sardinia

### *Hypotheses and specific goals*

As presented in section 2.3.2., wetlands have long been depreciated as wastelands, sources of mosquitoes or disease, but are found to be of key importance for disaster risk management. In the Sardinian case study, wetlands are at the basis of local defence and mitigation by offering regulating services and they represent a nature-based solution to tackle climate change-related hazards. The individual and social variables have a significant impact on how climate change-related risks are locally managed, which is why site-specific and cultural particularities need to be acknowledged (Joffe, 1999; Ivčević et al., 2019). This research contributes to risk management in the region of Sardinia by providing useful information to decision-makers in charge of adopting climate change mitigation measures and by contributing to resilience of the local population dwelling on Gulf of Oristano's wetlands.

The main research questions that are going to be responded are:

- a) How do locals understand the role of wetlands in risk mitigation?
- b) What are the variables that explain the willingness to invest and to protect from natural risks in the future in the specific context of our case study of West Sardinia?
- c) Are the inhabitants willing to pay to protect from future events and how much are they ready to invest?

The fieldwork procedure was quantitative, organized around questionnaires for the general public. The questionnaires were elaborated similarly as Moroccan ones, but in a reduced form and adapted to different topic, coastal hazards and wetlands. The secondary literature on risk management at the regional (Sardinia) and national (Italy) level was obtained as public documents free from the administrative web pages. These sources served to contrast the population's responses with the official directions in managing natural risks. Since this literature was easily accessible, the qualitative study in form of interviews with the local authorities was not considered to be essential for this research, unlike that was the case for North Morocco. In addition, the area of Gulf of

Oristano is rather small and homogenous compared to North Morocco so the interregional variability was not tested by Multiple Correspondence Analysis. However, instead of that, the economic study of contingent valuation was elaborated, as the final part of the questionnaire. It was considered that the economic exercise in order to test for the house insurance has grounds and interest to be developed in Italy, certainly more than it would be the case for Morocco. The reason is not only in economic standard, but also the political background, since the European Union is considering introducing insurance as way of dealing with climate-related extreme weather events and its consequences (European Commission, 2018).

The questionnaire consisted of thirty questions, starting from the question on the perception of the likelihood for the list of natural events that could occur in the respondent's town of residence from the study area: Oristano, Cabras or Arborea. A set of questions about the person's experience with natural risks and measures of precaution was asked, followed by questions testing for attachment to their municipality and other citizens. Next, the respondents were asked for their self-assessed knowledge about risks, followed by the level of information about natural phenomena which was measured in the form of a quiz where every phenomenon was presented by one statement that had to be evaluated. These questions were followed by the trust the respondents have to science in general, scientists, media, public institutes, universities and associations that take part in risk management, and finally to the national and regional government. The next block of questions was related to climate change, belief and knowledge respondents have about this phenomenon, followed by questions related to measures that they believe could help if they were taken. The questionnaire finished with socio-economic questions and with the contingent valuation exercise. The full original version of the questionnaire (in Italian) can be found in the Appendix (B.2.).

Before starting the questionnaire, the respondents were informed about the project 'Maristanis' and the objectives of this study, as well as reassured that the questionnaires are anonymous and will serve for educational and scientific study purposes only. Additionally, participants under the age of eighteen and participants who did not reside in municipalities Oristano (80 respondents), Cabras and Arborea (48 respondents each) were excluded from the analysis. Hundred and seventy-six inhabitants of the area of

West Sardinia from three different municipalities responded to our questionnaire in a public setting (Figure 17).

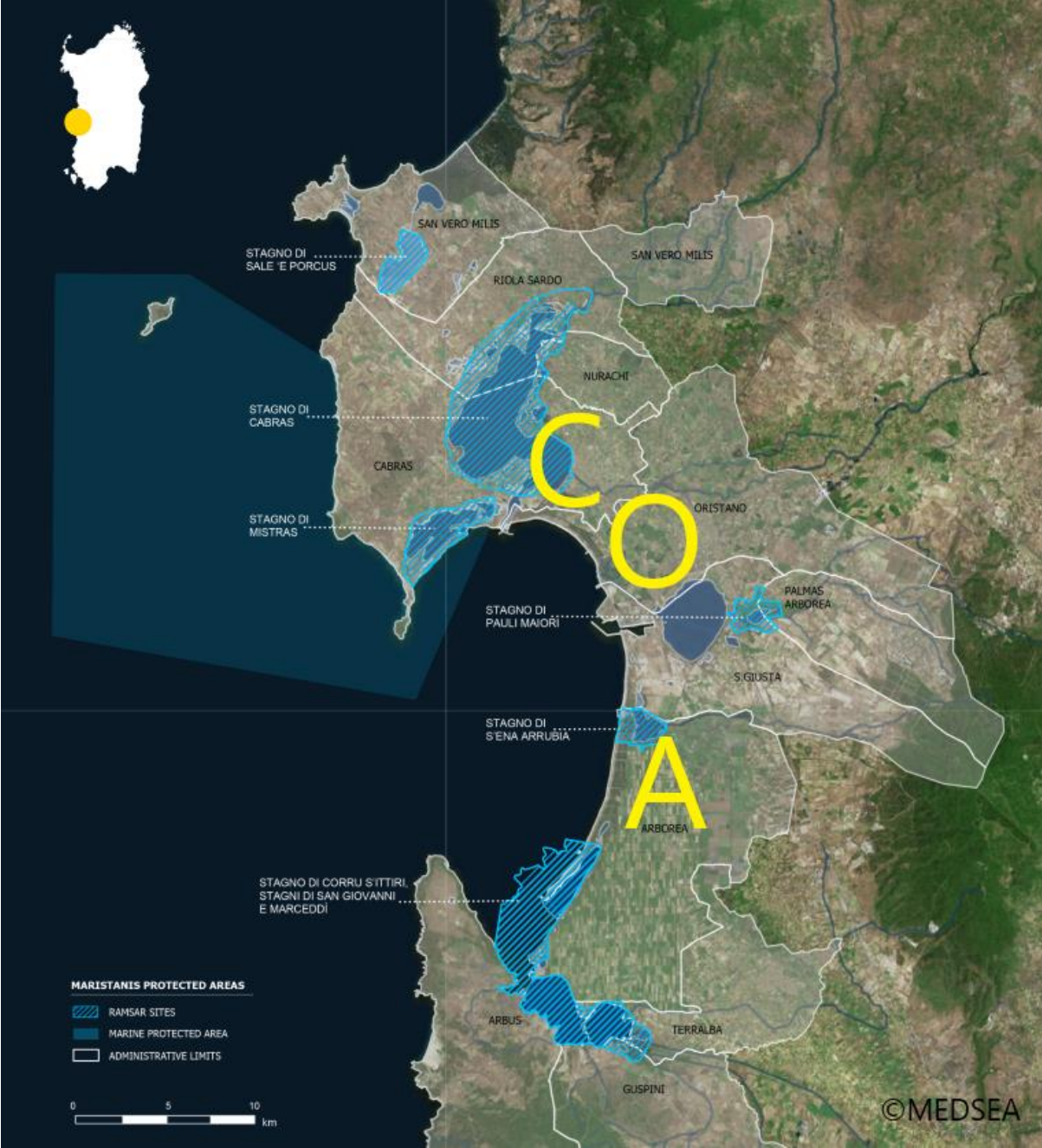


Figure 17: The Gulf of Oristano and the area of the ‘Maristanis’ project, with three sites of study: Cabras (C), Oristano (O) and Arborea (A).

The final sample is composed of 55% of female and 45% of male respondents (figures in the population are 51% and 49% from the 2011 census, so our sample underestimates male population). The average participant is 46.4 years old (44 is the

average age in population, census 2011), has either high school or bachelor's degree and mainly works in the tertiary or quaternary sector. The average household is composed of 3 members (larger than 2.3 that is the average household size in population), with below 0.5 children per person and with a net annual income between 15,000 and 30,000 euro. The majority of participants lives on the periphery of the municipality, at a 5.4 km distance from the sea, in an owned home (83%) that is 34 years old and of 120 m<sup>2</sup> on average.

### **4.3.1. Description of variables**

The first set of variables used in the regression models consists of demographic variables: age, gender, education, annual net income, housing surface, number of household members, number of kids under 12 years old in the household and municipality of living (Arborea, Cabras, Oristano). Secondly, the variables that were considered to contribute more in describing readiness to invest money to protect in the future were added, those related to risk awareness and climate change. The purpose of the final block of questions was to test the additional variables about future protection behaviour, such as trust, environmental identity, place attachment, source of information and different measures to take.

To start with, three indicators that describe the information and risk awareness level were constructed, followed by the belief in climate change processes.

*Information self-assessment:* respondents assessed their estimated level of information about nine natural hazards proposed (drought, flood, land movement, coastal storm, heatwave, earthquake, coastal erosion, wildfire and sea-level rise) and about climate change (from (1) 'not at all informed' to (5) 'very well informed', as in (Domingues et al., 2018)).

*Actual information:* actual knowledge about their environment was assessed through a series of statements that the respondents had to judge as 'true', 'false' or 'don't know'. The statements concerned each of the above-mentioned hazards.

*Risk awareness:* respondents were asked about their personal experience with natural hazards, about precautions taken and about risk dissemination sessions. Five different

yes/no statements were asked, the answers were summed up and those with four or five 'yes' answers were considered as high risk awareness (binary value 1).

*Climate change belief.* It was constructed based on the eleven items related to climate change, such as e.g. 'We already feel the effects of climate change in Sardinia' and 'I believe that the climate change is exclusively due to natural processes'. The respondents had to express their level of agreement using a 5-point scale (from (1) 'not agree at all' to (5) 'totally agree', as in (Feng et al., 2017)). Responses were then dichotomized: participants with responses above mean were part of the 'high belief in climate change' group, while those with responses below the mean were part of the 'low belief in climate change' group.

*Place attachment and environmental identity.* The place attachment indicator, although intuitive, is considered as an emotional tie that moves forward a resident to maintain a relationship with a particular place (Hidalgo & Hernandez, 2001; Lewicka, 2011). It was measured using a 5-point scale (from (1) 'not agree at all' to (5) 'totally agree', proposed by (Hidalgo & Hernandez, 2001)), using five items (like e.g. 'I am proud to live in this municipality.'). Likewise, the environmental identity indicator was measured to control the degree to which the locals identify their environment as an important part of their personality by two items (Bertoldo & Castro, 2016). The statements were: 'I think of myself as someone who cares about the environment' and 'I think of myself as someone engaged in environmental activities of my town', where the participants rated the extent to which they agree with them on the same scale.

*Social trust.* Secondly, people include their personal evaluation of the trustworthiness of the institutions implicated in risk management (Engdahl & Lidskog, 2014), especially when they cannot manage risks on their own. Statements related to trust in science (Achterberg et al., 2017) and institutions (Bertoldo & Castro, 2016) were divided into two groups, the former related to science in general, scientists and scientific information, the latter related to media, associations, national and regional government and public institutions involved with risk management, valued on Likert 5-point scale. The items were averaged into two indicators: trust science and trust state.

*Source of information about risk.* In addition, the respondents were asked about their source of information about natural risks. Those answers were grouped in two

indicators: a local source of information (school, municipality, associations) and distant source of information (traditional media, internet, social media networks). Finally, I added some practical measures and asked respondents to rate the extent to which they think those measures could help to fight natural hazards on Likert 5-point scale. Three measures were proposed on municipality level (increase green area, reduce threats on marine ecosystems, protect coastal marine wetlands) and averaged into an environmental measures indicator; three measures on a personal level (recycle, use public transport, eat more organic) and averaged into a personal measures indicator.

The last three measures were related to direct investing: to improved infrastructure, to general insurance introduced to everyone, and personal insurance based on the market offer. Those independent variables were used in the binary logistic model to describe the dependent variable 'invest money' to protect from future risks. All independent demographic and constructed variables used in the binary logistic regression are listed in Table 4.

Table 4: Variables used in Sardinian binary logistic regression.

<i>Variables</i>	<i>Description</i>	<i>Category</i>	<i>N obs.</i>	<i>Mean</i>	<i>St. Dev.</i>	<i>Min</i>	<i>Max</i>
<i>ARBOREA</i>	Demographic	Dummy	176	.2727	.44663	0	1
<i>CABRAS</i>	Demographic	Dummy	176	.2727	.44663	0	1
<i>ORISTANO</i>	Demographic	Dummy	176	.4545	.49935	0	1
<i>GENDER</i>	Demographic	Dummy	176	.55	.499	0	1
<i>AGE &lt; 36</i>	Demographic	Dummy	176	.2614	.44063	0	1
<i>AGE &gt; 58</i>	Demographic	Dummy	176	.2614	.44063	0	1
<i>EDUCATION</i>	Demographic	Dummy	176	.6250	.48550	0	1
<i>NET INCOME</i>	Demographic	Continuous	155	2.12	1.142	1	6
<i>FAMILY NUCLEUS</i>	Demographic	Continuous	166	2.94	1.374	1	9
<i>KIDS &lt; 12</i>	Demographic	Dummy	174	.18	.384	0	1
<i>HOUSE m<sup>2</sup></i>	Demographic	Dummy	155	.3032	.46114	0	1
<i>ACTUAL INFORMATION</i>	Constructed	Dummy	173	.7630	.42647	0	1
<i>RISK AWARENESS</i>	Constructed	Dummy	176	.1591	.36680	0	1
<i>INFORMATION SELF-ASSESSMENT</i>	Constructed	Dummy	167	.5090	.50142	0	1
<i>HIGH BELIEF IN CLIMATE CHANGE</i>	Constructed	Dummy	170	.3118	.46458	0	1
<i>LOW BELIEF IN CLIMATE CHANGE</i>	Constructed	Dummy	170	.5471	.49925	0	1
<i>TRUST SCIENCE</i>	Constructed	Dummy	167	.4551	.49948	0	1
<i>TRUST STATE</i>	Constructed	Dummy	167	.4970	.50149	0	1
<i>LOCAL SOURCE OF INFORMATION</i>	Constructed	Dummy	169	.5503	.49894	0	1
<i>DISTANT SOURCE OF INFORMATION</i>	Constructed	Dummy	169	.5266	.50077	0	1
<i>ENVIRONMENTAL IDENTITY</i>	Constructed	Dummy	174	.5805	.49491	0	1
<i>PLACE ATTACHMENT</i>	Constructed	Dummy	169	.5266	.50077	0	1
<i>INFRASTRUCTURE</i>	Additional	Dummy	169	.3609	.48170	0	1
<i>GENERAL INSURANCE</i>	Additional	Dummy	169	.2367	.42631	0	1
<i>PERSONAL INSURANCE</i>	Additional	Dummy	169	.2367	.42631	0	1
<i>ENVIRONMENTAL MEASURES</i>	Additional	Dummy	167	.5689	.49672	0	1
<i>PERSONAL MEASURES</i>	Additional	Dummy	167	.4970	.50149	0	1
<i>INVEST MONEY</i>	Dependent	Dummy	171	.6316	.48379	0	1

### **4.3.2. The contingent valuation exercise in Sardinian study**

Contingent valuation is a methodology created by environmental economists to attribute an economic value to non-market goods, such as environmental goods. Today it is also used for goods with a 'thin', incomplete or new market, to collect information on consumer preferences.

There are different techniques for estimating the value of non-market goods. The most relevant distinction is between revealed and stated preferences. Revealed preferences estimate the value of the price of an environmental good by assessing how the presence of the environmental good affects a market good (Caplin & Dean, 2011). The example is the hedonic price technique, which assesses the effect of the presence of an environmental asset on property (building) prices.

Stated preferences, on the other hand, estimate the value of the environmental asset by asking people to indicate the value for the asset under analysis through the elicitation of WTP or the willingness to accept. Contingent valuation (CV) and choice experiments are the most recognized methodologies. CV is used when the analysed good is characterized by only one attribute or when the analysis focuses on one specific attribute (Hanley & Barbier, 2009). The basic assumption is that the value of an asset is linked to the utility it generates: in the economic theory, utility is the total satisfaction received from a consumed good or service. Economists state that rational consumer acts to maximise his utility. The value may arise from the direct or indirect use of the good itself, from the will to keep it for personal future use, for future generations or from the existence of a specific environmental asset regardless of the possibility or willingness to use it.

CV estimates the total economic value of an asset through WTP to avoid a loss of utility or the willingness to accept some money as a compensation for accepting the loss of the good/utility (Hanley & Barbier, 2009). CV questionnaires follow specific protocols to provide correct information on the evaluated good and avoid biases that could affect the estimation (Mitchell & Carson, 1989). To elicit WTP, a hypothetical, but likely scenario (the contingent scenario) was designed. It reproduced a market situation where the respondents had to decide if they accept the proposal or refuse it. In this analysis, a double-bound dichotomous choice was adopted, with a first price offer, followed by a second increasing offer if the first offer was accepted, or by a decreasing



offer if the first offer was refused. For a more detailed description of the methodology you could refer to (Strazzera et al., 2012).

The scenario of the contingent valuation exercise was the last part of the questionnaire, as follows: *“Imagine that you have to take out compulsory insurance against disasters resulting from climate change (but not from the other natural risks seen above) to protect the house where you live. Suppose that this insurance is paid once per year depending on the characteristics of your home and that also those living in rental accommodation have to insure themselves. If you had to pay insurance equal to: (BID) per square meter, would you be willing to pay?”*

The bids proposed are the following:

<i>First bid</i>	<i>Second bid if first answer is NO</i>	<i>Second bid if first answer is YES</i>
0,75	0,65	0,85
0,85	0,75	0,95
0,95	0,85	1,05

Several questions on the housing characteristics are added to the questionnaire to take into account differences in house size, age, type etc.

The aim of this CV exercise is twofold. On one side, the objective is to evaluate the risk awareness of the climate change through the elicitation of WTP of residents in Arborea, Cabras and Oristano to protect their houses. On the other side, the aim is to assess the willingness to invest one's own money in the protection, using insurance. Additionally, an analysis of the determinants of WTP has been performed.

All used variables in the contingent valuation exercise are listed in Table 5.

Table 5: Variables used in Sardinian contingent valuation exercise.

<i>Variable</i>	<i>Category</i>	<i>N. Obs.</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
<i>Female</i>	Dummy	176	0.55	0.50	0	1
<i>Age &lt; 40</i>	Dummy	176	0.33	0.47	0	1
<i>House age &lt; 34</i>	Dummy	176	0.5	0.5	0	1
<i>m<sup>2</sup> &lt; 100</i>	Dummy	176	0.37	0.48	0	1
<i>Sea distance &lt; 1 km</i>	Dummy	176	0.02	0.14	0	1
<i>Informed activists</i>	Dummy	167	0.50	0.50	0	1
<i>Low income</i>	Dummy	176	0.31	0.46	0	1
<i>Informed through social network</i>	Dummy	176	0.64	0.48	0	1
<i>Already invested money in mitigation measures</i>	Dummy	171	0.63	0.48	0	1
<i>Arborea</i>	Dummy	176	0.27	0.45	0	1
<i>Cabras</i>	Dummy	176	0.27	0.45	0	1
<i>Oristano</i>	Dummy	176	0.45	0.50	0	1

## 5. Results

### 5.1. Results from the literature review on risk management indicators

Among 250 studies, we focused on natural hazards and excluded those related to human health and diseases, the biodiversity of flora and fauna, fishing and industrial pollution issues. Those papers including the term 'indicator' in their title were considered a priority (33 articles), expecting that such articles should be narrowly focused on its usage in risk management (listed in Table 6)<sup>c</sup>.

Furthermore, from the period of interest (2013-2017), the case studies were allocated according to the main topic of research and to their region of study. I decided to further focus on three different groups of natural hazards: earthquakes and seismic risk, floods and inundation risk, and coastal risk (tsunamis, coastal storms, erosion), for their interconnections and nature of being large catastrophic events. Among them, 26 case studies were related to seismic risk, dealing with geographical areas that are notorious for large and/or frequent earthquakes, with a significant number of victims and economic losses: the Caribbean Sea (the Dominican Republic and Haiti), Chile, Italy, Romania, Turkey, Iran, China, Japan and New Zealand. Secondly, 37 case studies were related to flood risk spread over all continents. Finally, among 37 articles dealing with coastal risks, most of them were related to North and South America and Asia, which made a total of 100 case studies. The geographical distribution of case studies is presented in Figure 18.

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<sup>c</sup> Published paper on this literature review: Ivčević, A., Mazurek, H., Siame, L., Ben Moussa, A. and Bellier, O., 2019. Indicators in risk management: Are they a user-friendly interface between natural hazards and societal responses? Challenges and opportunities after UN Sendai conference in 2015. *International Journal of Disaster Risk Reduction*, 41, p.101301.

Finally, to maintain a certain geographical consistency and aiming at finding a generalized approach in dealing with indicators, 35 out of 100 geographically widespread studies were chosen, to keep the survey within manageable proportions. Some of the studies included several countries at the same time or were at a broader regional level. However, our focus was on those case studies dealing with more than one risk. These 35 case studies plus the 33 initially retained papers on indicators gave us a final set of 68 studies.

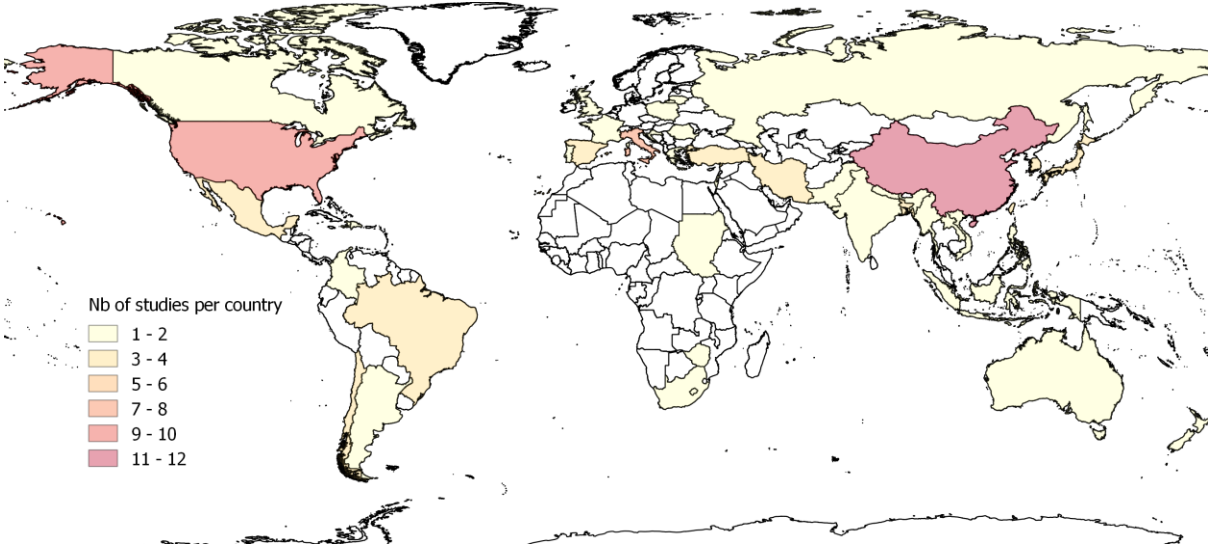


Figure 18: Geographical distribution of case studies included in this survey. The countries with most case studies are China (11), USA (9) and Italy (7).

Table 6: Studies specifically using indicators 2013-2017.

<i>Nb</i>	<i>Author(s), year</i>	<i>Case study/review</i>	<i>Type of indicators used/Terminology</i>	<i>Hazard/Topic</i>
1	Asadzadeh et al., 2017	Review	Composite indicator building for community disaster resilience; indicators vs. factors (components)	/
2	Murgante et al., 2017	Case study (Iran)	Indicators evaluated according to five dimensions: economic, social, political, physical and operational index; indicator ~index	earthquakes
3	Fatemi et al., 2017	Review (Iran)	Valid and useful indicators of the social vulnerability in disasters; indicators vs. variables	/
4	Minos-Minopoulos et al., 2017	Case study (Greece)	Archaeological Site Vulnerability Index; index > indicator > factor	earthquakes

5	De Ruiter et al., 2017	Review	Physical vulnerability indicators grouped in three categories; social ones in four	earthquakes and floods
6	Calo-Blanco et al., 2017	Case study (Chile)	Indicators to measure social cohesion; indicators ~ variables	earthquakes
7	Papathoma Köhle et al., 2017	Review	Indicators for debris flow physical vulnerability assessment of buildings	debris flow
8	Sena et al., 2017	Case study (Brazil)	Vulnerability and hazard indices based on two variables each, exposure based on one variable.	drought
9	Barrantes-Castillo et al., 2017	Case study (Costa Rica)	Affectation indicator for natural hazards, based on indicators of direct and indirect affectation; indicators vs. variables	multiple
10	Doorn, 2017	Review	Discusses resilience indicators, uses example of [102] to show social resilience being valued, with seven social categories; indicators vs. variables	/
11	Jülich, 2017	Case study (Switzerland)	Three local-level partial indicators for community resilience with stages of indicator operationalization; indicators vs. variables (parameters)	floods
12	Kuentz-Simonet et al., 2017	Case study (France)	Social vulnerability, quality of life indicators; indicators vs. variables	climate change
13	Pandey et al., 2017	Case study (India)	44 indicators selected for each dimension of vulnerability and for each capital; indicators ~ variables	climate change
14	Xie and Zheng, 2017	Case study (China)	Comprehensive indicator of climate adaptability with five factors and for each factor 3-4 single indicators; comprehensive indicator > factor > indicator	climate change
15	De Almeida et al., 2016	Case study (Brazil)	DRIB Index (based on WorldRiskIndex): four indicators describing the exposure; vulnerability based on 32 societal indicators; index ~indicator, indicators ~variables	landslides, floods, droughts, sea level rise
16	HS Chang and Chen, 2016	Case study (Taiwan)	Seven indicators in vulnerability (positive and negative), six in resiliences	floods
17	Nguyen et al., 2016	Review	Coastal (social) vulnerability index based on both physical and social parameters, as in literature; indicators vs. variables (parameters)	coastal
18	Cutter, 2016	Review	27 disaster resilience assessment approaches, each evaluated using four main attributes; indicators (concepts, attributes) vs. variables	/

19	Amjath-Babu et al., 2016	Case study (Sub-Saharan countries)	Agricultural transition, multi-dimensional transition index and constituent intermediate indices; domains of indicators with constituent sub-indicators	groundwater
20	Khalili et al., 2015	Case study (Australia)	Extracted and assessed social resilience indicators classified for each phase of disaster: pre-disaster, response and recovery; indicators (qualitatively)	floods
21	SE Chang et al., 2015	Case study (Canada)	Hazard Vulnerability Similarity Index: the framework around major types of capital: 20 indicators (each with only 1 variable selected); indicators vs. variables	coastal
22	Siebeneck et al., 2015	Case study (Thailand)	25 variables grouped in four factors; variables selected to serve as indicators of resilience; factors (indicators) ~ variables	floods
23	Asare-Kyei et al., 2015	Case study (Ghana-Benin-Burkina Faso)	Participatory indicator development: 50 indicators selected in all three countries at the local level, 42 indicators at the national level; indicators vs. variables	multiple
24	Eidsvig et al., 2014	Case studies (6, Europe)	Socioeconomic vulnerability estimation, with the criteria for indicators' ranking; indicators ~ variables	landslides
25	Holand, 2014	Case study (Norway)	9 lifeline vulnerability indicators addressing level of exposure; lack of redundancy; travel time or distance.	lifelines
26	Lee, 2014	Case study (Taiwan)	13 social vulnerability indicators; indicators ~ variables	floods
27	Loomis and Paterson, 2014	Case study (USA)	Five report card level ecosystem services with their corresponding indicators; indicators vs. variables	coastal
28	Tonmoy et al., 2014	Review	Methodological challenges facing indicator-based vulnerability assessment; indicators ~ variables	climate change
29	Imbrenda et al., 2014	Case study (South Italy)	Structural, biophysical and socio-economic indicators in an upgraded environmentally sensitive areas model.	soil and land degradation
30	Naumann et al., 2014	Case study (Africa)	Composite drought vulnerability index, consisted of 4 components and in total 17 variables	drought
31	Nguyen and Corotis, 2013	Review	Social, corruption perception index for society development indicators	earthquakes
32	Grozavu et al., 2013	Case study (Romania)	Physical quantitative indicators (distance from landslides and riverbanks, water level growth and service capacity of roads); indicators vs. factors	landslides and floods
33	Lung et al., 2013	Case study (Europe)	Indicator constructed of hazard and demographic variables, indicators vs. variables	heat stress, floods and forest fires

## *Indicators used in risk assessment*

### *On objectives and adopted terminology while using the indicators in risk assessment*

The objectives of the studies specifically using indicators differ (Table 6). Their common goal was to propose new or to help, to improve, to extend the existing programs, responses, activities, advising political deciders in order to tackle risk situations and possible disasters (such as Asare-Kyei et al., 2015; Fatemi et al., 2017). Some of the reviews offered a theoretical reasoning on the usage of indicators (Cutter, 2016; Doorn, 2017), some proposed valuation of different kinds of (physical) vulnerability assessments (Papathoma Köhle et al., 2017), others offered lessons and comparisons from different vulnerability assessments (de Ruiter et al., 2017) in order to facilitate comparability between different areas (Nguyen et al., 2016). In addition, reviews served to offer a unifying procedure in risk assessment, criticizing the lack of standard (Asadzadeh et al., 2017) or the lack of questioning the theoretical flaws while using certain methodologies (Tonmoy et al., 2014). As far as case studies are concerned, the goals were more practical and problem-solving oriented. In some studies the authors assessed vulnerability (Minos-Minopoulos et al., 2017) or exposure (Grozavu et al., 2013), explored spatial and temporal variation in exposure (Calo-Blanco et al., 2017), and offered an improved planning using sustainability indicators (Murgante et al., 2017). Often, the main direction was to propose a concrete evaluation or determination, of climate change vulnerability (Pandey et al., 2017), of climate adaptability (Xie & Zheng, 2017), of the location of the most vulnerable communities facing risks (Chang & Chen, 2016; Barrantes-Castillo et al., 2017). Finally, the omnipresent objective was to concretely inform policy- and decision-makers, by assessing, visualising and communicating levels of risk (such as De Almeida et al., 2016; Sena et al., 2017; Jülich, 2017).

Although indicators are key tools for measuring vulnerability since the Hyogo Framework for Action (2005) and although there is broad theoretical reasoning on the usage of indicators, different authors may define indicators differently (Birkmann, 2007), and our database reflects this general current situation. While the meaning of term 'indicator' is considered as clear in risk assessment, there is, however, an overlapping of terms 'indicator' and 'index', as well as terms that serve in constructing indicators, such as 'variable', 'factor', and 'parameter' in the studies (Table 6). For

example, in the study (Naumann et al., 2014) the authors construct composite drought vulnerability index/indicator using seventeen variables/factors/indicators, which noticeably demonstrates the overlapping of these terms. The absence of a universal definition of indicators is theoretically discussed by Doorn (2017), with a proposed definition of indicators from (Cutter, 2016) being “quantifiable variables that represent a selected characteristic of resilience [...]”, with the equivalence between ‘indicator’ and ‘concept’. A substantial number of studies also considers indicators as ‘variables’ (e.g. in Holand, 2014, de Ruiter et al., 2017, Calo-Blanco et al., 2017). For example, in (Lee, 2014), it is specified that “the indicators become variables when taken from the literature, modified and applied to the empirical study”, and in (Siebeneck et al., 2015) that the “25 variables were selected [...] that served as indicators of resilience”. In some studies, ‘indicator’ is a higher term than ‘variable’, and is described by a set of variables, like in (Fatemi et al., 2017, Jülich, 2017, Xie and Zheng, 2017).

#### *Seismic risk*

Earthquakes are one of the best assessed natural hazards in terms of physical vulnerability, with recent efforts to improve the social vulnerability as well (Douglas, 2007, de Ruiter et al., 2017). The hazard indicators used for seismic risk assessment are related to the structural characteristics of the active faults (length, segmentation, seismogenic depth) or expected, maximum magnitude, recurrence time between two events, date of the last event (instrumental, historical or paleo-seismological). In addition to seismicity (seismic risk categories, disaster probabilities, number of hazards), other hazard indicators used are related to terrain (terrain landslide susceptibility) (Ostadtaghizadeh et al., 2016, Banica et al., 2017).

The vulnerability indicators are related to the state of buildings (i.e., age, the material used, number of floors, walls area, thermal rehabilitation, the state of the structure), and systemic indicators (building density, distance to hospitals and emergency services) (Banica et al., 2017). The final group are socio-economic indicators, which are demographic, with a focus on how to integrate social vulnerability into the seismic risk analysis (Frigerio et al., 2016); how to characterize the specific risk based on economic and human loss (Sousa & Costa, 2016); how to include the community participation and environmental policies in community disaster resilience (Ostadtaghizadeh et al., 2016); and how to combine physical risk with social fragility and lack of resilience in a

composite indicator of urban seismic risk index (Salgado-Gálvez et al., 2016). The indicators are systematically presented in Table 7.

### *Risk of floods*

Floods are climate-change related natural hazards which vary in spatial and temporal scales according to river basin size and climatologic dynamics (Serinaldi & Kilsby, 2017). In the light of the population and economic changes, the societal vulnerability is increasing (the worldwide expenses for weather-related hazards and human losses from storms and floods have increased in the last 40 years and it is expected that 1.3 billion people will be living in the 1/100-year flood zone in 2050 due to population growth). Within this context, space and time relationships should be considered for any efficient evaluation of the flood (or other climate-change-related) risks (Fuchs et al., 2013, Piniewski et al., 2014, Haer et al., 2017). In addition, according to the IPCC 2014 report, climate change and sea-level rise are likely to intensify flood risk in the future. What remains a major challenge is the adjustment of vulnerable populations to a new flood risk evaluation under different climate change and the sea-level rise scenarios (Haer et al., 2017). Finally, research on floods is one of the positive examples of interdisciplinary gap reduction between social and natural sciences. Indeed, socio-hydrology integrates hazard and vulnerability paradigm to move forward in the understanding of socio-natural interactions, all for an objective of the improved impact of the UN Sendai Framework and disaster risk reduction in general (Fuchs et al., 2017, Di Baldassarre et al., 2018).

The hazard indicators are related to rivers (the generic environmental flow indicator, the floodplain inundation indicator and the river habitat availability indicator) (Piniewski et al., 2014), rainfall (the number of days with rainfall, the total rainfall, the maximum intensity, the average intensity, the rainfall intensity and the accumulated rainfall) (Camarasa-Belmonte & Butrón, 2015) and the return interval of floods and the erosion (the mean annual soil loss) (Pártl et al., 2017). On the other hand, the vulnerability indicators are related to flood exposure (the number of people in an area at risk, the land cover, the density of exposed assets, the share of exposed assets) (Serinaldi & Kilsby, 2017, Röthlisberger et al., 2017, Fuchs et al., 2017), the maximum possible damage of flooding (Shalikovskiy & Kurganovich, 2017) and the expected annual damage of flooding (Scorzini & Leopardi, 2017), and finally there is also a need to



include human decision making as part of an updated flood risk analysis (Haer et al., 2017).

### *Coastal risk*

Coastal risk is both non-climate and climate-related, the former in the form of tsunamis (as a consequence of an earthquake offshore, related to volcanic activity or submarine landslides), the latter as a consequence of coastal storms and flooding, sea-level rise and erosion (Nguyen et al., 2016) (Figure 19).



Figure 19: Coastal erosion in the centre of Larache on Moroccan Atlantic coast (with Muslim cemetery and mosque Mohammed VI)

The hazard indicators related to coastlines are: geomorphology, erosion rate, sediment budget (Merlotto et al., 2016, Ferreira et al., 2017), coastal slope, as well as elevation and distance to the sea (Yankson et al., 2017, Tavares et al., 2017, Mavromatidi et al., 2018). In addition, the indicators of coastal storm hazards are: storm waves effects (Merlotto et al., 2016), distance to the sea (Yankson et al., 2017, Tavares et al., 2017), relative sea-level rise, mean tidal range, mean significant wave height (Mavromatidi et al., 2018), depth and extent of inundation and overwash (Ferreira et al., 2017), highest storm surge level, exceeding the value of warning water level, and average slope of the

storm surge landfall position (Yang et al., 2016). Finally, hazard indicators could be even more specifically constructed, such as indicators of shoreline (the previous high tide high-water level, the wet/dry line or run-up maxima) (Gutiérrez et al., 2016).

On the other hand, the vulnerability indicators are social and demographic (Merlotto et al., 2016, Yankson et al., 2017, Tavares et al., 2017, Mavromatidi et al., 2018), related to building and tax assessment (Tavares et al., 2017), land use and cover (Merlotto et al., 2016, Tavares et al., 2017), artificial beach nourishment and beach control structures (Mavromatidi et al., 2018), and finally experience and perception of risk, as well as the household and communal risk adaptation strategy (Yankson et al., 2017)(Table 7).

*Indicators are more often used on a global spatial scale than on a local one.*

As far as logical argumentation of indicators is concerned, the majority of 33 selected studies do specially argue their usage as a key management tool, stating that the proposed indicators are found in the existing literature or coming from the own authors' expertise. As asked in (Asadzadeh et al., 2017), the question is whether or not the common indicators that are used nowadays correspond to managers' needs? In the review (Fatemi et al., 2017), the authors underline that only a few studies tried to validate the used indicators of social vulnerability. As stated in (Pandey et al., 2017), the used indicators are based on existing literature and on the experience of the authors, which is in line with the remark by (Nguyen et al., 2016) that selection of indicators is seldom based on objective criteria and mainly on the common sense of the authors. As shown in the review (Asadzadeh et al., 2017), the majority of selected disaster resilience assessments are developed based on a non-participatory method. This is confirmed in an African case study (Asare-Kyei et al., 2015) where the authors showed that there is a gap between top-down and bottom-up perception, inviting a closer collaboration between them by putting more emphasis on local knowledge and drawing the justification that the world needs a local scale for each unique case (Asare-Kyei et al., 2015). A similar call for local approaches comes from the Brazilian and Swiss case studies, where the latter resolutely states that it is impossible to make global indicators that truly work (de Almeida et al., 2016, Jülich, 2017). Furthermore, the Canadian case study proposes the Hazard Vulnerability Similarity Index which uses the local knowledge by comparing the similarity between different sites, since learning is of key

importance to resilience (Chang et al., 2015). Finally, the traditional knowledge, possessed by local communities, should be merged with scientific tools to bring a better understanding of local risks and more efficient risk management (Sena et al., 2017).

Table 7: Indicators used in risk assessment: seismic, floods and coastal risks, summary, based on the literature review

<i>Type of risk</i>	<i>Hazard indicators</i>	<i>Vulnerability indicators</i>	<i>Author(s), year</i>
<i>Seismic</i>	Active faults (length, segmentation, seismogenic depth)	Physical (related to the state of buildings)	Ostadtaghizadeh et al., 2016
	Magnitude, recurrence time, date of the last event	Systemic indicators (building density, lifelines)	Frigerio et al., 2016
	Seismicity (risk categories, disaster probabilities, number of events)	Socio-economic (demographic, human & economic loss, community participation & environmental policies, social fragility & lack of resilience)	Sousa & Costa, 2016
	Terrain related (terrain landslide susceptibility)		Salgado-Gálvez et al., 2016 Banica et al., 2017 de Ruiter et al., 2017
<i>Flood</i>	Related to rivers (generic environmental flow, floodplain inundation, river habitat availability)	Flood exposure (number of people in the area, land cover, density & share of exposed assets)	Piniewski et al., 2014 Camarasa-Belmonte & Butrón, 2015
	Related to rainfall (number of days, total rainfall, maximum intensity, average intensity, rainfall intensity, accumulated rainfall)	Flooding damage (maximum possible, expected annual)	Pártl et al., 2017
	Return interval of floods	Human decision making	Serinaldi & Kilsby, 2017
	Erosion (mean annual soil loss)		Röthlisberger et al., 2017 Fuchs et al., 2017 Shalikovskiy & Kurganovich, 2017 Scorzini & Leopardi, 2017 Haer et al., 2017
<i>Coastal</i>	Related to coastline (geomorphology, erosion rate, sediment budget, coastal slope, elevation, distance from the sea)	Social & demographic	Merlotto et al., 2016
		Related to building & tax assessment	Yang et al., 2016
	Related to coastal storms (storm waves effects, relative sea-level rise, mean tidal range & significant wave height, overwash depth & extent, highest storm surge level, average slope of the storm surge landfall position)	Land use & cover	Gutiérrez et al., 2016
	Shoreline (previous high-water level, wet/dry line or run-up maxima)	Related to beach (nourishment & control structures)	Ferreira et al., 2017 Yankson et al., 2017 Tavares et al., 2017
	Experience & risk perception		
	Household & communal risk adaptation strategy	Mavromatidi et al., 2018	

The examples from the additional case studies confirm that the local community is an indispensable agent in post-disaster reconstruction, as in the Chinese earthquake-related study focused on the NGOs collaboration (Lu and Xu, 2015). To integrate psychological and governance indicators with the traditional ones, (Werg et al., 2013) included only those factors that local decision-makers have a direct influence on, that is to say, focusing on community and household levels. Case studies from Romania (Török, 2017), Laos (Jiao and Moinuddin, 2016), Bangladesh (Ahsan and Warner, 2014) and Saudi Arabia (Alshehri et al., 2015) all implemented the local scale dimensions of vulnerability or resilience in their studies. Additionally, three parallel studies from Canada, the UK and Spain (Boyer-Villemaire et al., 2014) demonstrated that local environmental context is the main contribution to the perception of environmental risks. Similarly to this study's (Asare-Kyei et al., 2015) conclusion that the global and local approaches have to be more coupled, in (Birkmann et al., 2015) the authors analyzed one top-down and another bottom-up case study and summarized that the local aspects are equally as important as global approaches for trustworthy scenarios of vulnerability.

Another important remark comes from the way case studies are held. If looked at the sample of 33 articles on indicators, there are 9 reviews and 24 case studies. However, among those case studies there are only two studies that actually included fieldwork on terrain (Greece (Minos-Minopoulos et al., 2017) and Romania (Grozavu et al., 2013)), and three studies whose fieldwork was in the form of a practical workshop with different managers and experts (Australia (Khalili et al., 2015), USA (Loomis and Paterson, 2014), West Africa (Asare-Kyei et al., 2015)). The other case studies were focused on a theoretical approach by using indicators in risk management, like statistical analysis of the available data and modelling.

*Indicators are predominantly related to vulnerability and not to hazards.*

Following UNDRR, the improved criteria for disaster risk management include built resilience of communities to disasters (Feofilovs and Romagnoli, 2017), where the constant monitoring of risk is required and where the progress has to be measured in terms of changes in risk (Mysiak et al., 2016). Among the targeted articles only six studies dealt with UNDRR Sendai lines and advice. The study (de Almeida et al., 2016)

focused on the understanding of disaster risk in Brazil (Sendai's priority 1), the review (Cutter, 2016) identified 27 disaster reduction assessment approaches according to Sendai policy, and the review (de Ruiter et al., 2017) updated the practice by new approaches, offering improvements in both earthquakes and flooding by comparing their vulnerability indicators. The study (Sena et al., 2017) hopes that its risk index would be useful in addressing some of Sendai's priority areas related to drought and health, (Papathoma-Köhle et al., 2017) that the combination of approaches to assess physical vulnerability to debris flows would contribute to the resilience of mountain areas, and (Xie and Zheng, 2017) is the only case study implementing Sendai regulative, carrying out the study of climate adaptability in the city of Beijing, China. Moreover, the case studies of Ischia island (Alberico and Petrosino, 2014), Venice (Borg et al., 2014) and Saudi Arabia (Alshehri et al., 2015) used definitions of vulnerability, risk and resilience proposed by UNDRR. These are the minority of studies from our analyzed sample that consider the UN's promotion of a resilient territorial system's development.

The used indicators are mainly related to the vulnerability component of risk (blue columns of Figure 20). Twelve out of 33 studies (36%) consider only social dimensions of risk. Among 19 studies considering both social and natural component (58%), it is again the social dimension of risk that was mainly considered: 4/5 in (Murgante et al., 2017), 4/7 in (de Ruiter et al., 2017), 32/36 in (de Almeida et al., 2016), 10/13 in (Chang and Chen, 2016), 3/4 in (Chang et al., 2015), 4/5 in (Xie and Zheng, 2017) and 4/15 in (Amjath-Babu et al., 2016), to state some of them. Only one study (Imbrenda et al., 2014) is based mainly on natural indicators (three sub-indices out of four), and two among the studies (Grozavu et al., 2013; Papathoma-Köhle et al., 2017) are based exclusively on natural or physical indicators (6%).

Similarly, among the additionally analysed case studies, there is a predominant social dimension of risk (15 of 35 studies use only social indicators, 43%). Four studies (11%) are based on natural hazards only: two of them being modelling cases (Alberico and Petrosino, 2014, Bozza et al., 2017), whereas the other two are reviews of methodologies (Gallina et al., 2016) and risk assessment framework (Borg et al., 2014). The rest of the papers (16 of 35, 46%) consider both hazard and vulnerability. The most balanced studies are (Merlotto et al., 2016) and (Hardy, 2017) with even distribution of social and environmental indicators, and one study (Cuevas Jiménez et al., 2016) considers geomorphologic attributes of beach erosion vulnerability (three attributes)

more than the social attributes (one attribute). If the full sample of 68 studies was considered, a similar distribution of usage of social and natural indicators was again found (red columns of Figure 20).

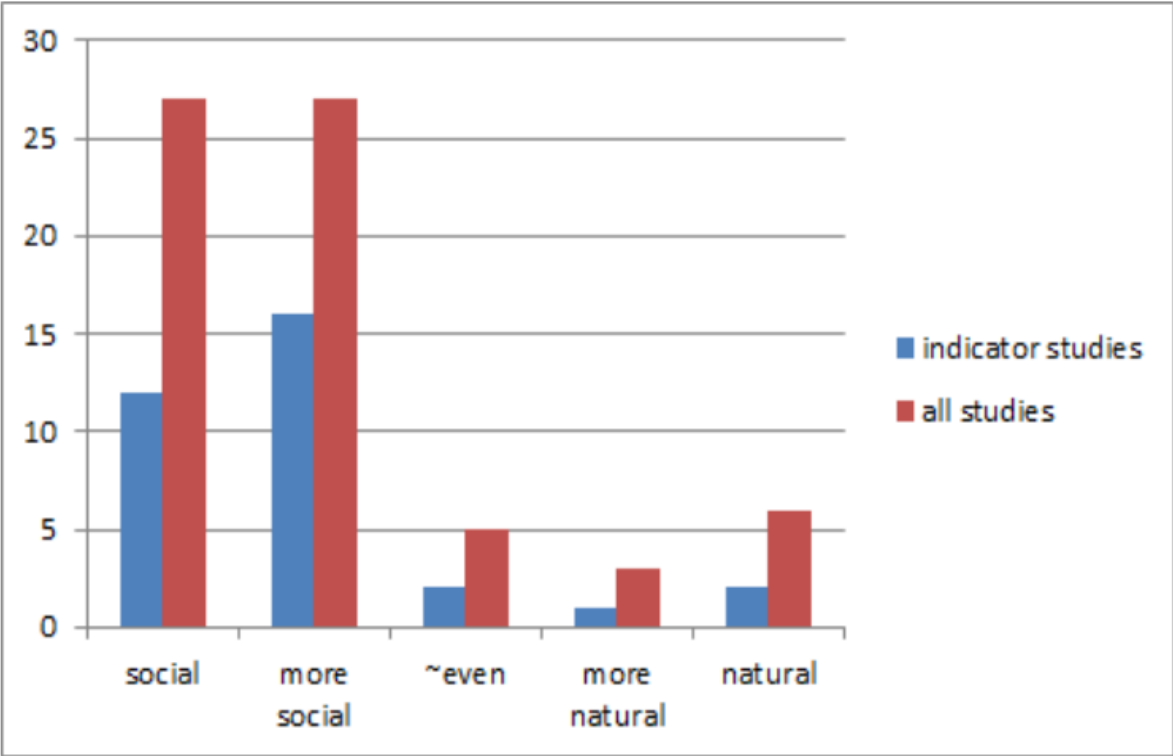


Figure 20: Social indicators are significantly more frequently used than natural indicators, which is evident both from the initial ‘indicator’ set of articles (in blue), and from the set enlarged by additional case studies (in red).

*While researching the temporal scale, the main phase to work on is the post-disaster one.*

The temporal scale is of equal importance as the spatial one. Three indicator studies have for their objective a research about temporal phases of disaster. A case study from Thailand (Siebeneck et al., 2015) created a new disaster resilience index to better understand pre-disaster conditions, the Greek case study (Minos-Minopoulos et al., 2017) worked on pre-disaster and disaster part of the disaster cycle, which is of importance for the cultural heritage management, and the Australian review offered a new outline in all three temporal phases for better social resilience (Khalili et al., 2015).

Almost all case studies focused on resilience time scale were interested in a post-disaster stage of the following events: the 1999 Taiwan earthquake (Chou et al., 2015),

the 2004 Indian Ocean tsunami (Frankenberg et al., 2013), the 2005 hurricane Katrina in the USA (Burton, 2015), the 2008 China's earthquake in Sichuan (Lu and Xu, 2015), the 2010 New Zealand's earthquake (Winstanley et al., 2015), the 2011 earthquake in Japan (Nakanishi et al., 2014), and a theoretical case in Saudi Arabia (Alshehri et al., 2015). One work was also a meta-analysis of flood disasters, considering all three disaster stages (Rufat et al., 2015). In this last study, thematic indicators are sorted by the proportion of citations within the three stages of a disaster, and it concluded that social vulnerability varies noticeably within the different temporal stages.

#### *Learning outcomes and risk perception are keys for future research*

The level of education is often cited as an important indicator of vulnerability to natural disasters and (Samir, 2013) showed it had a bigger effect on reducing disaster vulnerability than wealth, based on the example of communities in Nepal that face floods and landslides. Study (Chou et al., 2015) on learning outcomes from disaster-preparedness training in Taiwan underlines the need for an annual follow-up on learning satisfaction indicators. The objective is to establish standards that have to be attained, to improve the level of education related to disasters. It seems that knowledge produced by scientists and policymakers is not fully understandable for the general population (Kundak, 2017) and that local knowledge is not used to enrich the existing scientific tools (Sena et al., 2017). The initial step to enlarge human awareness is the established precise definitions of multi-risk concepts (Gallina et al., 2016).

Secondly, (Boyer-Villemaire et al., 2014) confirmed the strong relationship between community's adaptive capacity and the human perception of environmental risks, and (Rufat et al., 2015) found in its meta-analysis of flood disasters that the risk perception and coping capacity are weakly reflected in many social vulnerability indicators. Finally, as underlined in review (Tonmoy et al., 2014), 82% of all studies use methods whose theoretical requirements are rarely satisfied in the context of indicator-based vulnerability assessment.

To sum up, risk indicators used in the analysed studies were based more on social variables than on natural ones, with very few interdisciplinary studies that are praised in disaster risk reduction according to UN Sendai objectives, as case of socio-hydrology. The main goals of analysed indicators used in risk management were to propose new or

an improved responses to risk situations, offering a short advice to political deciders, to propose a concrete evaluation, visualisation and communication of risk. Indicators were mainly based on either personal experience of the authors or on existing literature, they were rarely constructed using a participatory approach, local scale for every unique case, questioning risk perception, or different phases of temporal scale.

## 5.2. Results from the first case study of North Morocco

### 5.2.1. Questionnaires from the local population

This study<sup>d</sup> contributes to explaining risk preparedness related to natural risks by describing the relations between risk awareness and precautionary behaviour in North Morocco. It explores the role of key variables in explaining the individual present and future precautionary behaviour. Finally, it is based on the natural distinctive features of the region of North Morocco (Figure 21).

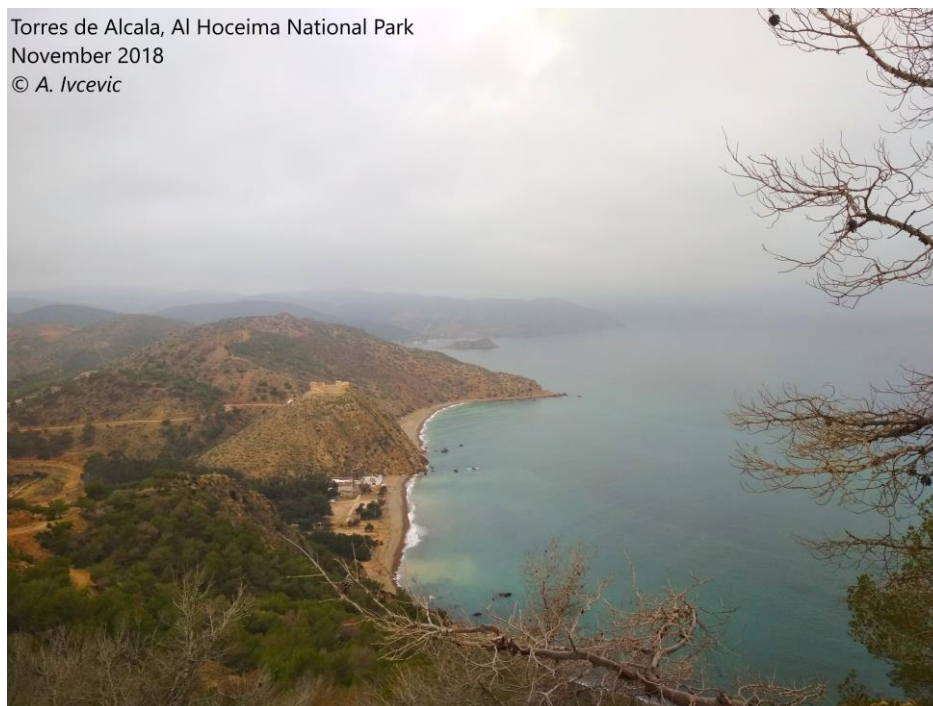


Figure 21: Natural features of the region of North Morocco are on the grounds of this study.

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<sup>d</sup> Published paper on Moroccan case study: Ivčević, A., Bertoldo, R., Mazurek, H., Siame, L., Guignard, S., Ben Moussa, A. and Bellier, O., 2020. Local risk awareness and precautionary behaviour in a multi-hazard region of North Morocco. *International Journal of Disaster Risk Reduction*, p.101724.



### *Main hazards locals are aware of are floods and earthquakes*

Answers to the first, open-ended question of the questionnaire, asking respondents what are the five natural hazards related to their municipality that come to their minds indicate that the main natural hazards that most locals are aware of are floods (148 of 391 responses) and earthquakes (69 of 391 responses). Together they represent 55.5% of the first spontaneously named hazards in each municipality (Figure 22). They are also cumulatively the most cited natural hazards, followed by wildfires, landslides, droughts and coastal storms. The three most threatening hazards per municipality are presented in Table 8. Also, according to literature, floods and earthquakes are the major historical natural disasters in Morocco and the region (Al Hoceima's earthquake in 2004 with 628 fatalities, Tangier's flood in 2008 with 30 fatalities) (Michel-Kerjan et al., 2014). Hypothetically, floods and earthquakes could also be better recognized not just because there are higher in number, but because they are more striking or just more apparent than some other hazards (like droughts).

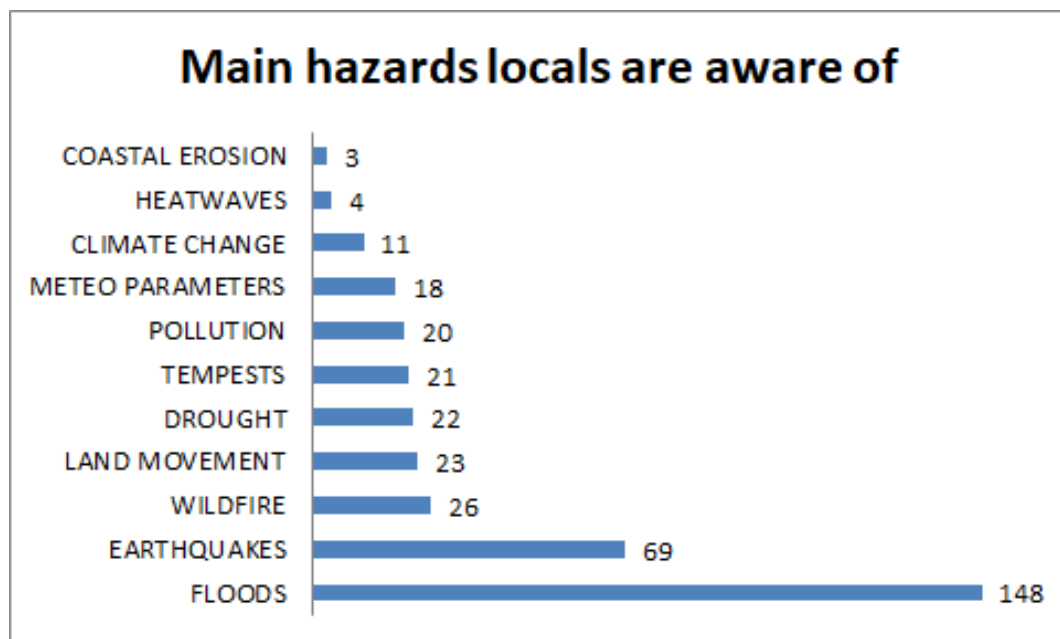


Figure 22: Main hazards locals are aware of: high dominance of floods and earthquakes in the region.

Table 8: Top three most threatening natural hazards per municipality.

	<i>First</i>	<i>N</i>	<i>%</i>	<i>Second</i>	<i>N</i>	<i>%</i>	<i>Third</i>	<i>N</i>	<i>%</i>
<i>Larache</i>	Wildfires	24	20.3	Floods	19	16.1	Pollution	11	9.3
<i>Tangier</i>	Floods	31	37.8	Wildfires	14	17.1	Pollution, Coastal storms, Earthquakes	6	7.3
<i>Tetouan</i>	Floods	54	26.2	Earthquakes	31	15.0	Wildfires	29	14.1
<i>M'Diq</i>	Floods	39	36.4	Wildfires	13	12.1	Earthquakes, Extreme weather	7	6.5
<i>Martil</i>	Floods	37	29.6	Coastal storms	24	19.2	Earthquakes	16	12.8
<i>Oued Laou</i>	Floods	22	25.9	Coastal storms	10	11.8	Pollution	9	10.6
<i>Chefchaouen</i>	Landslides	24	21.2	Floods	22	19.5	Wildfires	16	14.2
<i>Al Hoceima</i>	Earthquakes	51	32.7	Drought	23	14.7	Floods	20	12.8

*Correlations indicate the regional variability and the impact on precautionary behaviour*

Table 9 presents the correlations between the proposed constructed indicators. Among them, only environmental identity and risk sessions show significant and positive correlations with precautions taken. Environmental identity is positively correlated with risk sessions and with place attachment. Place attachment is negatively correlated with risk sessions, and 'trust state' is positively correlated with 'risk sessions' and with 'trust science'.

Table 9: Correlations between six constructed indicators and the precautions taken.

	<i>Nb items</i>	<i>Risk Informed</i>	<i>Risk Sessions</i>	<i>Place Attachment</i>	<i>Trust Science</i>	<i>Trust State</i>	<i>Environmental Identity</i>	<i>Precautions</i>
<i>Risk Informed</i>	11	1.00						
<i>Risk Sessions</i>	2	-.010	1.00					
<i>Place Attachment</i>	5	.091	-.103**	1.00				
<i>Trust Science</i>	3	-.027	.015	.066	1.00			
<i>Trust State</i>	4	.024	.120*	.088	.321**	1.00		
<i>Environmental Identity</i>	2	-.081	.335**	.143**	.095	.091	1.00	
<i>Precautions</i>	1	-.014	.227**	.035	-.019	-.028	.111*	1.00

\*\* with significance < .01

\* with significance < .05

If we check the correlations of three different areas (binary variable for each area) of our study with the constructed indicators, as well as with the dependent variables, the signal of regional differences is captured. The East area (zone Rif) is positively correlated with ‘risk sessions’, ‘environmental identity’, ‘protect future’ and ‘invest money’, unlike the central area (zone Mediterranean Martil), which is negatively correlated with ‘environmental identity’ and ‘protect future’. The West area (zone Atlantic) does not show correlation with any of the proposed indicators (Table 10). This variability within the region confirms a higher risk awareness of the East zone, which has a stronger risk memory than the central or, more particularly, the West zone.

Table 10: Correlations between the constructed indicators, dependent variables and three different zones of the study.

	<i>Risk Informed</i>	<i>Risk Sessions</i>	<i>Place Attachment</i>	<i>Trust Science</i>	<i>Trust State</i>	<i>Envi Identity</i>	<i>Precautions</i>	<i>Protect Future</i>	<i>Invest Money</i>
<i>Zone Rif</i>	.074	.177**	.040	-.043	.049	.171**	.070	.217**	.100*
<i>Zone Med Martil</i>	-.015	-.099	-.050	.084	-.092	-.193**	.012	-.148**	-.089
<i>Zone Atlantic</i>	-.068	-.085	.015	-.053	.056	.037	-.096	-.071	-.007

\*\* with significance < .01

\* with significance < .05

Precautions taken are positively correlated with ‘risk sessions’ (.227,  $p < .01$ ), and with ‘environmental identity’ (.111,  $p < .05$ ). Firstly, this indicates that the population of North Morocco seems to be learning and accepting the information communicated during risk sessions to boost its risk awareness and finally taking the precautions needed, and secondly, that people take more precautions to protect if they identify themselves as having a higher environmental identity.

In addition, the positive correlation between ‘environmental identity’ and ‘place attachment’ (.143,  $p < .01$ ) can be interpreted as an increased sense of place, which gives perspective to understand the place of environmental identity in the construction of the relationship to the territory (Bonaiuto et al., 2016). However, contrary to the positive correlation between ‘environmental identity’ and ‘risk sessions’ (.335,  $p < .01$ ), the correlation between ‘place attachment’ and ‘risk sessions’ is negative (-.103,  $p < .01$ ). This could suggest that people are more attached to their territory if they are not aware

of all the dangers that could be encountered there (Armaş, 2006), confirming that those respondents strongly attached to their municipality perceive natural hazards, but underestimate or deny their potential effects. These results could mean that strong place attachment is the cause for believing that the place is safe and that there is no need to feel at risk; contrary to environmental identity, which is higher as respondents are more aware of risks.

An interesting signal of the local differences within the region is shown if we consider the correlations between three zones of study and the constructed indicators and dependent variables (Table 8). The East part of the region (Rif) seems to be the most risk-aware, with the positive correlations with 'risk sessions' (.177,  $p < .01$ ), 'environmental identity' (.171,  $p < .01$ ), 'protect future' (.217,  $p < .01$ ) and 'invest money' (.100,  $p < .05$ ). The central part (Mediterranean Martil) is negatively correlated with 'protect future' (-.148,  $p < .01$ ) and with 'environmental identity' (-.193,  $p < .01$ ). The different tendency could be explained by the different history of natural hazards that these two zones have in common. The Rif zone was hit by a series of earthquakes in recent history. The most devastating among them occurred in 2004, revealing the state's failure to manage the disaster after the event. Indeed, the population seems to have learnt from this event to take some future protective measures. Also, the Rif Mountain zone was rather ignored in the Moroccan society during the 20th century, particularly after the Rif rebellion in 1958, due to ethnic tensions between Arabs and Amazighs (Berbers) (Lehtinen, 2008). The zone Atlantic does not show any correlation, possibly due to the lack of some big natural disaster that would remain fresh in the population's memory, or because the zone is populated by migrants from other areas.

#### *Variables explaining present and future readiness to protect differ from one model to the other*

Risk awareness was tested against the above presented demographic variables and constructed indicators, with a dependent variable 'precautions'. The regression analysis contained three blocks of variables: the first block was for demographic variables of gender, age, zone and education; the second block was for the assessed risk awareness (variables 'risk informed' and 'risk sessions'), personal experience with the risk and general feeling about the level of knowledge about the risk; and the last block included

variables related to trust in science and state, environmental identity, place attachment and willingness to move out. Results are presented in Table 11.

The first model (binary logistic, 'Precautions') shows significance of three variables: 'personal experience' (.904,  $p < .05$ ), 'environmental identity' (.349,  $p < .05$ ) and 'moving out' of the zone (.278,  $p < .01$ ), with Nagelkerke  $R^2 = .129$  (which says that 12.9 % of social variability is explained by this model). It is observed that demographic variables do not significantly predict if the respondents take precautions to protect themselves from the potential natural risk.

The second block of variables - where demographic variables are controlled - shows that personal experience positively influences precaution taking. This result confirms the importance of previous experience in taking measures to protect. People living in the Rif zone also take more precautions than people in other areas (marginal significance  $p < .1$ ). The local territorial variations within the region are confirmed by this result, where the Rif region has a fresher memory of previous disastrous events.

Furthermore, among the additional variables introduced in the third block, the variables of environmental identity and of moving out of one's municipality are significant and contribute to improving the model. This confirms the importance of recognizing the environment as an important part of one's personality, as well as the readiness to move out and to change municipality for some other. Finally, both place attachment and trust indicators did not contribute to explaining precaution-taking.

Table 11: Binary Logistic model of precautionary behaviour ('Precautions', N=307).

Block	Predictor	-2 Log-likelihood	Nagelkerke R <sup>2</sup>	$\chi^2$	df	Sig	B	SE	Exp(B)	95% C.I. for Exp(B)	
										Lower	Upper
1		286.003	.030	5.665	5	.340					
	Age						.002	.306	1.002	.550	1.826
	Gender						.153	.309	1.165	.635	2.136
	Education						-.012	.320	.988	.528	1.850
	Zone Rif						1.086*	.531	2.963	1.047	8.386
	Zone Med Martil						1.012*	.514	2.752	1.004	7.543
2		278.149	.070	13.518	9	.141					
	Age						.029	.315	1.030	.556	1.909
	Gender						.242	.317	1.274	.685	2.370
	Education						-.140	.343	.870	.444	1.704
	Zone Rif						.940	.548	2.560	.874	7.496
	Zone Med Martil						.752	.530	2.121	.751	5.990
	Personal Experience						.906*	.378	2.474	1.178	5.194
	Feeling How						-.097	.151	.907	.675	1.219
	Risk Informed						.230	.345	1.258	.639	2.475
	Risk Sessions						.296	.332	1.345	.702	2.576
3		266.436	.129	25.232	14	.032					
	Age						.147	.336	1.158	.599	2.239
	Gender						.258	.328	1.294	.680	2.463
	Education						-.123	.362	.884	.435	1.797
	Zone Rif						1.032	.561	2.806	.934	8.426
	Zone Med Martil						.801	.544	2.227	.767	6.464
	Personal Experience						.904*	.396	2.468	1.136	5.361
	Feeling How						-.199	.165	.820	.594	1.132
	Risk Informed						.144	.358	1.154	.572	2.331
	Risk Sessions						.165	.344	1.180	.602	2.314
	Trust Science						-.077	.157	.926	.680	1.261
	Trust State						-.060	.182	.942	.659	1.345
	Environmental Identity						.349*	.151	1.418	1.055	1.905
	Place Attachment						.007	.149	1.007	.751	1.349
	Moving Out						.278**	.098	1.320	1.090	1.599

\*\* with significance < .01

\* with significance < .05

The second model proposes the same variables to explain the willingness to protect from future risks (Table 12, 'Protect Future'), also through a logistic binary regression. Moreover, the third model tested is developed to describe precisely the readiness to protect from future risks by investing money (Table 13, 'Invest Money'). The type of model is the same, but instead of the variable of precaution-taking or protecting from future risks, the variable used is the readiness of the respondents to directly invest money to protect their lives and belongings in the future.

The second model (explaining the future protection) shows a significant association with origin from the Rif zone (.828,  $p < .05$ ) and attending risk sessions (.864,  $p < .01$ ), with Nagelkerke  $R^2 = .186$  (meaning that 18.6 % of social variability is explained by this model). The variable 'risk sessions' is positively and significantly associated. This suggests that people who attended risk awareness sessions rather consider protecting themselves in the future than those who did not take part in this type of risk awareness sessions.

Table 12: Binary Logistic model of future precautionary behaviour ('Protect Future', N=312).

Block	Predictor	-2 Log-likelihood	Nagelkerke $R^2$	$\chi^2$	df	Sig	B	SE	Exp(B)	95% C.I. for Exp(B)	
										Lower	Upper
1		409.940	.092	22.263	5	.000					
	Age						-.469*	.240	.626	.391	1.001
	Gender						-.092	.243	.912	.567	1.467
	Education						.445	.249	1.560	.957	2.544
	Zone Rif						.901**	.340	2.462	1.263	4.798
2	Zone Med Martil						.198	.320	1.219	.651	2.283
		393.712	.155	38.492	9	.000					
	Age						-.378	.247	.685	.422	1.113
	Gender						-.047	.252	.954	.582	1.564
	Education						.153	.270	1.165	.686	1.978
	Zone Rif						.784*	.357	2.191	1.088	4.413
	Zone Med Martil						.101	.339	1.106	.569	2.150
	Personal Experience						.216	.266	1.241	.737	2.091
	Feeling How						.041	.114	1.041	.834	1.301
Risk Informed						.402	.274	1.495	.873	2.560	
3	Risk Sessions						.848**	.254	2.334	1.419	3.841
		385.429	.186	46.774	14	.000					
	Age						-.424	.260	.654	.393	1.090
	Gender						-.001	.262	.999	.598	1.668
	Education						.284	.288	1.328	.756	2.335
	Zone Rif						.828*	.363	2.289	1.124	4.665
	Zone Med Martil						.155	.347	1.167	.591	2.304
	Personal Experience						.129	.276	1.138	.662	1.954
	Feeling How						.020	.124	1.021	.800	1.301
	Risk Informed						.373	.281	1.452	.838	2.516
	Risk Sessions						.864**	.264	2.372	1.414	3.980
	Trust Science						.004	.128	1.004	.780	1.291
	Trust State						-.085	.144	.918	.693	1.217
Environmental Identity						.132	.112	1.141	.915	1.422	
Place Attachment						.218	.125	1.243	.973	1.589	
Moving Out						.161	.083	1.175	.999	1.381	

\*\* with significance < .01

\* with significance < .05

The third binary logistic model (Table 13) is aimed at analysing the predictors of the respondents' readiness to invest money to protect themselves in the future. Among the variables that positively predict readiness to invest money are 'gender' (.618,  $p < .05$ ), 'education' (.621,  $p < .05$ ), and 'environmental identity' (.373,  $p < .01$ ), with Nagelkerke  $R^2 = .176$ . According to this, those respondents that are female, more educated and that are found to have an environmental identity declare to be more willing to invest money to protect in the future.

Table 13: Binary Logistic model of future financial precautionary behaviour ('Invest Money', N=309).

Block	Predictor	-2 Log-likelihood	Nagelkerke $R^2$	$\chi^2$	df	Sig	B	SE	Exp(B)	95% C.I. for Exp(B)	
										Lower	Upper
1		400.380	.080	18.849	5	.002					
	Age						-.255	.244	.775	.480	1.249
	Gender						.470	.250	1.600	.981	2.610
	Education						.914**	.260	2.494	1.498	4.151
	Zone Rif						.417	.341	1.518	.778	2.959
2	Zone Med Martil						.278	.323	1.320	.700	2.488
		388.908	.126	30.321	9	.000					
	Age						-.162	.251	.851	.520	1.393
	Gender						.559*	.259	1.749	1.053	2.905
	Education						.638*	.275	1.892	1.103	3.245
	Zone Rif						.295	.355	1.344	.670	2.693
	Zone Med Martil						.218	.340	1.244	.639	2.422
	Personal Experience						.158	.267	1.171	.695	1.975
	Feeling How						.201	.116	1.223	.975	1.533
	Risk Informed						.246	.278	1.279	.742	2.203
Risk Sessions						.459	.259	1.582	.953	2.626	
3		375.943	.176	43.286	14	.000					
	Age						-.116	.266	.891	.529	1.501
	Gender						.618*	.271	1.855	1.091	3.155
	Education						.621*	.294	1.860	1.045	3.313
	Zone Rif						.331	.361	1.393	.687	2.826
	Zone Med Martil						.316	.349	1.372	.693	2.716
	Personal Experience						.116	.278	1.123	.651	1.935
	Feeling How						.094	.126	1.099	.858	1.407
	Risk Informed						.155	.284	1.168	.669	2.037
	Risk Sessions						.329	.269	1.390	.820	2.354
	Trust Science						-.038	.131	.963	.745	1.243
	Trust State						-.114	.144	.893	.673	1.184
	Environmental Identity						.373**	.114	1.452	1.160	1.816
	Place Attachment						.010	.125	1.010	.791	1.290
	Moving Out						.117	.084	1.124	.954	1.325

\*\* with significance < .01

\* with significance < .05



From the above-presented models, some conclusions can be drawn about the Moroccan society's relation with multi-risks in the region (Table 14). All models use the same independent variables and they differ by the dependent variable tested. All models are improved with more blocks of variables included and, therefore, the variability of human risk awareness is better described.

The significance of the variable 'personal experience' from the first model 'precautions', together with the 'zone Rif', 'moving out' and 'environmental identity', shows the impact on inhabitants when it comes to taking precautions or not (in line with Mills et al., 2016). All four variables positively predict precaution taking. Firstly, those participants that had 'personal experience' of natural hazards present a significantly higher probability of taking precautions (.904,  $p < .05$ ), which confirms a traditional relationship (Armaş, 2006; Kung & Chen, 2012). However, it should be underlined that less than 17% of the respondents did take measures to protect. The significance of the variable 'moving out' in this model (.278,  $p < .01$ ) could be explained by the strong belief that precautions should be taken when facing high risks, even if that would mean to move out and leave the territory. Moreover, the models confirm the local variations within the region, as shown previously by correlations. Dwelling in the Rif zone has a marginally significant impact on risk awareness and protecting (1.032,  $p < .1$ ), which differs from other zones, due to recent seismic history, and due to the cultural and historical differences of this zone based on the interior distrust between the Rif zone and the central government (Lehtinen, 2008). Finally, 'environmental identity' shows that the relationship with nature seems to have an impact on risk awareness and taking precautions (.349,  $p < .05$ ). This information could be useful for policymakers, where they should promote ecological concerns and encourage local action to resolve environmental issues while promoting risk mitigation measures.

According to the result from the second model on future protection, those respondents that are from the Rif region and that have participated in risk awareness sessions do plan to protect themselves in the future. Contrary to the first model, here the variable 'risk sessions' is significant and with a positive signal (.864,  $p < .01$ ). This could be considered as a confirmation that residents learn and are willing to improve their behaviour in the future. As already discussed, the significance of the Rif municipalities of Al Hoceima, Chefchauen and Oued Laou (.828,  $p < .05$ ) could be explained by the more severe consequences that this part of the region experienced, such as landslides and

wildfire in Chefchaouen (Figure 23) and notably by Al Hoceima's earthquakes. Besides, only a slight change from future protection to investing money results in different significant variables. In the third model, the significant demographic variables are 'gender' and 'education' and a constructed variable 'environmental identity' (.373,  $p < .01$ ).



Figure 23: Landslide stabilisation works just in the neighbourhood of my interlocutor's association from Chefchaouen.

It is, therefore, worth noting that the predictors of future protection intention differ from the variables of future investment intention ('protect future' > 'invest money'). The latter model has different significant variables that cause the model's outcome. Further research on different types of respondents' protections is needed since not all measures are financially valued. It would be motivating to see if the non-financial measure of protection is seen more as a personal measure (e.g., improving the construction of the house on one's own without spending money) or as an ethical or divine compensation for a good life (e.g., praying and being a better person). This is why a future study should include the 'divine' component as a risk management tool. That study should rather be conducted by using interviews to understand the subtle and complex relationship that

religion can maintain with natural risks and the protective behaviour of the population, as suggested in (Joffe et al., 2013). The summary table with the best correlation from three binary logistic models follows (Table 14).

Table 14: The summary table with the best correlations from three Moroccan binary logistic models.

Model	Predictor	-2 Log-likelihood	Nagelkerke R <sup>2</sup>	$\chi^2$	df	Sig	B	SE	Exp(B)	95% C.I. for Exp(B)	
										Lower	Upper
1		266.436	.129	25.232	14	.032					
	Personal Experience						.904*	.396	2.468	1.136	5.361
	Environmental Identity						.349*	.151	1.418	1.055	1.905
	Moving Out						.278**	.098	1.320	1.090	1.599
2		385.429	.186	46.774	14	.000					
	Zone Rif						.828*	.363	2.289	1.124	4.665
	Risk Sessions						.864**	.264	2.372	1.414	3.980
3		375.943	.176	43.286	14	.000					
	Gender						.618*	.271	1.855	1.091	3.155
	Education						.621*	.294	1.860	1.045	3.313
	Environmental Identity						.373**	.114	1.452	1.160	1.816

\*\* with significance < .01

\* with significance < .05

*Three social profiles among the population of North Morocco are detected and they indicate a regional variability.*

A tool used to visually summarize data about the survey's respondents was a Multiple Correspondence Analysis, where the above-mentioned variables were integrated, to compose social profiles among the investigated population. Besides, the age variable, although binary in models, was now more specified with three categories (<35, 36-59, >60). All variables included in the analysis were numeric and nominal. Two dimensions obtained represent categories with the highest contribution to the total variance in the data. Dimension 1 ( $\alpha = .582$ ) accounts for 21.01 % of variance, and dimension 2 ( $\alpha = .383$ ) accounts for 15.27 % of variance, resulting therefore in 36.28 % of the total variance in the data displayed by the plot (Figure 24).

The variables that contribute to dimension 1 are the education level, notably holding a university degree, environmental identity, and the feeling of knowledge one has on

hazards. On the other hand, opposed variables related to dimension 2 are age, notably an age of over 60 years, place attachment, and trust in science and state. Only those variables are active but are plotted along with the variables that have a marginal contribution ('protect future', 'invest money') and with the supplementary variables of zones of study.

Three groups of variables emerge. The first group, with a positive contribution of the first dimension, is composed of those respondents that hold a university degree, that consider themselves well-informed and have a strong environmental identity. Members of this group are marginally ready to protect themselves in the future and they are named 'aware' in Figure 24. The second group, contrary to the first, with a negative contribution to the first dimension, consists of respondents without university degree that have a low environmental identity and are not considering future protection. They are named 'sceptical'. The final group, the positive contribution of the second dimension, comprises those respondents who are over 60 years old, who display a high place attachment and high trust in state and institutions. They are described as 'indifferent' in Figure 24.

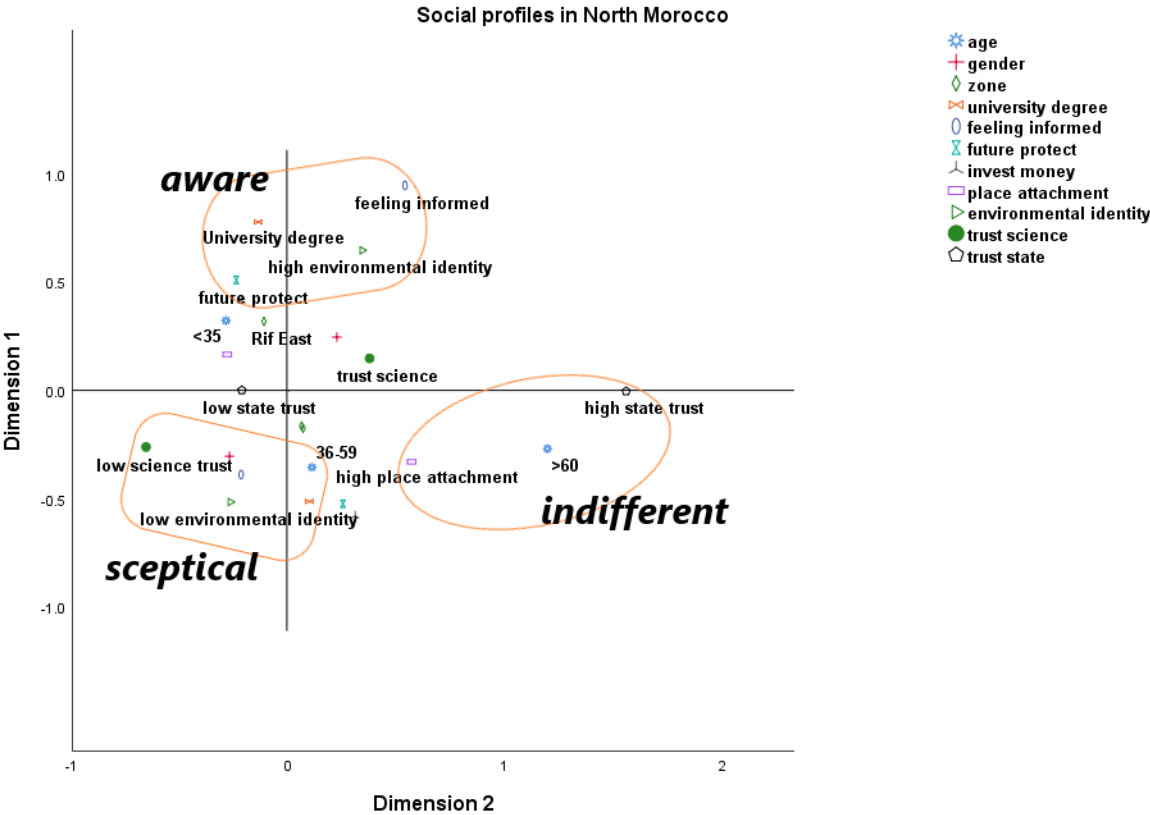


Figure 24: Detected social profiles in the region of North Morocco.

Although it could arguably be expected to see the distribution of social profiles (Figure 24), that the younger, educated and those with high environmental identity are aware of risks; that the less educated with low environmental identity are sceptical, and that the eldest with high trust in state and institutions are indifferent, it is the regional variability that is the added value of this analysis. The Rif zone of the region could be described as aware (or just preoccupied), and the Mediterranean and the Atlantic zones almost coincide and could be seen as sceptical. This could be due to both historical and cultural differences between those two zones, which were merged into the same region just recently, after the territorial reform of 2015 (Bulletin Officiel n° 6340, 2015). The Rif zone is not only as of recently part of the same region as Tangier and Tetouan, they share different cultural and historical background, as well. The Rif is a zone of ethnic group and language Amazigh, that was rather neglected in the period between 1958 when the Rif rebellion occurred and 1999 when king Muhammad VI was inaugurated (Lehtinen, 2008). The process of new 'unification' started with the creation of a Royal Institute of Amazigh Culture and went on until 2011 when the standardized Tamazight was recognised as a co-official language (L'encyclopédie Larousse, Encyclopaedia Britannica). Finally, this zone was hit by a series of earthquakes, among them the most devastating one from 2004, when the state failed in managing the crisis provoked by the earthquake. Bearing in mind that earthquakes have a special meaning for Muslims among all natural disasters (Paradise, 2005; Ghafory-Ashtiany, 2009), all the aforementioned reasons could explain why the population from the Rif zone is identified as aware among the region's social profiles, contrary to the two other zones.

### **5.2.2. Interviews and discourse analysis**

The interviews served not only to learn about the region and to build bridges with local contacts in the region, but also to contrast the general population's responses with the official directions in managing natural risks. The total of 25 interviews was divided into three different groups: eight interviews with the elected or installed representatives (later in the text *Administrator*), eight with the scientists and technicians of risk research or management (later in the text *Scientist*), and nine members of different local associations, dealing with environmental and social questions (later in the text *Associate*)(Table 3, Figure 25).

The interlocutors have been asked about risks, their memory of risks and the risk management policy in the region. Among the useful information given, some particular answers need to be discussed.



Figure 25: Moroccan associations contribute to social and environmental issues in their municipalities, and were always ready to share their experience concerning risks.

*a) Indicators*

The main topic that was aimed to be elaborated during these interviews were the indicators of risk management, both with the scientists and with the administrators. On the macro i.e. national level the Sendai indicators were recognized as global policy requirement that Morocco engaged to follow:

*“Yes, we are working in very close collaboration with Sendai’s international engagement policy. It is linked in every sense, except that the Sendai indicators are on the macro scale, public policies and strategies, but here we do not go into detail.”*

(Female Administrator at the level of Direction, 40, Rabat)

On the lower scale, other administrators are not aware of the Sendai policy indicators. As far as risk indicators are concerned, the administrators from smaller municipalities do not consider themselves in charge of risk management, possibly due to centralization of power, which is either in the region’s capital Tangier or in the national capital Rabat:

*“Wilaya produces the ORSEC and therefore I have no idea about the indicators.”*

(Male Administrator, 55, Oued Laou)

To clarify, ORSEC is a French acronym *Organisation de la Réponse de Sécurité Civile*<sup>e</sup> which is an emergency plan in case of disaster, here referred to floods. Besides, the concentration of power as far as risk is concerned is demonstrated in the term *wilaya* which is a parallel district to the region, where its head is not elected but appointed by the king. In short, higher entity *wilaya* is in charge of risk management, and small municipality is not informed about it. The similar signal comes from the municipality of M’Diq:

*“The indicators are not used [here], there is a specialized service that does this.”*

(Male Administrator, 60, M’Diq)

Moreover, when asked about indicators, the big urban centre is in a similar position, with an underlying statement of procedure that is not standardized.

*“The studies are carried out by consulting firms and consultants: there is no national standard, each develops its own methodology.”*, adding that *“earthquake protection is expensive, so it is reserved for certain types of buildings. It is difficult to enforce the regulations. The materials are not standardized in Morocco, so we don't know what we are*

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<sup>e</sup> In English: Organization of the Civil Security Response

*building with, we are building with what is on the market. The passage by an architect or an engineer (concrete) is obligatory, but the material used can be non-standard.”*

(Male Administrator, 55, Tetouan)

The scientist also draws attention to the fact that the standards are designed by private engineering consultants, which can be an additional problem when the space is over-constructed (Figure 26):

*“We lack control, work monitoring and the quality of the materials used. Everything functions economically. Some laboratories set the standards of materials, but since all the laboratories and design offices are private, ...”*

(Male Scientist, 30, Al Hoceima)



Figure 26: Over-construction in the coastal areas is sometimes followed by poor standards of materials used.

This opinion, however, is opposed to the following one, whether true or not, and indicates a communication gap:



*“I believe that in terms of construction, the problem does not arise, especially when you build in concrete. In 1994 we did a study on constructions in informal settlements, and we were surprised how this self-construction was quite solid.”*

(Male Scientist, 45, Tetouan)

Scientists call for more investment and more probabilistic studies.

*“For tsunami indicators, you need to install tide gauges. With the tide gauges in the ports you can record the wave height and refine the models. [...] We have only one tide gauge, east side, close to Algeria; the other in Casablanca was recently destroyed by a boat.”*

(Female Scientist, 50, Tangier)

Since in Morocco exist other tide gauges along 3500 km of coast, but are not under the national research institution, which is the case mentioned here, maybe the data sharing could be implemented, to avoid more purchase.

*“For risk management, you have to do probabilistic studies. The frequency of an event is an important indicator. The level of probability, which threshold to take, that is up to managers, if they choose to be more careful, if they are rather pessimistic or optimistic.”*

(Male Scientist, 35, Tangier)

In addition, two scientists from Tetouan, hired by two different city's environmental services, talk about the needs of politicians:

*“On the other hand, politicians want impact indicators and we cannot yet provide them since it is expensive and because we lack the expertise. For example, recently we have raised awareness in 40 schools, but after all, we do not know the success rate of schooling.”*

(Male Scientist, 50, Tetouan)

*“Elected officials do not ask for indicators but ask for studies.”*

(Male Scientist, 30, Tetouan)

This follow-up of the success rate is a remark to come back to, while discussing if it is possible to construct dynamic indicators, as a measure in time, as here the number of unaware kids before the campaign and the number of aware kids after the campaign.

To finish, back to the national point of view from Rabat, more time for improved urbanism and spatial planning is needed (as in November 2019):

*“The port of Tanger Med has already changed the region a lot. But it takes years to see results and read them and decipher them, along with the official indicators.”*

(Male Administrator, 45, Rabat)

*“By dealing with hazards we can actually talk about indicators, is that right? ... For us, the indicator phase would be the third phase, we haven't arrived there yet.”*

(Female Administrator, 40, Rabat)

#### *b) Disaster, emergency and awareness*

The hazardous events mentioned are mainly floods and earthquakes, which correspond to our results from the questionnaires in the previous section. The remarkable part is that the terms *disaster* or *urgency* were used only 22 times, which could be considered as reassuring if we consider that people should not stress out for natural risks, but could be also worrying if we are of opinion that people are not fully aware of the possible danger.

As underlined by the scientists:

*“At the level of before and post-earthquake, what needs to be done is to build according to the earthquake code, no ifs or buts. And when the disaster happens it depends on the behaviour of the population.”*

(Female Scientist, 50, Tangier)

*“The problem is that people forget, we need more awareness [campaigns], we need to train people at the institutional level. Also, everything that worked in theory during the disaster on the spot falls ... So the risk culture must be developed.”*

(Male Scientist, 50, Tetouan)

They both do talk about the need for risk awareness and how human behaviour is crucial, but we can see that for both of them the disaster is something natural that occurs or happens, and it is on humans to deal with it, which is opposite opinion developed by a group of disaster management scientists, that consider disasters as effectively the human failure of treating natural hazards (Maskrey et al., 1993).

Furthermore, the 2004 earthquake in Al Hoceima was truly a disaster, which stayed in the memory of the locals.

*“After the 2004 disaster, half the population sought help from a psychologist. I myself stayed with my family for 1 month in a tent.”*

(Female Administrator, 60, Al Hoceima)

Finally, the population expects more from the administration, as far as raising risk awareness is concerned:

*“Even the administration does not raise awareness; they arrive after the event to remedy it, but not before to anticipate it. The administration must have the action and emergency plan.”*

(Male Associate, 55, Chefchaouen)

*“For risk management, you must first put a culture of risk management in the population, because the population does not consider these disasters. We manage at the time, no forecast management, [only] on-site management and not prevention.”*

(Male Associate, 25, Tetouan)

As a response to the need for awareness, all the theoretical bases to proceed with it in the whole territory could be summed up in the following paragraph:

*“The population is aware of this problem, in any case, the municipalities are obliged according to the law, and municipal charter, and even according to the constitution to raise awareness of the population for the prevention of various risks.”*

(Male Administrator, 40, Martil)

That said leaves some hope, but there is need to raise awareness in rural municipalities and outside of big urban centres as well, because the campaigns, if they exist, evidently do not arrive in all parts of the region. The role of a mosque in society in terms of risk awareness has been underlined:

*“The mosque is the first awareness centre; it is a synonym for awareness, with the unblocking points for the population. But it is necessary to review the legislation because there are still laws of the time of protectorate.”*

(Male Administrator, 45, Rabat)

*“At school, there is no awareness. Even at the mosque, which is a showcase, in the speech on Friday, never a speech on the risks was mentioned. So there’s nothing, total absence.”*

(Male Administrator, 55, Oued Laou)

### *c) State, politics, law*

The role of State in the risks of the changing world and in the lives of the population, in general, can be summarized by some interviewees:

*“The State is well involved, the blue flags, the institutions, ... with specific awareness training, workshops organized, even initiatives to build ecological schools, made of local stone, how to better use energy. So the awareness is there and it should not be overlooked, in addition to the installation of the Fund to fight against natural risks. But we must not frustrate the people, the people who need special treatment. You don't have to be very direct, you don't even have to communicate the issues to them.” [...]*

*“The northern region, with the coast and relief with the cultivation of cannabis. There are small results of converting this crop to agriculture. But the difficulties are economic because instead of earning 50 € per day by producing cannabis, people cannot earn that by producing tomatoes, but still, there is progress. And there is a tourism and the development of the coastline covered in concrete. Will the population accept the changes or not, for that the State prefers to slow down a bit to see the evolution of things in the future.”*

(Male Administrator, 45, Rabat)

*“Regarding the risks, the municipality wasted a lot of money on the Quemado cliff, trying to manage the future collapse; we have already erased part of the cliff according to the water flow. We work secretly because the population is not interested in public work related to risk, it is the task of the municipality. We did not even communicate the risks to the inhabitants of the cliff.”*

(Female Administrator, 60, Al Hoceima)

*“People are not interested in the risks, there are few complaints in the town hall. 70% of the population are ‘poor’ and don't even think about the risks and want only their home.”*

(Male Administrator, 60, M'Diq)

As said, the State is working on improving the risk and environmental management of its territory, but they seem to care less to communicate the works to the population. From the point of view of the scientists, the laws are there but are not respected and there is a lack of control.

*“At the level of the law everything exists, the problem is if we respect the law or not. The regulations exist, but they are not followed strictly enough. In Al Hoceima people have experienced the earthquake and therefore they are more aware of the risk than their compatriots. The law is rather obeyed in the city where the controls are more frequent and where the sanctions are more severe.”*

(Male Scientist, 35, Tangier)

*“The land was expropriated for non-construction, but now according to the development plan, it is no longer. The state still decided to build a hotel and tourism projects. The vision was to expropriate the wadi area, but if the land is part of the tourism project, the owners want to be able to carry out the work themselves and invest. People are of course very aware of the risks [...] but when it comes to economic interests, everyone forgets about the risks. The [Martil] valley floods are very well known among the population, everyone knows and yet everyone forgets it when it comes to economic interest.”*

(Male Scientist, 30, Tetouan)

*“Here we do not master urbanization, there is no service that meets the needs of immigration pressure, the population does not accept the dynamics of the sea, and the most important point is that they do not respect the law. You have to make people respect the law.”*

(Male Scientist, 50, Martil)

According to them, not the population, nor the State respect the laws and the main reason noted is not the knowledge or the perception of risk, but the economic profit that could be derived from the territory (Figure 27).



Figure 27: The Mediterranean coast is being rapidly urbanized in Morocco, as it is the case of the municipality Oued Laou, which economically strongly relies on tourism.

Concerning remarks of the immigration and urbanism, the associates do confirm the problem of the non-regulated construction, which is listed as a worrying factor by the locals from different municipalities:

*“The state cannot assure the construction so the people build on their own and, on the other hand the local authority closes their eyes in front of the construction and when the district becomes too large it is after too difficult to stop the construction and the urban planning agency provides basic infrastructure and services and it remains for the population to pray to God that some great event does not occur.”*

(Male Associate, 55, Chefchaouen)

*“The district, 30 min by walking from the city centre, I have never been there, but it is another city, another world, there are districts that are called 'the districts of 15 min', built over night by the Moroccan immigrants who came here, bought the parcels and built without authorization and after a while, it is difficult to... 10,000 people, destroying the buildings, it is not feasible, there are social factors, economic, cultural... A case of the ground floor, a traditional oven and above the 3 floors, where is the logic, that's a big risk.”*

(Female Associate, 35, Tetouan)

*“For immigration, [...] these people who come to settle here they build shanty towns and trade vegetables illegally after the State gives them 70 m<sup>2</sup> and this has no interest or contribution for the city.”*

(Male Associate, 50, Larache)

*“The intense immigration has been here for the last twenty years. Basically they try to cross to Europe, but since they don't succeed, they settle here. It's difficult to integrate them, I don't know if they have diplomas, you see them rather begging or stealing.”*

(Female Associate, 30, Tangier)

Final remark relates to trust that some associates express dealing with the State. One is related to the memory of the 2004 earthquake in Al Hoceima, and the other about the traffic of cannabis in the Rif region and the collaboration with the State:

*“As far as the authorities are concerned, I don't think they have action plans, intervention plans, just in case. In 2004, 6 hours after the earthquake, the majority of the officials who are not from here took their children and they fled 300-400 km from here. We stayed here for two days with the complete absence of the State. I fear that if an earthquake happens*

*again that we will make the same mistakes. What has improved in 2004 is the construction which is a bit earthquake resistant, [but] even if we have problems, we need skilled manpower to put it in place."*

(Male Associate, 50, Al Hoceima)

*"We have worked with the municipality on the vision for the intermediary city 2030 and the municipality must integrate it into all projects. Behind all our work there is the support of politics, it is essential. For example, banning cannabis is a political choice, we cannot fight it, and we can only adhere to a political will."*

(Male Associate, 55, Chefchaouen)

#### *d) God*

The question of God and the will of God has an important place in the everyday life in the region, whose inhabitants are religious. God is important even in risk management, as confirmed by the following administrators:

*"We don't know when an earthquake will happen, it's God's will, but we do what we can, each in our own field, we follow building standards."*

(Female Administrator, 60, Al Hoceima)

*"To stimulate risk management, hah, we leave it to God. Something has to happen that we react. We don't have the big thing in our memory even if ORSEC reminds us that an emergency can happen. In the '80s the river overflowed, but without victims, so it's not a big thing, alhamdulillah may happen or not."*

(Male Administrator, 55, Oued Laou)

A scientist shared her experience from a tsunami-related project, which is in line with the expressed God's will, even punishment:

*"Especially the elderly people are very reluctant and for them a tsunami cannot happen: 'Tsunami, it is a punishment from God and if we have to die we die.' But young people are more open."*

(Female Scientist, 50, Tangier)



God's will is confirmed by an imam as far as the origin of natural risks is concerned, but the prevention is on other institutions:

*"If we talk about all the risks, we, therefore, believe that there is an extraordinary force which manages these phenomena, which controls the whole universe, the will of God. There is no difference from what we believe and what you believe, except that we believe that these risks are controlled by a stronger force of God. For example, indeed, here in Morocco, if the precipitation is less intense, if there is drought, we invite people to pray together the prayer of 'istiska' asking God to help us to have rain."*

*"Imams teach believers to protect themselves, in the communes they play a very important role, and it always remains at the level of Islam, but the other [institutions] do not do their duty. Here in Morocco, we are not in Japan, here we do not have prevention, we do not predict fires, flooding. This is a disadvantage. Nature is integrated into a man. If there is a flood, we lower our hands and say: It is the God who wants that, it is his decision and we cannot be against it."*

(Male Associate, 55, Tetouan)

e) *Urbanization aptitude maps*

One example that emerged from the interviews is the case of urbanization aptitude maps. It is currently a vast project in Morocco, to cover the Kingdom with the elaborated studies that would permit planned urbanization, paying attention to the natural basis of the territory<sup>f</sup>. It has been mentioned by various interlocutors without being asked as the question in the interview, and it confirmed the importance of the project for many different interviewees, but with some gaps in the transfer of information.

*"According to the public call for tenders, the design offices produced the [urbanization] aptitude maps to indicate the areas prone to major risks. All the scientific information is projected in the city's development and construction plans and this is the guide for the administration."*

(Male Scientist, 30, Al Hoceima)

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<sup>f</sup> Web page of the Ministry of National Spatial Planning and Urbanism, Housing and Urban Policy <http://www.muat.gov.ma/?q=fr/urbanisme/planification-urbaine> (Access on 17 January 2020)

*“And the ministry, as there is a government program from 2016 to 2021 to cover the whole territory with urbanization aptitude maps, with the 31 maps, so already there is a government commitment, second is the financing strategy of 30 to 50% of the projects and the third a vital need in the strategic vision of resilience of the territory, and this must converge for prevention and beyond. For the moment we are in prevention, so we have launched 10 maps since 2015, and 21 others since 2017 and they are essential benchmarks for urban planning. It is no longer a luxury, it is a vital necessity. First 10 maps were for prefectures and regions of the whole kingdom and then we decided to target the scale better for the most vulnerable areas, we went to urban areas to change the scale, maybe the area was not really a very good indicator, precisely it is the scale. We have 12 regions in Morocco, we are currently covering 9 regions, and among the regions that will soon be declared resilient is the region of North Morocco, Tangier-[Tetouan]-Al Hoceima.”*

(Female Administrator, 40, Rabat)

*“After the earthquake of 24 February 2004, the aptitude map was elaborated by a French institute. The land of the province is painted according to the aptitude for construction (red: unbuildable land; purple: construction is authorized, but with strict planning; blue: softer conditions; white: no restrictions). [...]~50 researchers collaborated in the production of this document, aptitude map together with the development plan and urban planning, it is very clear.”*

(Female Administrator, 35, Al Hoceima)

However, there are some detected flaws related to the aptitude maps. The additional problem, those particularly related to the possible improvement for risk management, are going to be discussed in section 6.2.3.

To sum up, the results from North Moroccan case study, targeting general population in a quantitative study, indicate that risk sessions and environmental identity seem to have an impact on precautionary behaviour, related to present and future protective measures. The importance of risk awareness sessions is confirmed by interviews in the qualitative study. It is shown that both scientists and members of associations call for more awareness campaigns, however the majority of administrators defend the position

that the population is aware of risks and that the institutions are well involved. However, administrators from smaller municipalities, from the zone of Rif, admit the absence of sessions and learning processes on risk. This is in line with the signal coming from the survey on general population precautionary behaviour, where only zone Rif of the region could be described as preoccupied or aware, and that could be explained by both cultural and historic particularities, as well as the hazard history that Rif zone recently experienced. Regardless of the actual situation, the rupture of information between different interlocutors is evident, undermining the success of the risk management processes.

### **5.3. Results from the second case study of Sardinia**

In West Sardinian case study, wetlands represent a nature-based solution to tackle climate change-related hazards. Every public policy has a cost and since citizens invest their own money and know they would need to pay a cost, they could be more attentive to their behaviour and choices. The result of our study<sup>§</sup> can provide a useful indication to policymakers in charge of climate change adaptation in Sardinia, particularly in light of the actual legal change of the regional environmental law allowing further coastal construction on the island, and while considering additional protection and management of wetlands (Figure 28).

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<sup>§</sup> Published paper on Sardinian case study: Ivčević, A., Statzu, V., Satta, A. and Bertoldo, R., 2020. The future protection from the climate change-related hazards and the willingness to pay for home insurance in the coastal wetlands of West Sardinia, Italy. *International Journal of Disaster Risk Reduction*, p.101956.

Cabras, May 2019  
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Figure 28: Wetlands are at the basis of West Sardinian climate change mitigation, as well as a local natural landmark and part of identity.

*The locals are poorly familiar with the wetlands' role in natural risks mitigation*

When asked to self-assess their level of information related to different natural hazards, the respondents answered mainly that they considered their level of knowledge to be average, being the least informed on landslides and the most on heatwaves.

However, when respondents were asked to evaluate the statements related to a set of natural hazards as correct or incorrect then the results presented a more complex pattern (Table 15). The locals showed the best knowledge related to floods and drought, where more than 90% of respondents correctly evaluated the statements describing these hazards. The respondents were less familiar with climate change (around 70%). Surprisingly, a large number of respondents is apparently not familiar with risks associated with erosion and coastal storms.

'Coastal erosion is a very slow process that takes hundreds of years and is unrelated to rising sea levels and the frequency of storms.' was a piece of information correctly evaluated by only 15% of respondents. And the statement 'Coastal wetlands are among our first defence against coastal storms because they slow down the speed of the wind.' received only 22% of correct evaluations, with 49% 'don't know' answers. Precisely this piece of information on wetlands shows how one of their main regulatory services remains unrecognised by the very inhabitants of these wetlands. This indicates a clear gap between lay and expert knowledge about the benefits that wetlands provide to areas confronted with coastal hazards.

Table 15: Level of information related to natural phenomena.

Natural phenomenon	Correct answer		Incorrect answer		Don't know	
	N	%	N	%	N	%
Flood	163	92.6	6	3.4	6	3.4
Drought	159	90.3	2	1.1	14	8.0
Landslide	144	81.8	12	6.8	19	10.8
Sea level rise	131	74.4	10	5.7	33	18.8
Heatwave	130	73.9	11	6.3	34	19.3
Climate change	126	71.6	9	5.1	38	21.6
Wildfire	122	69.3	13	7.4	40	22.7
Earthquake	76	43.2	59	33.5	40	22.7
Coastal storm	39	22.2	49	27.8	86	48.9
Erosion	27	15.3	108	61.4	38	21.6

However, when asked to evaluate the list of proposed measures that could help in reducing damage by the natural hazardous events (on the scale 1 to 5), the locals seem to recognise the need of protecting coastal wetlands, as well as the need of an integrated coastal wetlands management, although their main concerns are waste reduction and better management of water resources (Figure 29).

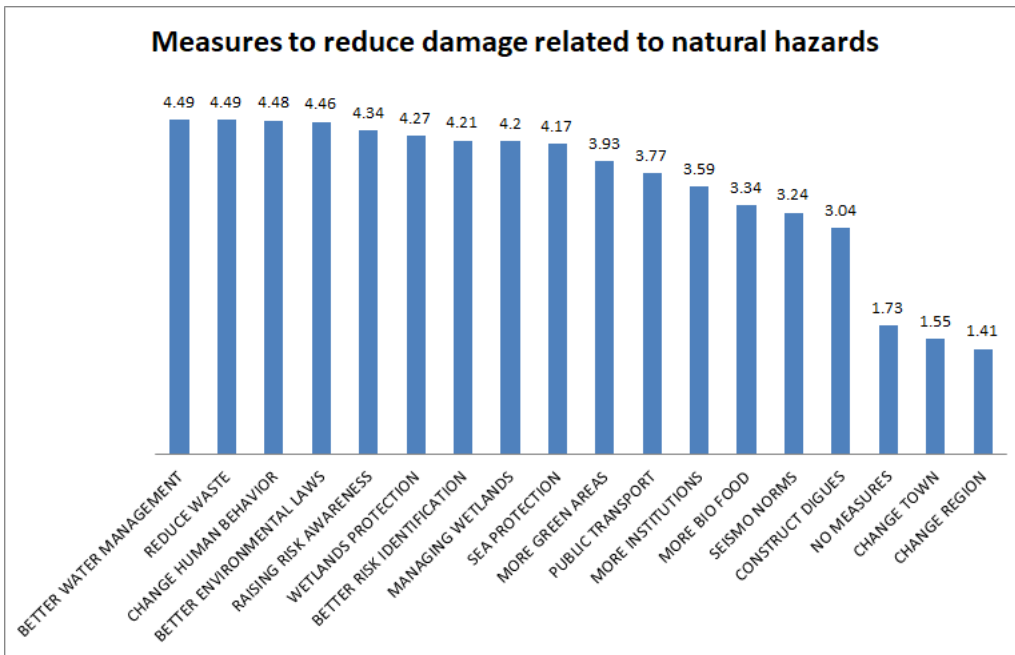


Figure 29: Locals name waste and water resources, as well as behaviour, laws, awareness sessions and protecting wetlands as main measures that could help reducing damage related to natural hazards.

Based on these results, the locals from the Gulf of Oristano, although living in an area of wetlands with even 6 Ramsar sites, do not seem to be fully aware of the benefits of wetlands related to coastal hazards. That is evident from the response of only 22% of the respondents that are aware that coastal wetlands protect us from coastal storms by slowing down the speed of the wind. Locals mention reducing waste and improving water management, as well as changing citizens' behaviour, improving environmental laws and calling for more informative campaigns on risk awareness as main measures that could help reducing damage related to natural hazards. Although they mention wetland protection as well (Figure 30), they do not seem to be aware of the regulating services related to coastal hazards that wetlands provide.



Figure 30: The respondents understand the importance of protection and better management of wetlands.

This leads to a conclusion that more risk awareness sessions on wetlands should be organised since the respondents claim that the management of water resources has to be achieved efficiently while calling for more informative campaigns. In that way, they can be informed about wetlands' utility not only for risk management but also for sustainable water resource management, among other environmental benefits. As calculated in (Marzi et al., 2019), unlike the major part of Sardinia and South Italy, the results for the Gulf of Oristano indicate a higher resilience against future disasters, and hopefully that is truly the case.

#### *Explaining future willingness to invest based on actual risk awareness*

Readiness to invest money to protect from future natural hazards was analysed through a binary logistic model. Readiness to invest money was regressed on three blocks of variables. The first block included demographic variables of gender, age, municipality, education, annual net income, the surface of the housing, number of family nucleus members and number of kids under 12 years old. The second block was for risk awareness, information self-assessment, actual information, as well as for the belief in climate change. The last block included variables that we hoped could clarify more which respondents are up to risk investing: trust (science and state), environmental

identity, place attachment, source of information (local or distant), measures to take (personal, environmental, infrastructure, general insurance or personal insurance). Results are presented in Table 16.

Table 16: Binary Logistic model of future financial precautionary behaviour in Sardinia ('Invest Money', N = 112).

Block	Predictor	-2 Log-likelihood	Nagelkerke R <sup>2</sup>	Chi <sup>2</sup>	Df	Sig	B	SE	Exp(B)	95% C.I. for Exp(B)	
										Lower	Upper
1		104.683	.314	27.452	10	.002					
	Arborea						.385	.753	1.470	.336	6.433
	Oristano						-.416	.631	.659	.191	2.273
	Gender						-1.233*	.537	.291	.102	.836
	Age < 36						.841	.703	2.320	.585	9.196
	Age > 58						-2.201**	.673	.111	.030	.414
	Education						.393	.570	1.482	.485	4.527
	Net Income						.198	.253	1.219	.742	2.001
	Family Nucleus						.006	.206	1.006	.672	1.507
	Kids < 12						-1.423	.748	.241	.056	1.045
	House m <sup>2</sup>						-.262	.572	.769	.251	2.361
2		94.411	.413	37.724	15	.001					
	Arborea						.491	.851	1.633	.308	8.662
	Oristano						-.341	.680	.711	.187	2.698
	Gender						-1.346*	.606	.260	.079	.854
	Age < 36						1.469	.830	4.345	.855	22.090
	Age > 58						-2.204**	.753	.110	.025	.483
	Education						.349	.607	1.418	.432	4.656
	Net Income						.196	.275	1.217	.710	2.084
	Family Nucleus						-.072	.241	.930	.580	1.491
	Kids < 12						-1.561	.813	.210	.043	1.033
	House m <sup>2</sup>						-.647	.642	.524	.149	1.843
	Actual Information						.952	.795	2.592	.546	12.302
	Risk Awareness						.895	.877	2.447	.438	13.662
	Information Self-Assessment						-.232	.545	.793	.273	2.306
	High Belief in Climate Change						1.967*	.776	7.152	1.562	32.742
Low Belief in Climate Change						-.323	.569	.724	.237	2.210	
3		72.792	.594	59.344	26	.000					
	Arborea						.765	1.077	2.150	.260	17.750
	Oristano						-.343	.863	.710	.131	3.856
	Gender						-2.111*	.851	.121	.023	.642
	Age < 36						2.569*	1.280	13.057	1.063	160.447
	Age > 58						-2.865**	1.082	.057	.007	.475
	Education						.359	.811	1.432	.292	7.012
	Net Income						.236	.416	1.266	.560	2.862
	Family Nucleus						-.206	.348	.814	.411	1.610
	Kids < 12						-3.396**	1.265	.033	.003	.400
	House m <sup>2</sup>						-.732	.835	.481	.094	2.473
	Actual Information						.852	1.183	2.345	.231	23.833
	Risk Awareness						.917	1.011	2.503	.345	18.153
	Information Self-Assessment						-.132	.656	.877	.243	3.169
High Belief in Climate Change						3.735**	1.263	41.897	3.527	497.692	



Low Belief in Climate Change		-580	.948	.560	.087	3.587
Trust Science		-280	.820	.756	.152	3.768
Trust State		.866	1.034	2.378	.313	18.048
Local Source of Information		-1.286	.960	.276	.042	1.815
Distant Source of Information		.880	.841	2.410	.463	12.530
Infrastructure		3.582**	1.223	35.938	3.267	395.287
General Insurance		2.813*	1.174	16.658	1.667	166.461
Personal Insurance		3.942**	1.348	51.535	3.668	724.131
Environmental Measures		-.825	.838	.438	.085	2.262
Personal Measures		.063	.785	1.065	.229	4.956
Environmental Identity		.746	.753	2.108	.482	9.218
Place Attachment		-1.370	.805	.254	.052	1.231

\*\* with significance < .01

\* with significance < .05

Results show that demographic variables that significantly predict 'readiness to invest' are: gender ( $-2.111$ ,  $p < .05$ ), age of the sample divided by percentiles to younger than 36 years old ( $2.569$ ,  $p < .05$ ), older than 58 years old ( $-2.865$ ,  $p < .01$ ) and having kids under 12-years-old ( $-3.396$ ,  $p < .01$ ). This result suggests that being male, under 36 and not having small kids is positively associated with monetary investments for natural risk protection.

Willingness to invest is also positively predicted by belief in climate change ( $3.735$ ,  $p < .01$ ), belief in investing in infrastructure ( $3.582$ ,  $p < .01$ ), in having personal insurance ( $3.942$ ,  $p < .01$ ) and in taking general insurance for all ( $2.813$ ,  $p < .05$ ). Place attachment is a marginally significant negative predictor ( $-1.370$ ,  $p < .1$ ) (Nagelkerke  $R^2 = .594$ ). The environmental identity and both trust indicators were not significantly associated with willingness to invest money in future protection.

If we consider investing money against risks related to climate change as one of the indicators of risk awareness, then locals from the Gulf of Oristano are aware of risks. Being young or middle-aged, being possibly better off and without incurring the cost of raising children, seem to be variables impacting the investment and that appears to be rather plausible. It is even more reasonable that those that are ready to invest do believe in climate change and chose measures of improved infrastructure, general and personal insurance. The influence of the belief in climate change on investing money ( $3.735$ ,  $p < .01$ ) is in line with the recent Canadian study (Withey et al., 2019) that showed the impact of the climate change perception on WTP in Halifax, as well as in the German

study (Kreibich, 2011), which showed that perception about the consequences of climate change is one of the factors influencing the uptake of private precautions.

On the other hand, place attachment ( $-1.370$ ,  $p < .1$ ), is a marginally significant predictor. According to this piece of information, those that are more informed about risks from their schools, municipalities or local associations, as well as those more attached to their municipality, do not seem likely to invest money to protect from future climate change-related risks. This can be explained with the fact that the local population is likely to rate environmental problems as more severe on the global than on the local level, as elaborated in the review (Bonaiuto et al., 2016), i.e. the local patriots believe how it is always better and safer in their territory than '*far away in the world*'. Besides, compared with (Bernardo, 2013), where it was found that risks perceived to be of higher probability, such as global warming, could be understood as less catastrophic or urgent, add to the explanation of why place attachment and belief in climate change contribute to the model differently.

#### *The econometric analysis reveals several interesting results*

One important step in the contingent valuation (CV) analysis is to identify the correct sample size to estimate the WTP. In a CV exercise, it could happen that part of the respondents refused to 'enter the market'. Practically speaking, it means that I need to identify those respondents who refused to pay any amount (the so-called 'No-No' answers) because the proposed amounts (bids) are not affordable for them. They can be included in the CV sample because they are expressing their correct WTP (so they 'entered in the market').

However, some respondents refused to pay for several other reasons. For example, those who disagree with the policy or tool proposed (they think that the Government has to avoid damages and protect citizens and refund them for damages) or they do not trust in the payment method (i.e. they do not trust in insurance), or for some other reasons and therefore they did not express a real valuation of the bid offered. These respondents are not expressing their correct WTP (so they 'do not enter in the market') and are considered by the CV literature as a 'protest vote' that needs to be excluded from the sample (Strazzera et al., 2012).

To identify the group of people that expresses a 'protest vote', a follow-up question has been inserted in the questionnaire and addressed to those that refused to pay any

amount. Those respondents that declared in a follow-up question that the amounts (bids) proposed were not affordable were kept in the final sample, while all the respondents that stated that they refused to pay for any other reason were excluded. After doing that, it turned out that 27% of respondents expressed a ‘protest vote’ (Table 17) and were left out from the final sample.

Nevertheless, it could be useful to understand the characteristics of those that express a ‘protest vote’. The analysis (Table 17) shows that respondents who have already invested money to protect themselves and their houses and respondents who collect information on natural risks through social networks have an inferior probability to refuse to pay. Concerning the dummies for municipalities, residents in Arborea have an inferior probability to express a protest vote than residents in Cabras.

Table 17: Protest vote analysis.

	<i>Coefficient</i>	<i>Robust Std. Err.</i>
<i>Invest money</i>	-1.877***	0.267
<i>Informed through social network</i>	-0.672***	0.250
<i>Arborea</i>	-0.276	0.320
<i>Oristano</i>	-0.709**	0.304
<i>Constant</i>	1.149***	0.318
<i>Log pseudolikelihood</i>	= -64.50	
<i>Pseudo R2</i>	= 0.36	

After excluding the respondents that express a protest vote from the dataset, the WTP was estimated. Due to the proposed scenario, the annual premium that each individual is supposed to pay by multiplying the proposed price per total square meters of the house is considered. The T-tests on the coefficients on a bivariate probit model indicate that the double-bound model can be used because the second bid answers are unbiased: considering that questionnaires were unbalanced concerning the bid, a weight to the biprobit and the double bound models to correct the bias was added.

The data indicate that the average WTP for insurance that protects an average size house from climate-related extreme weather events is equal to 143.68 euros per year:

these results cannot be compared with those found in the Veneto case study due to the differences in the elicitation model (open-ended questions) and the proposed scenario (Roder et al., 2019)<sup>h</sup>.

<i>Double bound estimation</i>	<i>Coefficient</i>	<i>Std. Err.</i>	<i>Confidence Interval</i>
<i>Annual premium (willingness to pay)</i>	143.68***	14.94	114.40 – 172.95

The model with covariates indicates that, as expected, respondents with a lower family income have a lower WTP than other respondents. Respondents who stated that they received enough information on the state of the local environment and participated in a local environmental initiative have a lower WTP for insurance that will protect houses against extreme weather consequences. This result may appear counterintuitive: it is noticed that people who work in agriculture, the fishing sector and forest management have a high probability to be included in this group. In this case study, these categories experienced the negative consequences of natural hazards, including climate-related extreme weather events (floods), in their economic activities. They could be more interested to preserve the arable land or the lagoon than their houses. Besides, the respondents that participate in local environmental activities and consider themselves to be informed about the state of the local environment tend to be associated with lower education and live mainly in Arborea, so they likely have little trust in insurances. Residents in Arborea demonstrated to be proactive to preserve their territory and especially the lagoon, but they experienced several floods in the past that affected the countryside and not the village itself, so they could believe that they do not need to protect their houses more.

On the contrary, people who live close to the sea (less than 1 km away from the coast) and who have already invested in the preservation of their assets have a higher WTP (Table 18). Additional correlation analysis shows that the latter category of respondents is especially sensitive to the sea-level rise consequences and prefers having an additional supporting tool.

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<sup>h</sup> In the case study from Veneto, the respondents were asked to consider a limited coverage for the building (excluding furniture), with a coverage of 50% of the value of the building and a deductible of 5% of damage suffered.

Table 18: Willingness to pay analysis.

	<i>Coefficient</i>	<i>Std. Err.</i>
<i>Invest money</i>	69.98**	27.89
<i>Infoactivists</i>	-39.24**	18.95
<i>Sea distance &lt; 1 km</i>	336.17***	69.21
<i>Low income</i>	-38.82*	20.97
<i>Constant</i>	113.90***	26.09
<i>Log pseudolikelihood</i>	= -56.85	

The variable that indicates respondents that have already invested money in the preservation of their assets appears to be relevant in explaining respondents' choices. The probit analysis indicates that male respondents under the age of 40, living in a house of a smaller size than the average size that was recently built (i.e. a house that is less than 34 years old), have more probability to have already invested to preserve their assets (Table 19).

In Italy, the insurance market is weaker than in other European countries (Cesari & D'Aurizio, 2019). Housing insurance products offered in the Italian market very rarely include the protection from climate-related extreme weather events consequences.

In addition, citizens are not interested in buying insurance (Assicurazione, 2020), because they are aware of the existence of public subsidies that could refund damages caused by climate change events, such as floods. However, in recent years, climate-related extreme weather events have happened more and more often, leading to a significant increase in expenditure for public bodies responsible for compensation. As these events are expected to become even more frequent in the future, the European Union is considering introducing insurance mechanisms to deal with climate-related extreme weather events (European Commission, 2018; Hudson et al., 2019).

Table 19: Socio-demographic characteristics of people that have already invested in actions to avoid negative consequences of natural disasters.

	<i>Coefficient</i>	<i>Robust Std. Err.</i>
<i>House size &lt; 100 m<sup>2</sup></i>	0.800***	0.310
<i>House age &lt; 34</i>	-0.672**	0.292
<i>Age &lt; 40</i>	0.837**	0.340
<i>Female</i>	-0.813***	0.291
<i>Constant</i>	-1.180***	0.279
<i>Log pseudolikelihood</i>	= -51.59	
<i>Pseudo R2</i>	= 0.153	

The result of this study can provide a useful indication to policymakers that are in charge of adaptation measures to climate change. The basic idea is that if citizens invest their own money, they are more attentive to the consequences of their actions and decisions and may, therefore, decide to avoid certain choices, knowing that they will have to bear the costs. Currently, as the damages caused by climate-related extreme weather events are reimbursed by public administrations, citizens may have no incentive to adopt the most efficient behaviour.

To sum up, the local population does not seem to be aware of wetlands' benefits as a nature-based solution to tackle climate change-related hazards, such as coastal storms, floods and sea-level rise, by providing regulating services. However, the respondents seem to consider that wetlands should be protected and managed, and are willing to invest to mitigate climate change-related hazards. This result can provide a valuable warning to policymakers in charge of climate change adaptation in Sardinia, taking into account the actual change of the regional environmental law allowing further coastal construction on the island.

## 6. Discussion

### 6.1. Indicators should be both combined natural and social

*More natural and improved combination of natural and social indicators needed*

The indicators used in the papers included in our dataset are predominately related to vulnerability and not to hazards, that is to social and not to natural or environmental components of risk (Figure 20). Additionally, social vulnerability indicators do not always include risk perception and coping capacity (Rufat et al., 2015) and the justifications for their usage are often limited (Tate, 2012, de Ruiter et al., 2017). Since risk is the product of hazard and vulnerability, it may be that one should not be considered without the other. I claim that corresponding indicators used from both hazard and vulnerability should be included and valued in a balanced way, as it is the case of studies from Brazil (Sena et al., 2017), Argentina (Merlotto et al., 2016) and the USA (Hardy, 2017) (Figure 31). If the indicators are used methodologically, and didactically like in these studies, then we can say that they are user-friendly tools for risk management, and transmitting integrative scientific information to risk managers. Finally, the review (Tonmoy et al., 2014) poses huge methodological issues that need to be addressed in the future, since we cannot expect an efficient risk assessment if we use methods whose theoretical requirements do not satisfy the context of assessment based on usage of indicators.

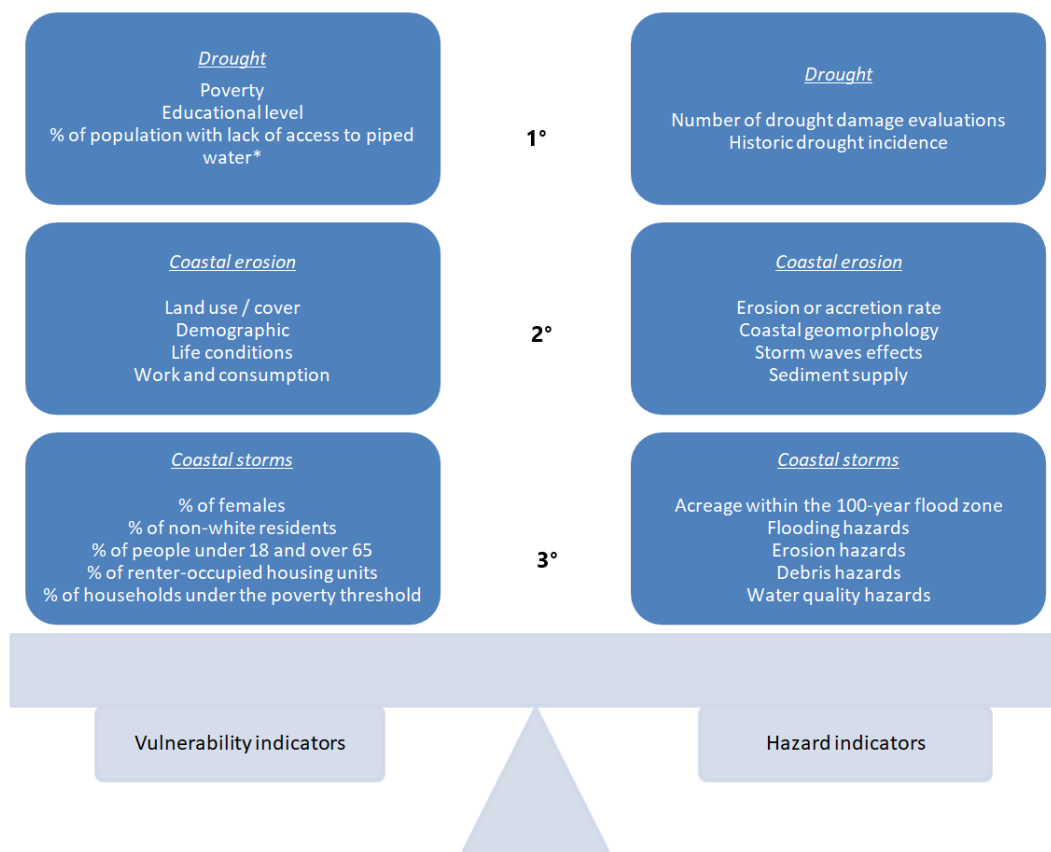


Figure 31: Examples of case studies with balanced social (vulnerability) and natural (hazard) indicators (\*originally in paper considered as exposure indicator) from studies 1° Sena et al., 2017, 2° Merlotto et al., 2016, 3° Hardy, 2017

### *Limitations and policy implications*

One of the limitations of this literature review is that some papers may have been left out and not enlisted by our Web of Science research. Similarly, there could be many case studies missing from the set, with even different outcomes, partly due to low publication capacity of some countries and partly due to the incompleteness of Web of Science research tool. In particular, publications related to risk management and institutional response are often carried out in reports and documents by ministries and international organizations. Besides, our focus on large catastrophic events should be extended with studies on slow-onset disasters for a broader view on interconnections, coupled hazards and cascading, as in recent works by Pescaroli and Alexander (2018). Furthermore, although one may argue that the presence of term 'indicator' in the keyword list is



enough, it is reasonable to give the priority to those papers validating and critically valuing indicators, and therefore having the key term 'indicator' in the title.

To sum up the requisites for ameliorated policy and more successful approach in risk management we again have to start from the indicators. More case studies with a clear methodology and with equal attention dedicated to both social and natural indicators (Merlotto et al., 2016, Hardy, 2017, Sena et al., 2017), with local participation (Asare-Kyei et al., 2015, Fekete, 2018, Klein et al., 2019) and information on risk perception (Boyer-Villemaire et al., 2014, Rufat et al., 2015) will advance the framework of local governance. In addition, human decision making with liable hazard mitigation actions is needed for improved risk management (Fuchs et al., 2017, Di Baldassarre et al., 2018). Finally, continuous research for indicators that could measure performance towards Sendai's objectives is required (Beccari, 2016). Those objectives will be attained only with permanent knowledge flow from research to practice and if backed by strong, global political commitment (Cutter et al., 2015) (Figure 32).



Figure 32: The scheme of the key gears in a mechanism for improved risk management policy, where indicators present the grounds of an accessible and sound framework, proposal by Ivčević et al. (2019).

### *Are indicators beneficial to the general population?*

It is expected that the general population benefits from successful risk management plans that are developed using numerous indicators. Since indicators give information to policymakers and local managers whether they should act or not confronting some of the risks they face, indicators are not directly, but indirectly useful for a broad public. General population surely has to profit from the transmitted information from scientists to managers via indicators, vectors of risk information. If those indicators are clear, straightforward and, therefore, user-friendly, then they will be beneficial to final users. This need for more efficient knowledge transfer is underlined in some of the analyzed studies (Fuchs et al., 2017, Di Baldassarre et al., 2018) and it should not be neglected in the future research. Nevertheless, the reverse direction of learning is of utmost importance, where local knowledge and perception on risks indeed nourish the risk management strategies (Rufat et al., 2015, Fuchs et al., 2017, Klein et al., 2019). The general population is, therefore, not an object, but both subject and object, dynamic actor in an efficient risk management strategy.

### *Indicators' terminology should be standardized.*

As previously exposed in the introductory section, UNDRR recommends the use of a defined terminology related to disaster risk reduction, where the term *indicator* is not elaborated. The possible reason for not doing so is that it was considered that this term is technical and comprehensible to those that should understand it and use it. I, therefore, call for the standardization of term *indicator* and of following terms like *index*, *variable*, *factor*, or *dimension* as well. To illustrate this need it is enough to look at our three exemplary case studies (Figure 31). What is considered as a variable that builds an indicator in one study (Merlotto et al., 2016), in another study that variable is considered as an indicator itself (Hardy, 2017), and in the study (Sena et al., 2017) there is a mixed usage of indicators and variables. An even better example of the overlapping of terms is the study (Naumann et al., 2014), where the composite drought vulnerability index/indicator is constructed by using seventeen variables/factors/indicators. Although the majority of policymakers and local managers understand what is the

meaning and expected content of those terms, standardized definition (i.e. index > indicator > variable) could put an end to another ambiguity.

## 6.2. Indicators on spatial scale

Previous studies have already addressed the need to improve the methodology of risk management based on the usage of indicators, with the question raised as to whether or not they correspond to managers' needs in the first place (Asadzadeh et al., 2017). They are usually chosen based on literature reviews and authors' own experience, which means that accurate criteria are generally missing while choosing the indicators (Nguyen et al., 2016, Pandey et al., 2017).

Concerning the spatial scale, although indicators for vulnerability evaluation range from local to the national or global level, and given that lots of indicators depend on characteristics of sites or hazards, there is a major issue in including more indicators determined at the local scale (Asare-Kyei et al., 2015, Birkmann et al., 2015, de Almeida et al., 2016, Jülich, 2017) and reducing the existing gap between bottom-up and top-down approaches (Asare-Kyei et al., 2015). Just a glance at the map (Figure 18) shows the absence of case studies in many countries (e.g. vast area of Africa) that could be partly because there are few publications on the Web of Science and also because there is little planning policy that uses the concept of integrated risk management with indicators.

Acknowledging the specific contexts of studied sites will necessarily draw a much clearer figure of general population's perception of risk (Boyer-Villemare et al., 2014), and consequently, improve the framework of local and national governance. More local studies, with direct fieldwork, are therefore needed since the main approach so far has been theoretical reasoning on indicators. Merging of field studies based on natural and social variables (ex. Grozavu et al., 2013; Minos-Minopoulos et al., 2017), and of fieldwork based on participative approach (ex. Asare-Kyei et al., 2015, Khalili et al., 2015) will result in better contextualization of indicators, with a developed interdisciplinary language between the natural and social sciences.

Based on the comparison of two case studies of North Morocco and Sardinia, there are remarks and conclusions to be discussed, arising from the particularities of the Mediterranean terrains.

### **6.2.1. Horizontal scale: local risk awareness in North Morocco and Sardinia**

Two field studies from North Morocco and Sardinia provide insight into risk awareness of the local population. In North Morocco, the local population is a heterogeneous group and the differences within the region do emerge. It is shown that sharing a common, homogenous territory depends on deeper bounds than those created by a purely administrative decision. The different historical and cultural background of the East part of the region, with the fresh memory of one big recent disaster (Al Hoceima earthquake), contributes to differences in risk awareness among them and the rest of the region. During that sad event of 2004, the state did not succeed in effectively managing the crisis. To avoid future disasters, there is a dire need of bridging between different social structures of the region.

Additionally, more follow-up on the indicators of risk awareness sessions should be established, to trace the success rate of the resilience of the Moroccan society, which is facing multi-risks. 'Risk sessions' seems to be a significant indicator in the model related to future protection measures, where further research is needed to either confirm the effectiveness of the model or to prove that it suffers from self-selection bias. 'Risk sessions' have an impact on local people deciding whether they will protect themselves and their belongings in the future and due to these positive links they should be supported by the local and national government. The same goes for 'environmental identity' that has to be promoted, too. By endorsing ecological concerns and taking local action to resolve the actual environmental questions, North Morocco could profit from the positive effects on the general awareness of risks. Environmental identity could be promoted through campaigns and be based on agricultural roots of the local people, which could make it close and comprehensible to the population.

In West Sardinia, wetlands are one of the nature-based solutions to mitigate climate change-related natural risks. The concept of nature-based solutions is very recent and in Italy it is being established only now. People do not see wetlands (or any other type of

natural environment) as an opportunity, but as a landscape and that is all. Actually, in the case of wetlands, the notion persists that they are only useful to produce billions of annoying mosquitoes. 'High belief in climate change' seems to be a significant indicator in the model related to future protection measure of investing money.

There is, hence, a need for awareness and educational sessions, not only on wetlands exclusively, but on nature-based solutions in general, ecosystem services and risk mitigation measures. The question of environmental protection of Sardinian coasts is more than actual today, given the promulgation of a new environmental law which permits more construction even within the mandatory 300 m coastal strip. In light of the ongoing climate change impacts on the Mediterranean coasts, such law certainly does not contribute to a successful climate change mitigation of the Sardinian coasts.

The results obtained from the analysis of the determinants of WTP are in line with those already found in the literature. The data indicate that the annual WTP for insurance that protects the house from climate-related extreme weather events is equal, on average, to 143.68 euros. In fact, most respondents accept to pay for private insurance as a measure to mitigate climate change risk. As in other references, the decision to accept insurance does not lead to moral hazard situations at all: in fact, people who have already invested in measures to reduce the damage caused by climate change are also more willing to pay to get insurance. Also, young people that live in newer houses are more willing to invest in insurance. Experience and risk awareness seem to play a relevant role in the decision to adopt a private mitigation measure, as demonstrated by some of the variables in the model. Concerning the protest vote expressed by 27% of the sample, distrust in insurance and the belief that the state should pay for damages is the main motivation. This surely does not mean that there should be exclusively a societal push for insurance, but for education on an alternative way of living in light of ongoing climate change and on the value of wetlands in their territory.

It is not always simple to compare two areas of study: risks are complex phenomena, there is no common intensity scale for all catastrophes, risk acceptable in one cultural context is not necessarily acceptable in the other one (Dauphiné, 2003). Nevertheless, to better understand complex stakes that are to be managed, it is worth trying to grasp at least some of both differences and similarities.

To start with, North Morocco is a region of slightly more than 15,000 km<sup>2</sup> and with more than 3,5 million inhabitants. The Sardinian surface is a bit over 24,000 km<sup>2</sup> with 1,6 million inhabitants. However, the municipalities included in our Sardinian case study from the Gulf of Oristano are of surface that is fifteen times smaller than those of the Moroccan case study, and with forty times fewer dwellers (1000 km<sup>2</sup>, 85,000 people). Size proportions are, therefore, the first to keep in mind while trying to compare these two Mediterranean territories.

Secondly, although sharing grounds of methodological approach, these case studies were not identical. It is important to recognise that the scope expected from the questionnaires was a variation from environmental psychology in the first case, to environmental economics in the second one. This could explain the usage and significance of some variables in Sardinian case study that were not even considered in Moroccan case, like the solutions of improved infrastructure, adopting general or personal insurance, or having kids in the household.

Local particularities of the studied sites are rather more detected within the Moroccan case, than in the Sardinian one, likely because of this incomparable sizes, as seen in previous chapters. When the binary logistic models of future protection and investing money are compared (Tables 10 & 11), the only regional difference that has an impact on decision making is the East Rif zone in Morocco (significant in the model 'protect future', Table 10). The reason probably stems from the cultural and historical differences of this zone of the region. In Sardinian case, the local differences of the Gulf of Oristano are not significant, also probably due to the size and a common history.

There are, however, some similarities between the two terrains. The comparison of the correlations of local differences with the main indicators in the studies gives additional insights for regional particularities. As a reminder, as far as Moroccan study is concerned, eight municipalities were grouped in three zones (Rif, Mediterranean Martil and Atlantic), to manage more easily the size of the territory. In Sardinia, however, there were three municipalities in total, which are considered as two zones for this purpose (urban Oristano, and rural Arborea and Cabras).

Having a look at the percentage of locals perceiving risks in their territories of living (Table 20) indicates some particularities of Moroccan and Italian case studies. Personal experience is the first indicator of awareness to be considered. Hazards personally experienced are mainly related to Martil wadi area prone to floods (70%), and the Rif

Mountains area prone to landslides and earthquakes (66%). In the case of Sardinians, both from urban and rural territories, only 34% have experienced hazard personally. Table 20 confirms that relations between Sardinian territories are negatively correlated with personal experience, conversely to Moroccan people, where the Rif and Martil areas show a positive correlation with personal experience.

Table 20: Percentage of respondents that show the following characteristics above mean and following correlations with common indicators of local awareness in both studies ('traffic lights' levels of correlations: 'green' stronger correlation, 'yellow' weaker correlation, 'red' no correlation).

Indicators	Morocco Rif		Morocco Atlantic		Morocco Martil		Sardinia urban		Sardinia rural	
	%	corr	%	corr	%	corr	%	corr	%	corr
Personal experience	66	.127**	46	-.067	70	.209**	34	-.168**	34	-.182**
Climate change is now	60	-.098*	51	-.161**	68	-.002	88	.174**	79	.104*
Risk informed	36	-.051	46	.055	36	-.064	51	.072	46	.017
Risk sessions	57	.220**	36	-.022	39	.009	34	-.087*	29	-.146**
Trust science	59	.022	58	-.002	68	.145**	30	-.208**	54	-.014
Trust state	11	-.149**	12	-.107*	10	-.199**	58	.365**	39	.186**
Place attachment	29	-.128**	40	.000	36	-.048	44	.038	56	.172**
Environmental identity	54	.073	41	-.042	34	-.176**	49	.014	65	.160**
Precautions	20	.031	10	-.090*	17	-.018	23	.045	21	.030
Invest money	62	.054	55	-.024	50	-.097*	61	.037	61	.047

\*\* with significance < .01

\* with significance < .05

As far as awareness of risks and climate change is concerned, the belief that climate change is happening precisely now and existing as part of their reality is positively correlated with both Sardinian areas, conversely to Moroccans from the Rif Mountains and the Atlantic coast. Being informed about risks does not seem to show big variability between the territories since none of them has a significant correlation with the indicator 'risk informed'. However, the significance of the indicator 'risk sessions' is

higher, since the Rif and both Sardinian zones show positive and negative significance of this indicator, respectively.

The additional indicators that contribute to higher risk awareness again show differences between Moroccan and Italian case study. Rif mountain dwellers are negatively correlated, and rural Sardinians are positively correlated with place attachment indicator. Rural Sardinia is positively correlated with environmental identity as well, where dwellers of Martil valley are negatively correlated with the same indicator. Martil valley dwellers are negatively correlated with the indicator of future investing money, and dwellers of the Atlantic coast are negatively correlated with the indicator of currently taken precautions. However, the most striking difference comes out from the indicators of trust. Trust in science and scientists is positively correlated with Martil valley dwellers, and negatively correlated with urban Sardinians (city of Oristano). Nevertheless, when compared trust in state institutions involved in risk management, then the gap between North Morocco and Sardinia is the clearest since all three Moroccan territories are negatively correlated to institutional trust, whereas both Sardinian territories are positively correlated to institutional trust. As indicated in Table 20, only 10-12% of Moroccan respondents show the level of state trust that is above mean, and as far as Italians are concerned, there are three to almost six times more trustful than their Moroccan counterparts. When the trust components are examined further in detail, as in Table 21, particularly worrying is the low trust in institutions included in managing risks, such as public institutes and government, and the highest trust is expressed for science and scientists from Sardinian urban citizens and dwellers of Martil valley. The similar (dis)trust all groups of respondents show for media. The lack of trust in public institutions involved in risk management, as well as in government, is seen as an obstacle in precautionary behaviour uptake.

Furthermore, based on the binary logistic models for both case studies (Tables 13 and 16 from chapters' sections 5.2.1. and 5.3), the significance of the indicators of risk sessions and environmental identity in Moroccan case is not mirrored by the Sardinian case, where the importance of future protective behaviour lies in a belief in climate change processes and reality. This leads to a conclusion that the learning process, both formal and informal education, has an impact on the people's perception and apprehension of the gravity of natural processes that the regions could encounter in the future. The significance of the indicator of environmental identity could lead to the



conclusion that the policymakers should promote ecological questions and support local action in dealing with environmental issues.

Table 21: Comparison of Moroccan and Sardinian trust in different actors related to risk awareness and management (average grade on 5-point Likert scale).

<i>Trust</i>	<i>Morocco Rif</i>	<i>Morocco Atlantic</i>	<i>Morocco Martil</i>	<i>Sardinia urban</i>	<i>Sardinia rural</i>
<i>Science</i>	3.88	3.83	4.16	4.32	3.89
<i>Scientists</i>	3.74	3.82	3.94	4.15	3.83
<i>Media</i>	2.77	2.72	2.61	2.56	2.88
<i>Public institutions</i>	2.77	2.69	2.48	3.00	3.48
<i>Government</i>	1.97	2.32	1.81	2.66	3.19

In addition, dwellers from the Rif Mountains are positively correlated with personal experience and risk sessions, and negatively correlated with a belief in climate change, trust in state institutions related to risk management and with place attachment. This adds to the beforementioned local variability within the region of North Morocco, which seems to confirm the local particularities of the Rif Mountains, not only in the ethnic, social and cultural background but even in the perception of natural risks and the ways of how to mitigate these risks.

Moreover, when asked about some measures to take that would help to fight the consequences of natural hazards in their municipality, some other differences between two terrains emerge (Table 22). At first glance, it could be concluded that Italians are a bit more sceptical or reserved while judging the utility of proposed measures. Both Sardinian areas seem to be the least convinced that more crisis committees and institutions should be formed to manage risks, and it is for even one point less than Moroccan counterparts think. It could be because Italians think they have already all institutions needed to tackle risks when compared with Table 21 and institutional trust. However, the same cannot be concluded for Moroccans. Rural Sardinia is particularly cautious: they consider that changing human behaviour and raising risk awareness is the least useful, they are the least partisans of protections of coastal areas (i.e. coastal wetlands, in their case), of anti-seismic constructions and of more green areas. Urban

Sardinia is the most convinced that the most important measures to fight consequences of natural hazards are to change human behaviour and to improve risk and environmental laws, while they find dykes and seawalls the least useful measures. On the other hand, Moroccans valued all proposed measures more uniformly. Dwellers from the Atlantic coast found the least useful a measure of improving environmental and risk laws, as well as the measure of improving the identification of risk zones. The Rif Mountains dwellers opt for more green areas and constructions following anti-seismic norms, as well as Martil valley dwellers, who additionally opt the most for coastal protection (i.e. against sand extraction, in their case), for dykes and seawalls, and better identification of risk zones.

How secured the residents feel by living in their municipality is also expressed with the measure of moving out. The most willing to change their municipality to reduce the threat of natural hazards are Moroccans from the Atlantic coast, and the least both urban and rural Sardinians. It could be that the population of North Morocco is already migrant from other parts of Morocco and therefore the place attachment is less and moving out more expressed. On the other hand, it is expected that Sardinians are less ready to move out since they lack recent big hazardous event to frighten them. Besides, place attachment could contribute to opting for this measure.

Finally, the religious values when perceiving existential risks (Langford, 2002) also need to be taken into consideration while comparing these two Mediterranean sites. Although there were no direct questions dealing with religion in any of the surveys, the local population referred to Muslim values in North Morocco and, to a lesser extent, Christian-Catholic values in Sardinia, more particularly on God's will while evoking natural hazards. Earthquakes have a specific connotation in the Muslim culture and they have already been elaborated in the academic literature (Paradise, 2005; Paradise, 2008), with an additional work that brings together risk communication and historical traditions, local knowledge and Muslim beliefs (Ghafory-Ashtiany, 2009). Still, this religious resistance regarding earthquake risk management was seen to be significantly more common among the less educated populations, who were "more likely to reject the significance of scientific assessment adding that 'Allah knows all' and that a belief in divine protection was more important and effective" (Paradise, 2008)(p. 228).

Table 22: Measures helpful in fighting consequences of natural hazards in areas (average grade on 5-point Likert scale).

<i>Measures</i>	<i>Morocco Rif</i>	<i>Morocco Atlantic</i>	<i>Morocco Martil</i>	<i>Sardinia urban</i>	<i>Sardinia rural</i>
<i>More crisis institutions/ committees</i>	4.46	4.51	4.63	3.57	3.62
<i>Changing human behaviour</i>	4.51	4.44	4.55	4.75	4.25
<i>Better environmental and risk laws</i>	4.38	4.19	4.47	4.65	4.3
<i>Raising risk awareness</i>	4.47	4.55	4.55	4.5	4.2
<i>Better risk zones identification</i>	4.33	4.06	4.48	4.27	4.17
<i>More vegetation and green areas</i>	4.55	4.38	4.49	4.23	3.68
<i>Constructing with seismic norms</i>	4.47	4.11	4.48	3.4	3.11
<i>Constructing dykes and seawalls</i>	4.48	4.42	4.61	2.97	3.09
<i>Coastal protection (sand, wetlands)</i>	4.3	4.28	4.51	4.39	4.04
<i>Moving out</i>	1.95	2.33	2.15	1.61	1.5

Although not directly asked, this reference to God’s will was informally introduced by the respondents many times during the survey. Moreover, during fieldwork in the region, the same aspect was highlighted in an interview with a theologian and imam (Male Associate, 55, Tetouan): “If we talk about all the risks we, therefore, believe that there is an extraordinary force which manages these phenomena, which controls the whole universe, the will of God. There is no difference from what we believe and what you believe, except that we believe that these risks are controlled by a stronger force of God.” During further meetings with town officials, the importance of religion in risk management was endorsed, as well: “The mosque is the first awareness centre; it is a synonym for awareness, with the unblocking points for the population. But it is necessary to review the legislation because there are still laws of the time of protectorate” (Male Administrator, 45, Rabat). A future study should, therefore, include the divine component as a risk management tool, not only to deal with seismic hazard but for all the other hazards encountered in the region. This could be particularly effective in rural communities where the mosque is sometimes the only institution of reference for the local people. In Sardinia, the will of God was also sometimes informally evoked, but with a remark that,

if the hazard is from God, the risk management stays on humans. Besides, the belief in God can have an impact on the risk awareness approach, as immigration is concerned. The historically high inflow of new population around the Mediterranean basin with different cultural and social backgrounds might increase local vulnerability since new inhabitants do not necessarily share histories about environmental risks specific for their new territory. Without risk memory, these people might be lacking local social support, as I personally witnessed in Tetouan, where the Spanish church (*Iglesia de Nuestra Señora de las Victorias*) in the city centre serves as a point of gathering for a variety of African immigrants in the region, similarly as the church (*Iglesia de San José*) in Al Hoceima (Figure 33). North Morocco is a migration hub, where temporary migrants gather while trying to cross the sea and reach Europe, following every accessible route. Only in 2019, slightly more than 26,000 people reached Spain by sea, mainly from Morocco (UNHCR, the UN Refugee Agency). Not all of them succeed in reaching Europe, however their official number is unknown. Those immigrants that in the end stay in the region and eventually settle down, indicate that there is a growing need to tackle immigrants' awareness of local risks, to find variables permitting to enhance the inhabitants' perception of risk, as well as their protection behaviour. Then, the divine component and fatalism as disaster risk mitigation tools should also be tested, since there could be both locals and immigrants believing in divine punishment or that nothing could be done against natural hazards.

To sum up, both case studies confirm the need for informal educational processes on risk awareness, while underlying the environmental and place particularities of the zone that could be promoted as local ecological action in the risk mitigation process. Risk management has to be institutionally improved and trust has to be built, which is particularly valid for North Morocco. That is why a discourse analysis complements the reasoning on information transfer and risk management.



Figure 33: Churches in the region are a meeting point for African immigrants, as here Spanish churches in Al Hoceima and Tetouan.

### 6.2.2. Vertical spatial scale: North Moroccan example

To test the compatibility of discourse between local risk managers, scientists and associates included in natural and social issues related to risks in North Morocco, the information on risks, risk management and proposed indicators obtained by interviews is crossed with the information obtained from general population by questionnaires.

If we start from the national level, the State is well included in risk management, as confirmed by our two interlocutors in Rabat:

*“Morocco has positioned itself as the hard-working student for the fight against climate change and for the protection of the environment within the COP21. The State is well involved, the blue flags, the institutions, ... with specific awareness trainings, workshops organized, [...]. So the awareness is there and it should not be overlooked, in addition with the installation of the Fund to fight against natural risks.”*

*“Without being pretentious, we are really in prevention. I am an architect, covering a great risk prevention action within a ministry, in a service truly dedicated to risk prevention, so as not to be cut and shared into pieces every time. It is an essential necessity following a very big strategy in Morocco, the national strategy of integrated risk management, launched by the interior ministry since 2008. Yes, it took a lot of time, it was necessary to make a beautiful strategy which is at the level of high international expectations, mounted on real pillars, built slowly but surely, to be progressive.” [...]*

*“At the meeting in Switzerland in May [2019] we saw the progress of Sendai's strategy, and Morocco is placed in a position of strength among the Arab countries.”*

As underlined by two administrators, all is there on national level: the plans, the international commitments, the risk awareness sessions. Besides, following the Moroccan *Référentiel de l'Urbanisme Durable (2017)*, the detailed commitment for which Morocco engaged by adopting the new urban agenda Quito Habitat III from October 2016 is elaborated. The fifth issue, dedicated to ‘Health and Citizens’ Security’, includes a special theme on ‘Management of Natural and Technological Risks’. There the natural risks treated are avalanches, wildfires, floods, landslides, cyclones, storms, earthquakes and volcanic eruptions, and the objectives of prevention listed are: to suppress the extent of hazard, to control its effects and to reduce the exposure of people and goods. The strategy of implementation is rather ambitious, with action, intervention, urgency and rescue plans, followed by the financial investments, to implement alerting systems, to develop risk cartography, to conform the constructions following the earthquake-resistant standards, to integrate risk management into local action plans and to realise infrastructure resilient to risks. The attention-grabbing detail that follows the elaborated strategy and recommendations of integration in urbanism documents are the indicators listed (p. 75).

There are seven indicators listed: whether there are (a) enterprises located in flooding or landslide-prone zones, (b) dwellings located in flooding or landslide-prone zones, (c) enterprises located in the proximity of industry at risk (pollution, fire), (d) dwellings located in proximity of industry at risk (pollution, fire), (e) enterprises or dwellings in the proximity of garbage dumps, (f) dwellings in the proximity of roads with strong circulation, railways tracks or the airports, (g) dwellings in the proximity of high voltage lines. It is to be underlined that all indicators listed relate to exposure, and

only the first two, easily reduced to one, relate to natural hazards. Also, as mentioned in section 5.2.2.a, the only reference to Sendai Framework indicators came from one administrator (Female Administrator, 40, Rabat): *“Yes, we are working in very close collaboration with Sendai’s international engagement policy [...] except that the Sendai indicators are on the macro scale, public policies and strategies [...]”* and up in the text: *“At the meeting in Switzerland in May [2019] we saw the progress of Sendai’s strategy, and Morocco is placed in a position of strength among the Arab countries.”*, who gave a summary of Sendai indicators as classification tool of world countries, and not as a local risk management tool.

However, there is some void that is argued by the interlocutors, that has to be commented. It starts from the lack of legal respect, lack of resources, through lack of awareness and trust, ending by the lack of expertise.

Firstly, although the State’s implication on a national level was appraised by the administrators, laws are there, but they are not respected, as stated by the scientists from Tangier (*“At the level of the law everything exists, the problem is if we respect the law or not. The regulations exist, but they are not followed strictly enough.”*) and Martil (*“[...] the population [...] they do not respect the law. You have to make people respect the law.”*). The population seems to disobey the legislation, as well as the local leaders, when it comes to the financial matters, which creates the distrust, as elaborated by the scientist from Tetouan (*“The land was expropriated for non-construction, but now according to the development plan it is no longer. The state still decided to build a hotel and tourism projects. People are of course very aware of the risks [...] but when it comes to economic interests, everyone forgets about the risks. The [Martil] valley floods are very well known among the population, everyone knows and yet everyone forgets it when it comes to economic interest.”*).

In line with this, what is called ‘mentality’ of the local population by the scientists from Tetouan, it could be considered as not being sufficiently aware (*“In construction, the responsibility lies with the architect. But not everyone passes by the architect and not everyone meets the standards, even if the architect is there. On the other hand, yes, that poses problems. But this is not due to the wrongdoing, but due to the mentality of the inhabitant himself. I don’t think there’s awareness among the locals. What we see is that*

*customers want the most space possible.”) or not having enough financial means (“Now to build a house or whatever, you need the architect plan and the reinforced concrete plan. And there is no follow-up. An engineer makes you the plan with what you have to do, and the authority gives you the authorization. You start to build, the engineer is somewhere, and you do what you want. You can save. The engineer tells you, for example, that the reinforced concrete plan costs you 300 € and goodbye. And if you want the follow-up it's 600 €, so you do the math. So you will save 300 € and more X € for materials. For that, I tell you that it is the mentality.”)*

This lack of financial means is likely not only present in private construction projects, but also could be the reason why the risk management is not a task left to the municipal level, but rather centralized to the higher entity of *wilaya*. As stated by smaller municipalities of Oued Laou and M'Diq, they do not use indicators of risk management therefore they do not manage risks on their own (“*Wilaya produces the ORSEC and therefore I have no idea about the indicators.*” and “*The indicators are not used [here], there is the specialized service that does this.*”). The lack of resources, not only financial but also human, is underlined by the administrator from Oued Laou:

*“We are 4 civil servants on 9665 inhabitants (2014) and during summer it is tripled.”*

Remarkable is the distrust between administrators and scientists and vice versa, and between administrators and the general population and vice versa. An example of distrust of local leaders towards scientists is shared by the researcher working in the national research institute CNRST (*Centre National pour la Recherche Scientifique et Technique*) in Rabat. While conducting her research on tsunami hazard in Tangier “*I retained by working with the managers in Tangier on the tsunami simulation is that initially by talking with them they are very understandable and they will follow up to the goal, that it is enough to make a request, and when D-Day comes they are reluctant and afraid to speak. Managers are afraid to scare tourists and the city's resident population. Morocco's economy is based on agriculture and tourism and Tangier is very touristic (4th on the national level). They are afraid that if the tourists look at the tsunami signs in the city that they will think that it is eminent that a tsunami is coming and therefore why to bother with the tsunami?*”

Similarly, the distrust between scientists and leaders is expressed by the two researchers from Tetouan, related either to hydrology “[...] *the delimitation of the*



*hydraulic public domain, which comes from the minister, is not clear, the elected leaders pull on one side, and our agency on the other and from 80 km of the hydraulic line in total only 6 km is defined with a decree of Minister, to delimit the private and public domain! In addition, sometimes the boundaries are not realistic.”, to awareness campaigns “Also, raising awareness among the population like in schools and associations is useless in a non-regulated way, it must be in the law. To intervene you must have authorization and basically our agency was already refused to avoid controversy.”, or to geology “[...] there is a big problem on the terrain because there is a conflict of interest between elected officials and technicians, so to speak us technicians from the terrain. And elected officials, especially presidents, they do not want it to happen one day that an area is dark yellow, it is in their interest that it is always unclear. And if it’s blurry, there’s baksheesh that turns from right to left. So on the terrain we found a lot of problems, we suffered, with the presidents, because they don’t want to receive us.”*

The distrust towards the administration is felt from the broad population as well, expressed by the following associates from Chefchaouen (*“I do not believe that people are sufficiently aware of natural hazards. We have worked a lot in raising awareness about forest fires, a little also on landslides and the link with deforestation, but we have not intervened on the other risks. Even the administration does not raise awareness, they arrive after the event to remedy it, but not before to anticipate it. The administration must have the action and emergency plan.”*) and from Tetouan (*“For management the most important is to do a good job, to work. It’s not to repeat with each election ‘we’ll do this, we’ll do that’, and after 4 years the results will be nothing and the loop will come again ‘we’ll do this, we’ll do that’, it is not the continuation of the projects as it is elsewhere, they do not do their job. And I think citizens also do not make a good choice on elections.”*). That the distrust is mutual is shown by both national and local administration from Rabat (*“The State is well involved [...] with specific awareness training [...] But we must not frustrate the people, the people who need special treatment. You don’t have to be very direct, you don’t even have to communicate the issues to them.”*) and Al Hoceima (*“We work secretly because the population is not interested in public work related to risk, it is the task of the municipality. We did not even communicate the risks to the inhabitants of the cliff.”*).

In addition to lack of legal control and distrust, the cost and the expertise pose problems while working in natural risk management, as expressed by interlocutors from

Tetouan (*“On the other hand, politicians want impact indicators and we cannot yet provide them since it is expensive and because we lack the expertise. For example, recently we have raised awareness in 40 schools, but after all we do not know the success rate of schooling.”*) and from Tangier (*“For tsunami indicators you need to install tide gauges. With the tide gauges in the ports you can record the wave height and refine the models. [...] We have only one tide gauge, east side, close to Algeria; the other in Casablanca was recently destroyed by a boat.”*). Similarly, as noted by the scientist from Al Hoceima, the lack of expertise is connected to the lack of standard (*“There are laboratories that set the standards of materials, but since all the laboratories and design offices are private,...”*)

Passing through the vertical scale, from the national and local authorities, scientists and to the general population, the ways of reaching the improved risk management differ. Based on the information received from the questionnaires submitted to broad local population from the region of North Morocco and presented in the section 5.2.1., two indicators could and should be taken into consideration while elaborating efficient risk management plans. The attending of risk awareness sessions and the environmental identity show to have an impact on the general population when making decisions to protect their families and belongings in the future or to invest money to protect. Based on the discourse analysis presented in section 5.2.2. and discussed in the previous paragraphs of this section, the environmental identity indicator does not seem to be included or at least mentioned in the process of managing risks, and it is certainly not one of the indicators listed in the *Référentiel de l'Urbanisme Durable (2017)*. The environmental identity should be promoted by endorsing ecological issues in the region, based on the fact that the local population lives of land usage and agriculture in high proportion. However, the attending of risk awareness sessions is elaborated by all three groups of interlocutors. As stated by the administrators in Rabat, Martil or Al Hoceima, the risk sessions exist and the population is aware of the risks, but in Oued Laou or Tetouan they do not agree on this, where the latter states *“[...]this question of risk is not a regulatory, institutional or scientific problem, it is a problem of raising public awareness. The population is not susceptible, they want to build.”* Similarly, the scientists talk about partial awareness, where one of them from Al Hoceima underlines that *“awareness exists, but there is still a high illiteracy rate so we are making a great effort to explain it to everyone.”*

As for the results from quantitative surveys, a bit over one-third of our population (135 respondents) followed previously some natural risk awareness sessions, and they mainly followed it at schools and in associations. Since it matters significantly in deciding whether they would protect in the future, it should be more encouraged as a risk mitigation measure. The associates state that *“Awareness has a cost, awareness must be budgeted.”* (Male Associate, 60, Tangier), *“The city does not organize awareness sessions, but there are nature protection associations and they organize seminars.”* (Female Associate, 50, Tetouan), *“I do not believe that people are sufficiently aware of natural hazards. We have worked a lot in raising awareness about forest fires, a little also on landslides and the link with deforestation, but we have not intervened on other risks.”* (Male Associate, 55, Chefchaouen). However, a point stated by an associate from Al Hoceima: *“Natural hazards, yes, people are aware and informed that this region is seismic. Much the same as with garbage, people know that it’s not good. But what do we do? Is this awareness sufficient to change behaviour, attitudes?”*, considered along with the scientist from Tetouan sharing their lack of expertise when stating *“recently we have raised awareness in 40 schools, but after all we do not know the success rate of schooling.”* is why risk awareness should be further elaborated, possibly concerning the importance of religion and mosques in Moroccan society.

Mosques are recognised both by national (*“The mosque is the first awareness centre; it is a synonym for awareness, with the unblocking points for the population.”*) and local administration (*“Even at the mosque, which is a showcase, in the speech on Friday, never a speech on the risks was mentioned.”*), as shared by the interlocutors from Rabat and Oued Laou. As far as the information received from the general population, there were many references on God’s will, although there was no question on God in the questionnaire, since it was considered straightforward that the respondents were religious. What is important is whether there are both direct and implicit protective measures taken. As we were told by our interviewee, an imam from Tetouan, *“imams teach believers to protect themselves, in the communes they play a very important role, and it always remains at the level of Islam, but the other [institutions] do not do their duties. Here in Morocco, we are not in Japan, here we do not have prevention, we do not predict fires, flooding.”* It is, therefore, to conclude that the improved risk awareness and protection sessions have to be organised with the mosque, *“the first awareness centre; it is a*

*synonym for awareness*”, “*which is a showcase*” since, when working with imams, the authorities can promote risk mitigation measures. It seems reasonable to expect the success of this bearing in mind that the population is religious, that the population attends mosques and that sometimes mosques are the only present institutions in remote rural areas. The society could be beneficial from this just as it is elaborated in the publication about the compatibility of Muslim teaching and risk communication and dissemination by Ghafory-Ashtiany (2009).

### **6.2.3. Rupture of information**

In the previous section, the distrust and the lack of risk management communication to the local population were elaborated. Here the rupture of information flux will be presented based on the example of urbanization aptitude maps in the case of North Morocco (introduced previously in section 5.2.2.e), and finally followed by a short reflection on the rupture of information from the Sardinian case study.

As stated, urbanization aptitude maps contain scientific information, which is presented on maps as a guide for the local administration. They are considered as “*essential benchmarks for urban planning*”, whose scope “*is no longer a luxury, it is a vital necessity*”, as told by the responsible administrator in Rabat. It certainly seems to be a useful tool to detect the zones where special managing attention is needed prior to constructing, all to reduce risks and minimise possible future human and financial losses.

However, some remarks need to be underlined. Firstly, it is the insufficiency of actual maps, as underlined by the main administrator in charge of them on the national level: “*We are really in the cartography. On the other hand, the idea is that the aptitude maps remain, I cannot say, insufficient, the idea is to use them for the constructability maps, which is very different, and what is a real decision-making tool. I don't know if it's related to the indicators, but for us it's the next step inshallah. Because, for our pilot study of Al Hoceima, there is the aptitude map that exists, it is operational, but the map is there and people are still building. Constructability is an indicator. [...] Actually, the lack of the aptitude map is the constructability indicator.*”

(Female Administrator, 40, Rabat)

This lack is recognised on the local level, and the need to enlarge it with a general risk map is stressed:

*“There are no criteria or orientation in the aptitude maps. We are at the beginning of the reflection in the urbanism documents. This urban planning map should be superimposed on a general risk map, which has not yet been done.”*

(Male Administrator, 55, Tetouan)

The second problem seems to be even deeper, and it was expressed by the very same expert who takes part in elaborating the aptitude maps:

*“I work in this project of aptitude maps for urban planning, Chefchaouen, Tetouan-Fnidaq... The objective is to give in the end a map with colours, green, yellow, red... But there is a big problem on the terrain because there is a conflict of interest between elected officials and technicians, so to speak us technicians from the terrain. And elected officials, especially presidents, they do not want it to happen one day that an area is dark yellow, it is in their interest that it is always unclear. And if it's blurry, there's baksheesh that turns from right to left. So on the terrain we found a lot of problems, we suffered, with the presidents, because they don't want to receive us.” [...] “Urbanization aptitude maps, well, it's a pity, I work on that as an expert, but frankly, it's not... because we pumped up an idea and we're trying to adopt it and yet it's not the same mentality. It is like the Risk Prevention Plan in France and of course, culturally and intellectually, it is not the same thing for French and a mountain dweller from the Rif.”*

(Male Scientist, 65, Tetouan)

The mentality that is mentioned is probably related to territorial, cultural, social, ethnic or historical differences, stated again, by the same expert:

*“But before we started with these [aptitude] maps we had to start with the field, with the state of play, the mentality, and from the mentality we try to see how to make these cards. So I'm really ... Al Hoceima's aptitude map is not the same as the Kenitra area. If it's dark yellow for that region, it should be less dark for Al Hoceima. Morocco is a mosaic and you*

*don't have to make a law for everyone, you will have a problem applying this map, you have to adapt, play with it."*

This reference to the Rif mountain, to Morocco as a mosaic, with all the social differences, is since Al Hoceima province joined the region of North Morocco just recently, after the territorial reform of 2015 (Bulletin Officiel n° 6340 du 5 mars 2015). The Rif is not only newly merged with Tangier and Tetouan, they share a different cultural and historical background as well. The Rif is a zone of ethnic group and language Amazigh (plural *Imazighen*, sometimes referred to as *Berbers*), that was rather ignored because of the Rif rebellion in 1958 until 1999 and the inauguration of the king Muhammad VI (Lehtinen, 2008). The process of new 'unification' started with the Moroccan official recognition by the creation of a Royal Institute of Amazigh Culture and, since 2011, the recognition of Tamazight as an official language (L'encyclopédie Larousse, Encyclopaedia Britannica). Finally, this zone was hit by a series of earthquakes, among them the most devastating one from 2004 and during that disaster, the state showed the failure in managing the crisis during and after the earthquake, which was already elaborated by interviewees from the area, both by an administrator: *"After the 2004 disaster, half of the population asked for the help of a psychologist." I myself stayed with my family for 1 month in the tent!"* and by the associate: *"In 2004, 6 hours after the earthquake, the majority of the officials who are not from here took their children and they fled 300-400 km from here. We stayed here for two days with the complete absence of the State."* All this could contribute to the so-called mentality and mosaic that could have an impact on the aptitude map's implementation.

This is why it is appropriate to ask ourselves whether there is a degree of rupture of information flux between the administrators and the scientists. From one side, the urbanization aptitude maps are presented as a key tool for improved urbanism in the state, and from the other side are considered as unfit for the actual territory particularities by the expert that contributes to their elaboration.

Another example of rupture of information between administrators and scientists is related to the quality of material used in construction. Administrator (male, 55) from Tetouan's urbanism agency considers that: *"The materials are not standardized in*

*Morocco, so we don't know what we are building with, we are building with what is on the market. The passage by an architect or an engineer is obligatory, but the material used can be non-standard.*” and a scientist from Al Hoceima (male, 30) agrees with him: *“Many times one finds the differences between the constructed construction and this authorized plan. We lack control, monitoring of work and the quality of the materials used. Everything works economically. There are laboratories that give material standards, but since all laboratories and design offices are private,...”* However, scientist and architect (male, 45) from Tetouan states opposite: *“I believe that in terms of construction, the problem does not arise, especially when you build in concrete. In 1994 we did a study on constructions in informal settlements, and we were surprised how this self-construction was quite solid.”* which confirms that lack of coherent information transfer between administrators and scientists.

The crucial remark is surely the *coup de grâce* that confirms that the information flux between the administrative and scientific sphere is not efficient, and consequently it would be difficult to imagine that the information transfer exists towards the general population. The last quote: *“I am not informed about urbanization aptitude maps.”*, by the same (male, 45) scientist from Tetouan is to underline the total rupture of information transfer, since it is difficult to comprehend how an architect, director of the National School of Architecture, directly concerned by this project since *“In construction, the responsibility lies with the architect.”* and since *“The architect is in contact with the town and the urban agency which gives its opinion, who says town says wilaya because the construction file goes through wilaya.”* still is not aware that this national project is ongoing, initially in Al Hoceima after 2004, and from 2015 in whole Kingdom (as explained by the administrators from Al Hoceima and Rabat in section 5.2.2.e).

As a final remark on the rupture of information, which again is related to risk awareness communication, it cannot be forgotten that although scientific or technical solutions to managing natural hazards could be almost perfect, they entirely depend on the social component of the risk. Without efficient communication, the vulnerability is bound to increase and this statement will only be true in theory: *“among the regions that will soon be declared resilient is the region of North Morocco, Tangier-[Tetouan]-Al Hoceima.”* In addition, proclaiming the region resilient calls for caution, since that decision could be

exclusively a political act, a political agenda that is pushed for, as discussed by Reghezza-Zitt et al. (2012) and by Gilbert (2013).

As far as the Sardinian case study is concerned, there is a lack of explicit evidence of the rupture of information among the local society experiencing and managing risks. However, just as a food for thought, some of the interesting findings need to be reported, where everything seems to be taken into consideration, but in a form of a theoretical wish list. In 'Elements for National Strategy of Adaptation to Climate Change' (Castellari et al., 2014), the elements *"must be aimed at development and updating of a suitable set of indicators for the monitoring of impacts and climate change vulnerability on a national [Italian] scale"* (p. 183). The authors call for indicators of state on a local scale and integral environmental, social and economic indicators. The importance of risk perception is recognised: *"investments in innovative monitoring technologies, investments to improve communication and to raise awareness of perception and risk management by citizens (an informed population is more aware and safer), they are priority measures of 'non-structural' adaptation in the context of climate change"* (p. 38) and *"an effective communication, awareness and information activity to the interested parties for the purpose is, therefore, essential to ensure an adequate perception of these risks"* (p. 216).

Similarly, in the Sardinian 'Regional Strategy of Adaptation to Climate Change' (adopted 2019), among the general criteria in developing the objectives is the *"awareness and education on climate change, to ensure full awareness of the future risks associated with expected climate pressures and to stimulate responses also oriented to the development of a bottom-up well tailored to specific local needs"* (p. 37). The strategy identified sets of indicators to describe climate changes and their consequences on natural and man-made systems, and the used indicators deemed relevant for the study of changes in the characteristics (frequency and intensity) of particular impacts must be carried out for the climatic analysis. This document is followed by an extensive and detailed 'Methods and Tools for the Regional Strategy of Adaptation to Climate Change' (2018), where indicators useful for knowledge of the state of the environment in Sardinia are listed, through the platform SIRA (*Sistema Informativo Regionale Ambientale*), according to the thematic area, and are chosen based on the reliability, measurability and usefulness of the initial database. The farmers' perception of the threats related to climate change is elaborated, as well as farmers' dissatisfaction with delays in reimbursements of



insurance against disasters they have encountered. In addition, a following document 'Guidelines for Regional Adaptation Strategies', elaborates the role of the coordination group, and dedicates a place for questionnaires and workshops in the process of adaptation: "developing specific surveys with questionnaires or semi-structured interviews, focus groups, participatory workshops, laboratories managed with methodologies relating to participatory planning, etc" (Cocco et al., 2019). Finally, a document 'Guidelines, Standardized Principles and Procedures for Climate Analysis and the Assessment of Vulnerability at Regional Level', from the same MASTER ADAPT project (Giordano et al., 2019), calls for the quality of input data, "*to devote every possible effort to the collection of quality data and the most significant data in order to populate adequate indicators*" (p. 5) and states that "*[a] deeper understanding of how a sector / system / territory behaves with respect to climate changes contributes, in fact, to setting adaptation objectives and targets, to supplying the elements necessary for planning adaptation measures, to raising awareness of the community and to monitoring and evaluating adaptation policies*" (p. 31).

To state again, all the documents look very professional and well elaborated, nevertheless without concrete measures of a broad assessment of risk awareness. Based on the results from the Sardinian survey (section 5.3.), the indicator of belief in climate change seems to be significant in deciding whether or not the local population invests in future protection. These documents do recognize the need for awareness and education sessions, but there seems to be the end. It is as if there is no follow-up of these wishes in concrete monitoring, which therefore does not provide a useful indicator of climate change adaptation. All this can indicate a rupture of information between the administrators ordering the studies, the scientists elaborating them, and the general population that sends signals that are in the end not taken into consideration as a concrete measure that can be useful while mitigating the effects of climate change.

To sum up, it seems to be true that there is rupture of information between different actors in both North Moroccan and Sardinian society, between the opinion about natural hazards that the general population expressed in here presented studies from one side, and the reasoning of the local administrators and scientists from the other side. One indicator of this rupture is the discourse on urbanisation maps, where on the higher administrative level the maps are presented as an immense national project, but

scientists and architects seem to be either sceptical of their utility, or not even aware of the project itself, showing that local level does not seem to integrate the mechanisms from the regional or national level. The second rupture of information is the difference of opinion about construction material being solid and worthy, where urban planning administrator from Tetouan and scientist from Al Hoceima denounce the materials that are not standardized, but the scientist-architect from Tetouan thinks that in terms of construction, especially while building in concrete, the problem does not arise and that it is surprising how solid the self-construction in popular districts is. Third notice of rupture is the possible transfer of prevention measures from administration to population since in some rural areas the only institutions present are mosques, and there the only prevention is praying. Finally, when departing from the responses by the general population in both North Morocco and Sardinia, if risk sessions, environmental identity, belief in climate change and insurance seem efficient indicators for measuring local resilience, and those indicators are not followed up by the institutions, then there is a rupture of information and the lack of mechanisms to build indicators at the regional or national level from the local scale input. This rupture of information can be a very important indicator to measure the effectiveness of risk management. The question is if it could be tested around the workshops and focus groups where all the relevant stakeholders actively take parts.

## **6.3. Indicators on temporal scale**

### **6.3.1. Each time phase has its own indicators.**

Based on the literature review, to improve the social resilience, research on pre-disaster and disaster phase has to be continued, because until now these temporal scale phases are under-represented compared to the post-disaster phase (Khalili et al., 2015, Rufat et al., 2015). Since one of the seven targets of the Sendai framework for disaster risk reduction is to increase the number of countries with national and local disaster risk reduction strategies (Mysiak et al., 2016), there is an evident need to increase the local approach to resilience. Finally, an interesting remark on the scale and meeting the Sendai's objectives comes from the study by Beccari (2016) in which the author

concluded that the current approaches in disaster research are mostly custom-made to individual contexts. It could, therefore, pose a barrier in achieving the Sendai Framework where agents have to agree on indicators to measure performance towards set objectives (Beccari, 2016), which calls for further research on disaster risk indicators.

The temporal scale is of equal importance as the spatial one. Three indicator studies have for their objective research about temporal phases of disaster. A case study from Thailand (Siebeneck et al., 2015) created a new disaster resilience index to better understand pre-disaster conditions, the Greek case study (Minos-Minopoulos et al., 2017) worked on pre-disaster and disaster part of the disaster cycle, which is of importance for the cultural heritage management, and the Australian review offered a new outline in all three temporal phases for better social resilience (Khalili et al., 2015).

Almost all additional case studies focusing on resilience time scale were interested in a post-disaster stage of the following events: the 1999 Taiwan earthquake (Chou et al., 2015), the 2004 Indian Ocean tsunami (Frankenberg et al., 2013), the 2005 hurricane Katrina in the USA (Burton, 2015), the 2008 China's earthquake in Sichuan (Lu and Xu, 2015), the 2010 New Zealand's earthquake (Winstanley et al., 2015), the 2011 earthquake in Japan (Nakanishi et al., 2014), and a theoretical case in Saudi Arabia (Alshehri et al., 2015). One work was also a meta-analysis of flood disasters, considering all three disaster stages (Rufat et al., 2015). In this last study, thematic indicators are sorted by the proportion of citations within the three stages of a disaster, and it concluded that social vulnerability varies noticeably within the different temporal stages.

### **6.3.2. Are dynamic indicators possible to construct?**

It would be useful to develop indicators to be followed up for each phase of the temporal scale: pre-disaster, response and recovery (post-disaster), along with hazard indicators. However, the conceptual possibility to pair resilience indicators with vulnerability indicators is not in the practice, and the question is whether it is theoretically possible and how would it be technically done. In improved risk management, indicators should be used to collect and gather information on every phase of the disaster management cycle, building a society that is less vulnerable and

more resilient (Figure 34). The indicators would, in that sense, become more dynamic measures of the changes they are supposed to depict by their definition and would be more resilience oriented, contributing to improved risk management.

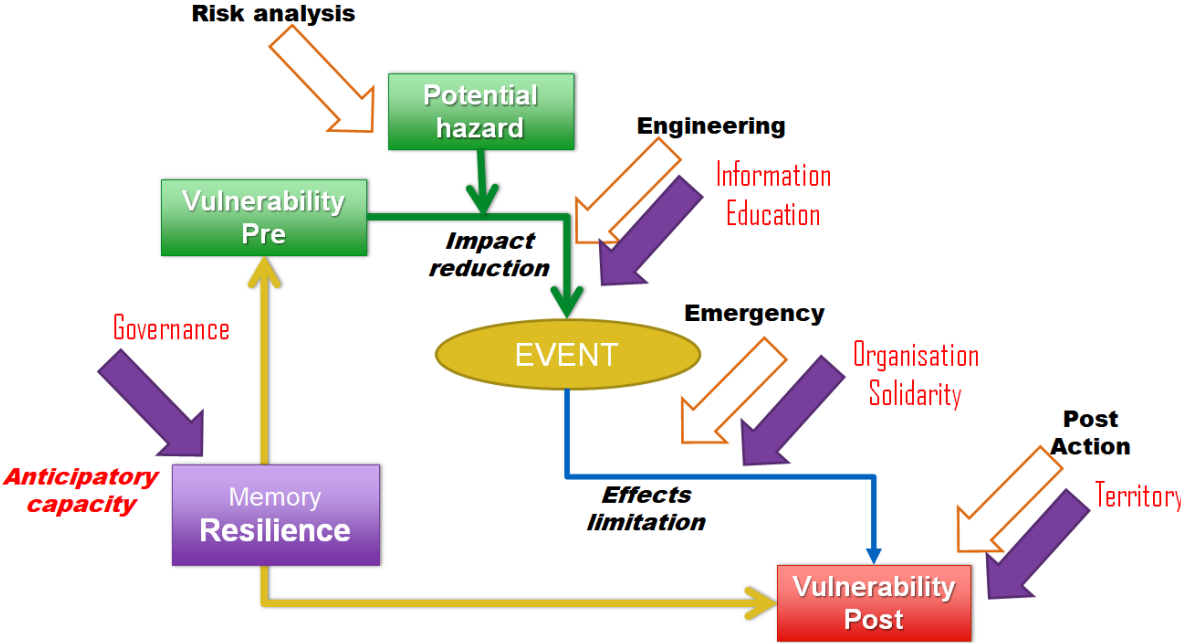


Figure 34: To make a move from less vulnerable to a more resilient society, indicators should be used to collect information on every single step of the process before, during and after the disastrous event (©H. Mazurek, in Ivčević et al., 2019).

Indicators are usually modelled through statistics (i.e. % of women, per capita income). Are we able to create dynamic indicators by considering them on a temporal scale? If we consider flood hazard, and the number of people living in the area exposed to flood, that would be an example of vulnerability indicator. Since it could be assumed that we have the information about flood frequency and maximum or average intensity, the educational campaign in that area could be organized. The number of people that moved out from that flooded area based on the input of the educational campaign, in some limited time frame, could be measured and be considered as a resilience indicator. These pieces of information could speak about the success of flood awareness campaign, but also about the local readiness to cope with the ongoing change. Moreover, if we consider the sea-level rise and coastal storm effects as a consequence of climate change, the community can be informed about the annual cost of beach nourishment and possible control structures. If the coastal storm damage is registered, and the benefits of nature-based solutions to mitigate the impact of climate change divulged to population,

it could be that the community would see the utility and financial benefit of nature-based solutions, as it is promoted in the case of wetlands from the Sardinian case study. A similar example can be constructed in the case of coastal erosion and alternative ways of fighting it, by moving additional meters away from the coast, possibly using this new land for ecological restoration of some autochthonic habitat. This example can be used complementarily with the tax and insurance policy if it is linked proportionally with higher exposure to hazards, which would contribute to the interdisciplinary research of related branches of science. Likewise, if we consider an example from geology, the fault length could be measured, with additional pieces of information on earthquakes' magnitudes and seismicity, and the number of anti-seismic houses bridged with the information on destroyed houses (if an event occurred) and with the information on reconstructed houses (if an event occurred or as prevention).

Some dynamic indicators could be developed similarly for social sciences. For example, in economics, cost-benefit analysis of the actual and new policy, before and after the investment, could be coupled. Also in management, for instance, the number of middle- or high-school pupils educated on risk and climate change could be coupled with the number of resilient pupils in an affected area and those that consequently developed a belief in climate change processes, which showed to have an impact on the Sardinian population in adopting precautionary behaviour. In addition, the information on hazard history, recurrence time of earthquakes or return interval of floods can be used as input data for risk awareness sessions, that would boost both awareness and perception, and provoke changes in attitudes towards precautionary behaviour, as was shown in North Moroccan study. Risk awareness sessions could be followed up on a time scale, as well, contributing further on the interdisciplinarity of risk science with policy, psychology, and economics. Another signal from the case study is the environmental identity that could be boosted with the collective, local ecological actions.

Furthermore, the North Moroccan example showed the need for integrating risk awareness sessions with religious institutions. The hazard history of great earthquakes and floods could be used as input risk information during religious discussions with an outcome of an ethical maxim of adopting precautionary behaviour to save human lives. The last example of the rupture of information, that can indicate the failure of risk management process, can be measured by initially identifying the individual positions of the risk management stakeholders, and consequently reaching consensual priorities of

all stakeholders after participatory focus groups. This, however, does not need to wait for a disaster to occur, since the participatory approach is always of equal importance for a successful information flux between all actors of risk management processes.

These and additional ideas presented in Table 23 are some of the possible, recommended changes that dynamic indicators could bring to the community. These combined measures seem feasible, but it is to evaluate the benefit of this combined piece of information. It is evident that this kind of representations initially should go through an intense discussion between scientists and policymakers since it may not be pragmatic to have the measurement indicators in time scale due to a time-consuming and costly process.

Table 23: Some examples and ideas of constructing dynamic indicators.

<i>Discipline</i>	<i>Hazard Indicators</i>	<i>Vulnerability (pre-disaster)</i>	<i>Impact (response, during disaster)</i>	<i>Resilience (recovery, post-disaster)</i>
<i>Climatology</i>	flooding (frequency, maximum intensity, total rainfall, floodplain inundation)	number of people living in an area at risk (basic indicator of flood exposure), land use and cover	number of households affected	number of people moved out from the area after an educational campaign
<i>Climatology (climate change)</i>	relative sea-level rise, storm waves effects, significant wave height	beach nourishment and control structures	coastal storm effect and damage on shoreline	nature-based solutions to mitigate the impact of climate change
<i>Geomorphology</i>	coastal erosion rate, sediment budget, coastal slope, distance from the sea	land use and cover as indicator of financial damage	marine erosion, economic valuation of land loss	added value of tourism and of new infrastructure, ecological restoration
<i>Geology-Seismology</i>	fault length, magnitude scale, seismicity	number of anti-seismic houses, state of buildings, building density	number of destroyed houses and human loss	number of reconstructed houses (organizational resilience)
<i>Psychology-Sociology</i>	hazard history, last disaster date, recurrence time of earthquake, return interval of floods	risk experience, risk awareness and perception	societal response, risk awareness sessions	changes in attitudes towards precautionary behaviour

<i>Religion</i>	hazard history	information on big earthquake and flood events	risk awareness discussions in the religious institutions	adopting precautionary behaviour in order to protect lives as ethical maxim
<i>Economics-Policy</i>	disaster probability, any	cost-benefit analysis of the actual policy, proportional tax and insurance for more exposed houses	investment or insurance	cost-benefit analysis of the new policy
<i>Rupture of information</i>	any	individual positions of different risk management stakeholders identified	number of participants and stakeholders in focus group workshops	consensual priorities of all risk management stakeholders identified
<i>Management</i>	any	number of high-school pupils educated on risk, environment and climate change	number of affected pupils	number of resilient pupils (psychological recovery), developed belief in climate change
<i>Activism</i>	any	community participation	collective ecological actions clean-ups	developed environmental identity and local activism

## 6.4. Personal reflections on the conducted research

### 6.4.1. Contribution to literature

In this manuscript, the outcome of my research contributes to existing academic and policy literature. The literature review theoretically assesses that the indicators of risk management are used, but are not too questioned. The review confirms that there is a lack of studies questioning their evaluation before using them in some specific case study, for example presenting all the physical and social indicators related to earthquakes and floods, but focusing on their practical usage (De Ruiter et al., 2017). As showed, the validity of indicators of social vulnerability was discussed by Fatemi et al.

(2017), as well as the validity of indicators of social resilience by Doorn (2017), which opens a second conclusion from this research, stating that the majority of indicators discussed and used in risk assessment is related to social science, with even fewer papers of using both sciences equally, as in Merlotto et al. (2016) and Hardy (2017). That would be the best way since the risk is on the interface between social and natural sciences and, therefore, one source of scientific information should not be excluded from risk assessment. The third remark is the terminology, possibly since it is considered that this term is technical and comprehensible to those that should understand it and use it. We, therefore, call for the clarification and standardization of term *indicator* and of following terms like *index*, *variable*, *factor*, or *dimension* as well. The best example of term overlapping is the study by Naumann et al. (2014), where the composite drought vulnerability index is sometimes called an indicator. It is constructed by using seventeen different variables, sometimes called factors, and other times called indicators. Although the majority of policymakers and local managers understand what is the meaning and expected content of those terms, standardized definition (i.e. index > indicator > variable) could be a solution. Finally, this research opens the question of dynamic indicators and whether it is possible to construct them. The suggested idea of joining vulnerability and resilience information together could be an important contribution to risk literature (Ivčević et al., 2019).

Moreover, the contribution from two Mediterranean case studies analysed is threefold. The first one is the region's North-South coupling and comparison, where Morocco and Italy could easily serve as pilot studies to other countries, sharing the methodology and adapting to local physical and social particularities (Ivčević et al., 2020). Next, the feasible policy advice related to multi-risks and risks related to climate change is offered, which could contribute to disaster risk reduction in light of the UN Sendai's recommendation, preventing future human and financial loss. Furthermore, the willingness to pay elicitation in the contingent valuation exercise offers a way to go for decision-makers in charge of adopting climate change mitigation measures, due to the lack of analysis on climate change insurance adoption in both Mediterranean basin and worldwide. This could be particularly feasible in developed countries that indeed have the main responsibility in the ongoing climate crisis, urging them to pay more for the historic development responsibilities. Finally, it seems that there is a rupture of



information between local, regional and national level and that, therefore, the local scale does not manage to integrate mechanisms from above, and that there are still no mechanisms to build indicators at national level departing from the local input.

## **6.4.2. Limitations**

### *Design soundness*

To start with, it is reasonable to ask oneself whether the design of the research project is sound to contribute to the improved management of natural hazards, putting indicators in project's rationale. Has this project contributed to improved risk management by choosing this methodology, research questions and the terrain?

Firstly, I consider that the bibliographic research on indicators resulted with a tangible answer that the indicators mainly used are coming from social sciences and that a true blend of social and natural sciences should be achieved if we want to improve management of natural risk, which is itself right in between those scientific branches. Furthermore, using both qualitative and quantitative methods from social sciences gave insight into different societal mechanisms that are installed in a multi-risk zone of North Morocco, as well as in the area of coastal wetlands in Sardinia. Their comparison highlighted the challenges ranging from physical, social and cultural distances between two terrains, to the adequate communication between different levels of the community taking part in risk management, always bearing in mind that our experimental work is an imperfect version of the complex reality that can be found in the field. Finally, the temporal scale was not adequately tested, mainly since it could be achieved in a rather time-consuming process, but partly since the conceptual possibility to pair resilience indicators with vulnerability indicators is disputable and goes beyond the scope of this research project.

### *Culture and language*

This study is particular for choosing two terrains, one fieldwork in North Morocco, other in Sardinia, Italy. Although these parts of the Mediterranean region share many common characteristics, particularly in terms of climate change-related vulnerability and as being

unavoidable, exclusive place of importance to all the countries, the cultural difference between the South and the North coast cannot be neglected.

The first fieldwork was in Morocco. I was surprised about the administrative procedure to do the survey. The intention had to be declared to local and regional authorities, and the authorisation to do the survey needed to be obtained. For a non-commercial study related to the university I found it a bit exaggerated. A few months after, my second fieldwork was held in Sardinia, with none authorisation demand nor approval needed this time. My feeling is that I was limited by being a European PhD researcher in Morocco, by not being able to be independent in research and by not passing the questionnaires on my own. Besides, I do not speak sufficiently the standard Arabic, not at all the local Moroccan Arabic dialect *darija*. The fact that the majority of locals is usually able to communicate in French or Spanish does not suffice since people tend to find excuses to engage in a survey by claiming that they do not understand. The only limit I had in Sardinia, since speaking Italian, is that I possibly received more feedback from women, by being 'nice, handsome, pitiable' or 'funny foreigner speaking their language', undertaking a study in their region. Since in Sardinia I participated in environmental sessions with kids, my visit there was not only academically successful experience but a pedagogical development as well (Figure 35).



Figure 35: Activities with MEDSEA: Climate march in Cagliari (1), environmental divulgation sessions in Oristano (2), a screenshot of a video presenting a project for high school (3).

In addition, it is discussed that the research is both structured and structuring (Bourdieu, 1994), that our understanding of the world cannot be detached from the society in which it is produced (Latour, 1991), and that it is not possible to entirely free oneself of perceptual biases related to cultural experience (Johnson & Covello, 2012), nor that the scientific research can ever be neutral (Mertens, 2018). Based on my experience from the fieldwork, I am happy to have an opportunity for this comparison, where I tend to

use my Moroccan and Sardinian experience as a personal reference point for my future engagement on risk management.

### *Interdisciplinarity*

As argued by Veyret & Reghezza (2005), geography included risks in its main concepts of space and territory, and it relies on both natural and social sciences, but works on hybrids, which include elements of both branches simultaneously. The risk research should be interdisciplinary, but the question is whether it is truly interdisciplinary, or it is only of interest for geographers to have this approach to risk research. Come what may, perhaps the part of this research project that I appreciate the most is the interdisciplinarity. Originating from the geophysical and oceanographic background, and enrolling a project relating geosciences with social psychology and environmental economics, I have learned the value of interdisciplinarity, opening new frontiers by discussing with various researchers and borrowing methods from different fields of science. In that process, the methodology adopted from different disciplines should not be put in question because the learning process is never-ending, and the openness to it has to be recognized. Besides, the interdisciplinary work does not produce experts in other fields due to the apprehension process that always lacks parts of background theory. Although I tried to be exact while using social sciences, I am aware that it was possibly not adequate, leaving it to expert's judgements. Although I claim that both vulnerability and hazard indicators should be equally used in risk research, social sciences are predominant, possibly because it is difficult to work on interdisciplinary indicators that include geological or geophysical parameters, therefore few arguments on hazard indicators in here chosen case studies. Nevertheless, I believe that interdisciplinarity is a path to follow.

### **6.4.3. Future implications**

#### *Policy implications*

Based on the Moroccan case study, the advice for improved risk awareness and protection policy is the campaign organised with the mosque, since by working with

imams the authorities can promote risk mitigation measures. Given that the population is religious and attending mosques, and sometimes mosques are the only existing institutions in remote rural areas, the whole society could be beneficial from this collaboration.

The result of the Sardinian case study can provide useful advice to policymakers that are in charge of adaptation measures to climate change. Climate-related extreme weather events recently happen more and more often, leading to a significant increase in expenditure for public bodies responsible for compensation. As these events are expected to become even more frequent in the future, the European Union is considering introducing insurance mechanisms to deal with climate-related extreme weather events. If citizens invest their own money, they could be more attentive to the consequences of their actions and decisions and may, therefore, decide to avoid certain choices, knowing that they will have to bear the costs. Currently, as the damages caused by climate-related extreme weather events are reimbursed by public administrations, citizens may have no incentive to adopt the most efficient behaviour.

However, the results from the Sardinian economic exercise do not go only into directions of insurance, but for education about the value of wetlands in their territory, since it is showed that one of the main regulatory services remains unrecognised by the very inhabitants of these wetlands.

### *Research perspectives*

Based on the research presented in this manuscript, to advance in risk management, the way of using indicators has to be more investigated. Their usage should be justified not only by theoretical valuation but also discussed in interviews with different scientists, risk managers and local stakeholders in order to evaluate the efficacy of these indicators in risk management. Moreover, local practices and differences between developing and developed country should be acknowledged.

Undertaking further risk perception case studies in developing countries from the South could help us to get out from the North mindset while developing indicators that should

be useful for efficient risk management in the huge South part of the world. To start with, comparative studies with Moroccan should initially be Algerian, Tunisian and Mauritanian case study, with further application to other Arabic states. As far as Northern states are concerned, similar economic evaluation study to Sardinian could be generated initially in Croatia, France and Spain. As far as economic studies eliciting willingness to pay to protect are concerned, further exercises should be done using the methodology of choice experiment. A choice experiment is in general more time-consuming exercises than, here used, contingent valuation, but includes workshop and learning process, which could reach better results for this kind of environmental questions.

In general, the comparative studies would generate new knowledge that has to be constantly shared in form of risk awareness sessions, improving the information transfer between different interlocutors and different Mediterranean people.

## 7. Conclusions

Indicators are a useful tool in managing risks. Many different pieces of information can serve as an indicator of a state that leads us to act, to improve the natural, built, or social environment. However, interdisciplinarity is a buzzword of risk management. Based on the results previously exposed, there is a need to use social and natural indicators in risk assessment equally. Indicators taken from the literature to be used in future studies should be valorised in interviews with different stakeholders to justify their usage, based on the particularities of each field study. Furthermore, indicators should be developed using a bottom-up sense because the local practice differs from the top-down measures valid for large scales. Besides, as every region is specific, based on its basic environmental and social characteristics, there is a rising need to increase the number of case studies based on fieldwork uniqueness that would contribute to fundamental knowledge on natural risk management. On the other hand, since indicators and risk assessment on large scales are useful for different objectives than local ones, mainly for comparison across countries, they should both be used in a complementary way. In this thesis, indicators were examined related to three main research questions, that are responded based on the literature review and the results from two case studies, North Morocco and West Sardinia, Italy.

- 1) What kind of indicators could be useful in risk management and how to construct them both naturally and socially?

The indicators used in the papers presented in the literature review are predominately related to vulnerability or social component of risk, and not to hazards, or natural or environmental components of risk. Additionally, social vulnerability indicators do not always include risk perception, with often limited justifications for their usage. Since risk is the product of hazard and vulnerability, it is claimed that corresponding indicators used from both hazard and vulnerability should be included and valued in a balanced way. If the indicators are used methodologically and didactically, then we can

say that they are user-friendly tools for risk management and that they clearly transmit integrative scientific information to risk managers. Methodological issues need to be additionally addressed in the future since an efficient risk assessment cannot be expected if we use methods whose theoretical requirements do not satisfy the context of assessment based on the usage of indicators. The solution seems to lie in interdisciplinarity. However, there were very few interdisciplinary studies that are praised in disaster risk reduction according to UN Sendai objectives, with a positive example of socio-hydrology. The main goals of analysed indicators used in risk management were to propose new or improved responses to risk situations, offering short advice to political deciders, to propose a concrete evaluation, visualisation and communication of risk. There are, however, some further shortcomings that need to be addressed in the future elaboration of risk management indicators. Indicators were mainly based on either personal experience of the authors or existing literature, and they were rarely constructed using a participatory approach. The usage of indicators, therefore, should be justified not only by theoretical valuation but also discussed in interviews with different scientists, risk managers and local stakeholders to evaluate the efficacy of these indicators in risk management.

2) What is an indicator on a spatial scale, both related to horizontal variability and vertical hierarchy?

As seen above, risk indicators need to integrate combined information on hazard indicators and vulnerability indicators. Hazards occur regardless of the situation, and it is vulnerability that is a dynamic process, always relative to a certain situation. Local practices and differences between developing and developed country should be acknowledged, respecting local scale for every unique case and questioning risk perception. The theory of common sense helps to clarify the importance of local knowledge and cultural particularities, keeping them from oblivion. The results from two Mediterranean case studies, North Morocco and Sardinia, confirm the importance of interdisciplinarity in risk management, since hazard history and environmental conditions, as well as societal and cultural characteristics, contribute to increased risk awareness and precautionary behaviour of the local population. Those two case studies showed willingness for different forms of precautionary behaviour. Moroccans are more likely to protect themselves if they have followed risk awareness sessions and if they



consider themselves with developed environmental identity, and Italians if they have a high belief in climate change processes and if they are open to insurance of their belongings. This information should be useful for policymakers on regional and national levels. Unfortunately, on the one hand, the policy literature and interviews held with the administrators and scientists indicate the gap between institutional and technical speeches, where the local level does not manage to integrate mechanisms from the national level, which could lead to a failure of risk management policy. On the other hand, the general population seems to reveal adequate indicators for measuring local resilience, and those indicators are not adhered to by the institutions. It could be that there are no mechanisms to build indicators at the regional or national level from the local scale input, which indicates a rupture of information in risk management.

3) How to create more dynamic indicators, how to build them on the temporal scale?

Different phases of the temporal scale need to be respected. It would be useful to develop indicators to be followed up for each phase of the temporal scale: pre-disaster, response, and recovery (post-disaster). In improved risk management, indicators should be used to collect and gather information on every phase of the disaster management cycle, becoming in that way more dynamic measures of the changes they are supposed to depict, becoming more resilience-oriented, contributing to improved risk management. Resilience as a concept is here used complementary with vulnerability, to manage risks by defining indicators dynamically, bridging the two concepts that describe pre- and post-disastrous events. However, the conceptual possibility to pair resilience indicators with vulnerability indicators is not in the practice, and the question is whether it is theoretically possible and how would it be technically done. Since it could be a rather time-consuming and costly process, the further discussion between scientists and policymakers on this kind of dynamic representations is needed. However, as shown and concluded, there is a certain rupture of information transfer between the interlocutors included in the risk management process. To overcome it, undertaking similar studies in comparative sites could improve the participatory, learning and information transfer process.

The information transmitted by indicators and the vocabulary used while managing natural risks should be clear and comprehensible by the broad, non-specialist population and they should be directly adapted to management needs. If they are not used for monitoring and risk assessment, then they fail not only to reach Sendai's objectives but also to tackle the increasing human and economic loss worldwide. However, although there is a constant improvement in risk management policy, with the Sendai Framework and the increase of participatory approach and local perception studies, the question is how to make a step forward. The communication gap is one of the problems, where the language used is not adapted to different levels of society included in risk management. The technical documents can be well done, but the information should be transmitted clearly, popularized, even vulgarized, to the general population, from door to door in risk areas, if needed.

The responses on the initial questions and the additional remarks are important to underline the need for further research on indicators. There are not enough studies that not only use indicators but that also critically discuss and validate them. If the Sendai Framework's goals and objectives have not inspired the researchers, but mainly managers, then it is possible to raise a question about the utility of the indicators for the managers, and also about the communication interface between scientists and managers. In a nutshell, improved dialogue and participatory approach between the scientists, managers, and civil society has to be enhanced by all means. The risk for societies could be tackled both based on scientific and local knowledge and based on institutional adaptations (i.e. new risk management strategies) and social adaptations resulting from them. It is, therefore, important to address the physical phenomena of hazards as well as how they are socially constructed, not only by developing more natural indicators but also by associating them with social components in a combined series of indices. This index construction permits different cultural, economic, and demographic contexts with a participatory approach to be involved in the process of building scientific knowledge. Scientific knowledge must therefore be both consolidated and made accessible to society. Different sources of knowledge - scientific, local, and institutional knowledge - are available and must be solicited to strengthen the resilience of territories. The constant knowledge flow between those sources will contribute to Sendai's priority areas for action and it is a crucial condition for a step towards a more

responsible disaster risk reduction policy. Finally, the knowledge flow and interdisciplinary approach used in the process of the indicators' construction between the natural and social scientists will result in a common vocabulary of risk management elements, comprehensible to local authorities, managers, and institutions, as well as to the final users of the improved risk management strategy, the general population itself.

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# APPENDIX

# A. Papers published

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## Indicators in risk management: Are they a user-friendly interface between natural hazards and societal responses? Challenges and opportunities after UN Sendai conference in 2015



Ante Ivčević<sup>a,b,\*</sup>, Hubert Mazurek<sup>a</sup>, Lionel Siame<sup>b</sup>, Abdelkhalak Ben Moussa<sup>c</sup>, Olivier Bellier<sup>b</sup>

<sup>a</sup> Aix Marseille Univ, IRD, LPED, Marseille, France

<sup>b</sup> Aix Marseille Univ, CNRS, IRD, INRA, Coll France, CEREGE, Aix-en-Provence, France

<sup>c</sup> Département de Géologie, Faculté des Sciences de Tétouan, Université Abdelmalek El-azhadi, Tétouan, Morocco

### ARTICLE INFO

**Keywords:**  
Indicators  
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### ABSTRACT

Risk management indicators are used to mitigate the potentially dramatic effects of natural hazards. Local authorities and managers use them in elaborating rescue and urbanism plans, which do not always work, highlighting society's vulnerability in the particular context of global environmental and climate changes. Within this context, the United Nations (Sendai, 2015) advised to construct a series of indicators to better cope with human losses and economic disasters. Actually, the question is whether or not such indicators do constitute successful decision-making tools. In this article, we critically reviewed the recent literature (from 2013 to 2017) using the Web of Science database of Clarivate Analytics to assess how indicators are currently being constructed in risk management, with a focus on risks of inundations, coastal and seismic risks. This task allowed us to discuss the spatial and temporal scale at which indicators of risk management can be applicable, to what extent they should be physically oriented and if they can fit the needs of governance framework. Based on our findings, we suggest further work on a new series of less descriptive, more dynamic and more user-friendly indicators. Finally, we encourage the dire need for continuous work to overcome the misinterpretation of used indicators and how to reduce the communication gap between the scientific community, decision makers, managers and the population.

### 1. Introduction

Every year the world feels new burdens due to either climate-related or telluric natural hazards with strong societal, economic, and environmental issues. In 2017 alone there were 318 disasters recorded, with 9503 deaths, 96 million people affected, together with 314 billion dollars of economic damage, making it the second most costly year ever [1]. For decades, it has broadly been acknowledged that the disasters that cause human and economic losses are not only natural, but depend on the social conditions of the areas where natural hazards occur [2]. In order to make society respond more efficiently, and to tackle the increasing losses, the United Nations (UN) developed disaster risk management plans to set goals and objectives for reducing risks associated with natural hazards. After the International Decade for Natural Disaster Reduction (1990–1999), disaster risk and risk management expectedly attracted more attention worldwide. One of the frameworks

developed was that from the "Program for Latin America and the Caribbean", which, in addition to relative indicators at the national level, included a limited number of aggregate indicators to serve policy makers. Four composite indicators were used to measure each country's progress in risk management and its proposed monitoring tool for risk management is still used in modified form on national levels [9,100, 101]. On a larger, global scale, the first framework for disaster risk reduction, i.e., the *Hyogo Framework for Action 2005–2015*, was adopted. The five priorities for action were: ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation; identify, assess, and monitor disaster risks and enhance early warning; use knowledge, innovation, and education to build a culture of safety and resilience at all levels; reduce the underlying risk factors; strengthen disaster preparedness for effective responses at all levels [108]. Among its identified shortcomings was the need to encourage a mutual responsibility for disaster resilience at all levels [88], which was

\* Corresponding author. Aix-Marseille Université, St Charles, case 10, 3 place Victor Hugo, 13331 Marseille Cedex 3, France.  
E-mail address: [ante.ivcevic@univ-amu.fr](mailto:ante.ivcevic@univ-amu.fr) (A. Ivčević).

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## Local risk awareness and precautionary behaviour in a multi-hazard region of North Morocco

Ante Ivčević<sup>a,b,\*</sup>, Raquel Bertoldo<sup>c</sup>, Hubert Mazurek<sup>a</sup>, Lionel Siame<sup>b</sup>, Séverin Guignard<sup>d</sup>, Abdellhalak Ben Moussa<sup>e</sup>, Olivier Bellier<sup>b</sup>

<sup>a</sup> Aix Marseille Univ, IRD, LPED, Marseille, France

<sup>b</sup> Aix Marseille Univ, CNRS, IRD, INRAE, Coll France, CEREGE, Aix-en-Provence, France

<sup>c</sup> Aix-Marseille Univ, LPS, Aix-en-Provence, France

<sup>d</sup> Aix Marseille Univ, Université Côte d'Azur, Avignon Université, CNRS, ESPACE, UMR 7300, Avignon, France

<sup>e</sup> Département de Géologie, Faculté des Sciences de Tétouan, Université Abdelhak El-Abadi, Tétouan, Morocco

### ABSTRACT

North Morocco (region Tangier-Tetouan-Al Hoceima) is characterized by high demographic and economic pressures, which intensify the vulnerability of the coastal areas. Morocco lies both along the Atlantic and the Mediterranean coast, having a rich relief of mountain chains (Atlas and Rif). This diverse context induces the challenge of adapting to environments that are drastically different, and of answering the question to which extent the local population is aware of different natural risks. Risk awareness is addressed as a predictor of precautionary behaviour in a questionnaire-based survey. Here the variables explaining the readiness of inhabitants to protect themselves and their belongings from natural risks in the present and the willingness to invest and to protect in the future are explored. Furthermore, based on the different response patterns in the survey, we used multiple correspondence analysis to identify profiles of typical dwellers. The results indicate local regional differences, where the Rif Mountain dwellers are more prone to protect themselves than the ones living in other parts of North Morocco. Finally, environmental identity indicates that the relationship with nature has an impact on risk awareness and precautionary behaviour. This study brings out information which could be useful for policy makers who should promote ecological concerns and encourage local action in resolving environmental issues when promoting risk mitigation measures.

### 1. Introduction

The Mediterranean basin is one of the cradles of civilisation that has always been an attractive migration hub. More than 500 million people are estimated to live nowadays in its bordering countries [1] and the Mediterranean coasts represent the most visited tourist spot in the world, with more than 330 million visitors in 2016 [2]. In the European suburbs, just on the other side of the Strait of Gibraltar, lies Morocco, a country that seems to offer a perfect example of the Mediterranean essence. The country has been praised since the medieval times, like Ibn Battūta described it as “the best of countries, for in it fruits are plentiful, and running water and nourishing food are never exhausted” [4]. These beauties of Morocco attracted more than 10 million arrivals in 2017 [5].

The vulnerability of the region of North Morocco, which is exposed to the Strait of Gibraltar and to Europe, has however increased since the region became a big economic hub at the end of the 20th century. The region's vulnerability has its roots in the Rif Mountain, one of the most vulnerable Mediterranean domains when it comes to natural disasters [7], located on a seismically active zone [8], prone to landslides [9,10],

and soil erosion [6]; with the interior prone to drought, floods and flash floods [7], whereas Moroccan coastlines are highly exposed to climate change and sea-level rise consequences [11,12]. Due to this context of multiple risks we can call the region of North Morocco a multi-risks zone.

Local communities were seen to creatively integrate scientific elements to their cultural understanding of risks, in ways that might either contribute to their protection or increase vulnerability. Since scientific information is transmitted from scientific to common-sense knowledge, it integrates culturally available elements so that individuals make active use of historical and cultural ideas when collectively responding to risks [16,17]. More specifically the cultural specificities of North Morocco, where a strong government is allied with the omnipresence of the Muslim culture, compose a singular cultural setting [23] where vulnerability and risk preparedness are to this day ill understood.

This article analyses elements which are, today, effective to support individual and collective action for risk preparedness. By this means, a face-to-face questionnaire-based survey of the general population in North Morocco was conducted. While cultural differences involved in

\* Corresponding author. Aix-Marseille Université, St Charles, case 10, 3 place Victor Hugo, 13331, Marseille Cedex 3, France.  
E-mail address: [ante.ivcevic@univ-amu.fr](mailto:ante.ivcevic@univ-amu.fr) (A. Ivčević).

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## The future protection from the climate change-related hazards and the willingness to pay for home insurance in the coastal wetlands of West Sardinia, Italy

Ante Ivčević<sup>a,b,\*</sup>, Vania Statzu<sup>c</sup>, Alessio Satta<sup>c</sup>, Raquel Bertoldo<sup>d</sup>

<sup>a</sup> Aix-Marseille Univ, IRD, LPED, Marseille, France

<sup>b</sup> Aix-Marseille Univ, CNRS, IRD, INRA, Coll France, CEREGE, Aix-en-Provence, France

<sup>c</sup> Mediterranean Sea and Coast Foundation (MEDSEA), via Molise 6, 09127, Cagliari, Italy

<sup>d</sup> Aix-Marseille Univ, IJRS, Aix-en-Provence, France

### ARTICLE INFO

#### Keywords:

Wetlands  
Coastal hazards  
Contingent valuation  
Willingness to pay  
Sardinia  
Climate change

### ABSTRACT

Wetlands are severely endangered ecosystems worldwide. They provide important services, like water supply, recreation opportunities, flood and climate regulation. Still, they are also considered as disruptive areas, a source of mosquitoes and diseases, which is why they are frequently destroyed by changes in land use. Their degradation is likely to advance from this time forth due to climate change processes. It is, therefore, important to examine how the local population understands the importance of wetlands in coping with different coastal risks in West Sardinia. Our study is focused on West Sardinia (municipalities Cabras, Oristano and Arborea), counting for remarkable biodiversity of wetlands. This area is characterized by high environmental and agricultural pressures which intensify the vulnerability of the coastal areas. To test for local population's preparedness to change, data collection was performed through field methods and questionnaires. The study was undertaken by asking key questions on the role of wetlands and willingness to pay to protect from future events (contingent valuation exercise). The results indicate that the locals do not seem to be aware of the regulating services provided by wetlands, but are willing to invest in order to mitigate climate change-related hazards. The obtained results could serve in future governance frameworks for the mitigation of natural hazards in the Mediterranean region and wider.

### 1. Introduction

Water is one of the key natural resources at stake in the present and future world, having a crucial role for both societal and economic component of sustainable development. One of the solutions in preserving the healthy water cycle are wetlands, "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed 6 m", as defined by the intergovernmental Ramsar Convention [1]. The Ramsar Convention aims at conservation and wise use of wetlands in the widest sense, where wetlands may include even coastal zones, islands and the adjacent sea [2]. Wetlands are globally significant carbon stocks, with the organic carbon stored per unit area similarly as in forests [3]. In addition, wetlands mitigate the effects of natural hazards: they provide sediment

stabilisation and soil maintenance [4], they regulate water flow and control floods [5] and they scatter sea waves, buffer winds and protect coasts [6]. However, the importance of wetlands is underestimated, and their significant flood regulation and climate change mitigation capacity is overlooked [70]. Only in the Mediterranean region wetlands reduced in area by 48% between 1970 and 2013 [8], which is against our common interest in mitigating climate-change induced risks through adaptation.

The Mediterranean Sea has been detected as fragile and sensitive to climate change and its ecosystems are among the most concerned by global climate change [7]. Likewise, the second biggest Mediterranean island of Sardinia is prone to high level of hazards, particularly its West coast, which is among one third of the Mediterranean coastal areas exposed to the highest level of hazard. That is particularly due to extremely high values of wave heights, as shown in the study in which

\* Corresponding author. Aix-Marseille Université, St Charles, case 10, 3 place Victor Hugo, 13331, Marseille Cedex 3, France.

E-mail address: [ante.ivcevic@univ-amu.fr](mailto:ante.ivcevic@univ-amu.fr) (A. Ivčević).

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## B. Questionnaires

### B.1. North Moroccan survey

Enquête sur la mémoire, perception et conscience des risques naturels dans la région Tanger-Tétouan-Al Hoceima

Ce questionnaire vous est proposé dans le cadre d'une étude conçue par l'équipe d'Université Aix-Marseille et de Centre Méditerranéen pour l'Environnement et le Développement de Tétouan.

Nous vous demandons de lire attentivement et de répondre à toutes les questions le plus spontanément et le plus sincèrement possible. Il n'y a pas de bonnes ou de mauvaises réponses, seul votre avis personnel nous intéresse.

Les données que nous récoltons lors de cette recherche demeureront strictement confidentielles.

Ce projet a reçu un financement du programme de recherche et d'innovation Horizon 2020 de l'Union européenne dans le cadre de la convention de subvention Marie Skłodowska-Curie n ° 713750. En outre, il a été réalisé avec le soutien financier du Conseil régional de Provence-Alpes-Côte d'Azur et avec le soutien financier de l'A\*MIDEX (n ° ANR-11-IDEX-0001-02), financé par le projet Investissements d'Avenir financé par le gouvernement français, géré par l'ANR.

Parmi tous les risques naturels que vous connaissez, quels sont les risques naturels qui vous viennent spontanément à l'esprit par rapport à votre commune ?

Parmi les risques que vous avez mentionnés ci-dessus, pouvez-vous désormais les classer du plus important (1) au moins important (5).

Selon vous, les risques naturels dans votre commune sont :

Inexistants	Faibles	Modérés	Elevés	Très élevés	Ne sait pas

Avez-vous déjà vécu personnellement une catastrophe naturelle ?

oui	Non



Connaissez-vous dans votre entourage une personne ayant vécu une catastrophe naturelle ?

oui	Non

Concernant les risques naturels, vous sentez vous:

Pas du tout informé(e)				Tout à fait informé(e)
1	2	3	4	5

Pour chaque risque naturel, qualifiez-le à quel point il concerne votre commune:

	Pas du tout				Tout à fait		Sans avis
Sécheresse	1	2	3	4	5		
Inondation	1	2	3	4	5		
Glissement de terrain	1	2	3	4	5		
Tempête côtière	1	2	3	4	5		
Vague de chaleur	1	2	3	4	5		
Tremblement de terre	1	2	3	4	5		
Changement climatique	1	2	3	4	5		
Érosion côtière	1	2	3	4	5		
Feu de forêt	1	2	3	4	5		

Pour chaque risque naturel, qualifiez-le à quel point il est dangereux pour votre commune:

	Pas du tout				Tout à fait		Sans avis
Sécheresse	1	2	3	4	5		
Inondation	1	2	3	4	5		
Glissement de terrain	1	2	3	4	5		

Tempête côtière	1	2	3	4	5		
Vague de chaleur	1	2	3	4	5		
Tremblement de terre	1	2	3	4	5		
Changement climatique	1	2	3	4	5		
Érosion côtière	1	2	3	4	5		
Feu de forêt	1	2	3	4	5		

A quel point estimez-vous être informé sur ces risques ?

	Pas du tout informé(e)				Tout à fait informé(e)
Sécheresse	1	2	3	4	5
Inondation	1	2	3	4	5
Glissement de terrain	1	2	3	4	5
Tempête côtière	1	2	3	4	5
Vague de chaleur	1	2	3	4	5
Tremblement de terre	1	2	3	4	5
Changement climatique	1	2	3	4	5
Érosion côtière	1	2	3	4	5
Feu de forêt	1	2	3	4	5

Par quel moyen avez-vous appris ces informations sur les risques naturels ? (plusieurs réponses possibles):

Journaux	Radio	Télévision	Internet	Réseaux sociaux	Aucune	Autre : laquelle

Avez-vous eu connaissance de ces risques par la voie de l'éducation formelle (école, lycée) ?

	Pas du tout				Tout à fait
Sécheresse	1	2	3	4	5
Inondation	1	2	3	4	5
Glissement de terrain	1	2	3	4	5
Tempête côtière	1	2	3	4	5
Vague de chaleur	1	2	3	4	5
Tremblement de terre	1	2	3	4	5
Changement climatique	1	2	3	4	5
Érosion côtière	1	2	3	4	5
Feu de forêt	1	2	3	4	5

Avez-vous eu connaissance du déroulement de séances d'information et de sensibilisation sur les risques naturels près de chez vous ?

oui	Non

Si oui, y avez-vous participé, où ?

à la municipalité	dans des associations	dans des clubs de quartier	dans les écoles	autres

Comment considérez-vous l'information sur les risques naturels (plusieurs réponses possibles):

	Pas nécessaire	Utile	Intéressante	Indispensable	Je ne la cherche pas	Je ne la trouve pas
Sécheresse	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Inondation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Glissement de terrain	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tempête côtière	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vague de chaleur	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tremblement de terre	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Changement climatique	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Érosion côtière	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feu de forêt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Concernant les risques naturels, quelle est la confiance que vous accordez :

	Je n'ai pas confiance	Je n'ai plutôt pas confiance	Je ne sais pas	J'ai plutôt confiance	J'ai confiance
A la science	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aux scientifiques	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A l'information produite par les scientifiques	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A l'information diffusée par les médias sur les risques naturels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aux organismes privés impliqués dans la gestion des risques naturels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aux institutions publiques impliquées dans la gestion des risques naturels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Au gouvernement national	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Pour chacun des risques naturels suivants, dans quelle mesure pensez-vous que l'homme en est responsable?

	Pas du tout responsable				Tout à fait responsable		Sans avis
Sécheresse	1	2	3	4	5		
Inondation	1	2	3	4	5		
Glissement de terrain	1	2	3	4	5		
Tempête côtière	1	2	3	4	5		
Vague de chaleur	1	2	3	4	5		
Tremblement de terre	1	2	3	4	5		
Changement climatique	1	2	3	4	5		
Érosion côtière	1	2	3	4	5		
Feu de forêt	1	2	3	4	5		

A quel point pensez-vous que l'homme soit capable d'agir pour réduire les dégâts des catastrophes naturelles?

	Pas du tout				Tout à fait
Sécheresse	1	2	3	4	5
Inondation	1	2	3	4	5
Glissement de terrain	1	2	3	4	5
Tempête côtière	1	2	3	4	5
Vague de chaleur	1	2	3	4	5
Tremblement de terre	1	2	3	4	5
Changement climatique	1	2	3	4	5

Érosion côtière	1	2	3	4	5
Feu de forêt	1	2	3	4	5

Selon vous, les risques naturels sont ils devenus plus fréquents ces 20 dernières années ?

	Tout à fait moins fréquents	Moins fréquents	Pas de changement de fréquence	Plus fréquents	Tout à fait plus fréquents		Je ne sais pas
Sécheresse	1	2	3	4	5		<input type="radio"/>
Inondation	1	2	3	4	5		<input type="radio"/>
Glissement de terrain	1	2	3	4	5		<input type="radio"/>
Tempête côtière	1	2	3	4	5		<input type="radio"/>
Vague de chaleur	1	2	3	4	5		<input type="radio"/>
Tremblement de terre	1	2	3	4	5		<input type="radio"/>
Érosion côtière	1	2	3	4	5		<input type="radio"/>
Feu de forêt	1	2	3	4	5		<input type="radio"/>

Les risques naturels pourraient changer la fréquence, mais aussi la quantité de dégâts. Selon vous, est-ce que les risques naturels aujourd'hui génèrent plus ou moins de dégâts matériels qu'il y a 20 ans?

	Pas de dégâts	Tout à fait moins dégâts	Moins dégâts	Pas de changement de dégâts	Plus dégâts	Tout à fait plus dégâts		Je ne sais pas
Sécheresse	0	1	2	3	4	5		<input type="radio"/>
Inondation	0	1	2	3	4	5		<input type="radio"/>
Glissement de terrain	0	1	2	3	4	5		<input type="radio"/>

Tempête côtière	0	1	2	3	4	5		<input type="radio"/>
Vague de chaleur	0	1	2	3	4	5		<input type="radio"/>
Tremblement de terre	0	1	2	3	4	5		<input type="radio"/>
Érosion côtière	0	1	2	3	4	5		<input type="radio"/>
Feu de forêt	0	1	2	3	4	5		<input type="radio"/>

Pensez-vous que votre commune est plus ou moins concernée par les risques naturels que les autres communes de région ?

Moins concernée				Plus concernée
1	2	3	4	5

Quels sont les mots ou expressions qui vous viennent spontanément à l'esprit quand vous entendez l'expression « changement climatique » ?

---

Avez-vous déjà entendu parler du « changement climatique » ?

Oui	Non

Croyez-vous que le « changement climatique » existe ?

oui	Non

Si oui, pensez-vous que le « changement climatique » a une origine :

Totalement naturelle				Totalement anthropique
1	2	3	4	5

Selon vous, à quel degré chaque risque naturel ci-dessous est-il lié au changement climatique ?

	Pas du tout lié				Tout à fait lié		Pas de lien
Sécheresse	1	2	3	4	5		<input type="radio"/>
Inondation	1	2	3	4	5		<input type="radio"/>
Glissement de terrain	1	2	3	4	5		<input type="radio"/>
Tempête côtière	1	2	3	4	5		<input type="radio"/>
Vague de chaleur	1	2	3	4	5		<input type="radio"/>
Tremblement de terre	1	2	3	4	5		<input type="radio"/>
Érosion côtière	1	2	3	4	5		<input type="radio"/>
Feu de forêt	1	2	3	4	5		<input type="radio"/>

Selon vous, quand votre région commencera-t-elle à ressentir les effets du changement climatique ?

Nous ressentons déjà les effets	Dans les 10 années à venir	Dans les 25 prochaines années	Dans les 50 prochaines années	Dans les 100 prochaines années	Au-delà des 100 prochaines années	Jamais	Je ne sais pas	Pas d'opinion

Selon vous, le changement climatique affecte surtout :

Ma commune	Ma région	Le Maroc	Les pays en développement	Les pays développés	Autre

Avez-vous pris des précautions en vue d'une catastrophe naturelle potentielle ?

oui	Non



Pensez-vous que les solutions suivantes soient adaptées pour éviter les dégâts des risques naturels ?

	Pas du tout				Tout à fait
Déménager	1	2	3	4	5
Planter de la végétation	1	2	3	4	5
Modification des comportements des citoyens	1	2	3	4	5
Campagne d'information pour «sensibiliser »	1	2	3	4	5
Éviter l'exploitation du sable	1	2	3	4	5
Meilleure identification des zones à risques naturels	1	2	3	4	5
Appliquer des normes parasismiques aux bâtiments	1	2	3	4	5
Meilleurs lois et règlements	1	2	3	4	5
Création d'un «comité d'urgence»	1	2	3	4	5
Construire digues et barrages	1	2	3	4	5
Autre, lequel :	1	2	3	4	5

Que seriez-vous prêt à faire (à la maison ou au travail) pour vous protéger contre le risque naturel ?  
Quelles mesures ?

---

Est-ce que vous avez déjà été informés par quelqu'un des solutions possibles pour vous protéger contre les risques naturels ? (plusieurs réponses possibles)

Jamais	fonctionnaire de l'Etat	à l'école ou l'université	à la mosquée	association	média	connaissances, amis	autre (qui ?)

...et sur quels types de risque :

Sécheresse	Inondation	Glissement de terrain	Tempête côtière	Vague de chaleur	Tremblement de terre	Érosion côtière	Feu de forêt

Concernant votre commune, diriez vous que : (cochez la case correspondante pour chaque ligne)

	Pas du tout d'accord	Plutôt pas d'accord	Je ne sais pas	Plutôt d'accord	Je suis totalement d'accord
Je suis fier(e) d'habiter cette commune.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Je pense que cette commune constitue un bon cadre de vie.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Je m'identifie aux habitants de ma commune.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Je regretterais si je dois déménager vers un autre quartier.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Je regretterais si je dois déménager vers une autre commune.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Je me considère comme quelqu'un ayant des préoccupations écologiques.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Je me considère comme quelqu'un d'impliqué dans les questions environnementales.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Pensez-vous vous protéger financièrement dans le futur contre le risque naturel ? Par quel moyen (plusieurs réponses possibles)?

Non, pas d'intérêt	Infrastructure améliorée	Assurance niveau national	Assurance niveau régional	Assurance niveau local	C'est à chacun au niveau personnel	Je ne sais pas
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Personnellement, combien de dirhams êtes-vous prêts à investir par an pour vous assurer contre les potentiels risques naturels ?

0 Dh	0 à 200 Dh	201 à 400 Dh	401 à 600 Dh	601 à 800 Dh	801 à 1000 Dh	Plus de 1000 Dh
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Avez-vous des biens qui peuvent être détruits par une catastrophe naturelle ?

Maison/appartement	Voiture	Appareils ménagers	Matériel informatique	Meubles	Autres	Aucun
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Caractéristiques de l'enquêté(e)

Age

18-23	24-29	30-35	36-41	42-47	48-53	54-59	60-65	66-71	Plus de 72

Sexe :

féminin	masculin

La taille du ménage (Nombre de personnes vivant au foyer):

1	2	3	4	5	6	7	8	9	10	Plus de 10

Métier - Profession : \_\_\_\_\_

Nombre d'années à l'école:

aucune	primaire	collège	lycée	Université ou écoles						
				sans licence	licence	master	doctorat	ingénieur	autres	

Commune et quartier de résidence : \_\_\_\_\_

médina	Centre ville	Nouveau quartier	Quartier populaire	Quartier périurbain	Zone villa	Quartier structuré	autres

Lieu de naissance (commune) : \_\_\_\_\_

Nombre d'années de résidence dans votre commune

Depuis ma naissance	5	6-10	11-15	15-20	21-25	26-30	Plus de 30

*Merci pour votre contribution !!*

Nom d'enquêteur : \_\_\_\_\_

Qualité d'enquête : \_\_\_\_\_

Durée d'enquête : \_\_\_\_\_

## B.2. Sardinian survey

MEDSEA, Mediterranean Sea and Coast Foundation, Cagliari  
 Università d'Aix-Marsiglia, Francia

Questionario n. \_\_\_\_\_

Luogo: \_\_\_\_\_

Data e ora: \_\_\_\_\_

### Progetto MARISTANIS-DOCZAMU - QUESTIONARIO SULLA PERCEZIONE DEI FENOMENI NATURALI

Gent.ma/mo,

l'Università d'Aix-Marsiglia e la Fondazione MEDSEA nell'ambito del progetto MARISTANIS - DOCZAMU stanno conducendo un'indagine sulla percezione dei fenomeni naturali.

Lo scopo di questo questionario è quello di raccogliere informazioni utili a favorire una gestione integrata delle zone umide costiere. A tal fine Le chiediamo la cortesia di compilare il seguente questionario riguardante la sua percezione.

Tutte le risposte sono UGUALMENTE IMPORTANTI e NON VI SONO RISPOSTE CORRETTE O SBAGLIATE. Non abbiamo bisogno del Suo nome o dei Suoi dati di contatto. Tutte le risposte rimarranno ANONIME ed i dati saranno utilizzati solo ai fini della ricerca scientifica.

Il titolare dei dati e il responsabile del trattamento dei dati è Ante Ivcevic che può essere contattato al seguente indirizzo e-mail: ante.ivcevic@univ-amu.fr.

Grazie per la gentile collaborazione.

1. Secondo la sua opinione, quali dei seguenti fenomeni naturali potranno verificarsi in futuro nel Comune in cui risiede ora? Risponda in base alla scala seguente:

1	2	3	4	5
È altamente improbabile che possa verificarsi	È poco probabile che possa verificarsi	Non so	È molto probabile che possa verificarsi	Si è già verificato

Siccità	1	2	3	4	5
Alluvione	1	2	3	4	5
Frana	1	2	3	4	5
Tempesta costiera/mareggiata	1	2	3	4	5

Ondata di calore	1	2	3	4	5
Terremoto	1	2	3	4	5
Cambiamento climatico	1	2	3	4	5
Erosione costiera	1	2	3	4	5
Incendio boschivo naturale	1	2	3	4	5
Sollevamento del livello del mare	1	2	3	4	5

2. Ha mai avuto esperienza diretta nella sua vita di una calamità naturale?

<sub>1</sub> Sì <sub>0</sub> No

3. Conosce qualcuno a Lei caro che ha avuto esperienza di una calamità naturale?

<sub>1</sub> Sì <sub>0</sub> No

4. Ha mai adottato qualche precauzione, come delle tecnologie (per es. uso di materiali da costruzione più resistente, sistemi domotici, parafulmini...), che permetta di evitare i danni derivanti da un possibile fenomeno naturale?

<sub>1</sub> Sì <sub>0</sub> No

5. Ha mai partecipato a corsi d'emergenza, di sicurezza, antincendio, ecc. o adottato comportamenti che permettano di evitare i danni che potrebbero derivare da un possibile fenomeno naturale?

<sub>1</sub> Sì <sub>0</sub> No

6. Ha mai partecipato ad attività informative e di sensibilizzazione sui fenomeni naturali?

<sub>0</sub> No, mai (-> andare alla domanda n. 7)

<sub>1</sub> Sì, mi è capitato

6a. Se sì, chi ha organizzato l'attività (Comune, Associazioni, Scuola, Circoli...)?

\_\_\_\_\_

7. In generale, quanto considera possibile che si verifichino delle calamità nel suo Comune?

1	2	3	4	5
Inesistente	Basso	Moderato	Alto	Molto Alto

8. Quanto ritiene che il suo Comune sia esposto a calamità rispetto ad altri Comuni costieri della Sardegna?

1	2	3	4	5
Molto meno degli altri	Un po' meno degli altri	Come gli altri	Un po' più degli altri	Molto più degli altri

9. Quanto è d'accordo o in disaccordo con le seguenti affermazioni? Dopo aver letto ogni affermazione, indichi il suo grado di accordo/disaccordo utilizzando la scala da 1 a 5.

Completamente in disaccordo	Abbastanza in disaccordo	Né d'accordo né in disaccordo	Abbastanza d'accordo	Completamente d'accordo
1	2	3	4	5

Sono orgoglioso di vivere in questo Comune	1	2	3	4	5
Credo di non essere sufficiente informato sulle calamità naturali	1	2	3	4	5
Mi considero una persona a cui sta a cuore l'ambiente	1	2	3	4	5
Non mi identifico con gli abitanti della mia comunità	1	2	3	4	5
Mi dispiacerebbe se dovessi cambiare vicinato	1	2	3	4	5
Mi considero coinvolto nelle attività ambientale del mio comune	1	2	3	4	5
Gli abitanti del mio Comune non hanno a cuore l'ambiente	1	2	3	4	5
Mi dispiacerebbe se dovessi trasferirmi in un altro Comune	1	2	3	4	5
Penso che questo Comune non sia un bel posto in cui vivere	1	2	3	4	5
Gli abitanti del mio comune possono accedere facilmente a tutte le informazioni utili sulle calamità naturali.	1	2	3	4	5

10. In questa tabella sono indicate alcune fonti di informazione sui *fenomeni naturali*. Indichi quanto è rilevante ogni fonte utilizzando la scala da 1 a 5.

1	2	3	4	5
Per niente importante	Poco importante	Mediamente importante	Abbastanza importante	Molto importante

Media tradizionali (radio, televisione e giornali)	1	2	3	4	5
Internet	1	2	3	4	5
Social network	1	2	3	4	5
Parenti, amici e conoscenti	1	2	3	4	5
Il Comune	1	2	3	4	5
Scuola e l'Università	1	2	3	4	5
Associazioni di volontariato e ambientali	1	2	3	4	5

11. Quanto ritiene di essere informato su ciascuno dei seguenti fenomeni naturali? Risponda seguendo la scala seguente:

1	2	3	4	5
Per nulla	Poco	Mediamente	Abbastanza	Molto

Siccità	1	2	3	4	5
Inondazione	1	2	3	4	5
Frana	1	2	3	4	5
Tempesta costiera/mareggiata	1	2	3	4	5
Ondata di calore	1	2	3	4	5
Terremoto	1	2	3	4	5
Cambiamento climatico	1	2	3	4	5
Erosione costiera	1	2	3	4	5
Incendio boschivo	1	2	3	4	5
Sollevamento del livello del mare	1	2	3	4	5

12. Quanto considera utile la diffusione di informazioni sui fenomeni naturali?

1	2	3	4	5
Per nulla	Poco	Mediamente	Abbastanza	Molto

13. In questa tabella sono indicate alcune affermazioni che riguardano i fenomeni naturali. Dopo aver letto ogni affermazione indichi se considera l'affermazione vera, falsa o se non è in grado di indicarlo (non so).

	Falso	Vero	Non so
L'inappropriata gestione del territorio in combinazione con i cambiamenti climatici può intensificare la siccità e portare alla desertificazione.	0	1	2
In Sardegna non esiste un reale pericolo di alluvioni perché le alluvioni possono accadere solo se viviamo vicino a grandi fiumi che non sono presenti sull'Isola.	0	1	2
Il rischio di frane aumenta per via della deforestazione, dell'attività agricola e dalle costruzioni.	0	1	2
Le zone umide costiere sono tra la nostra prima difesa contro le tempeste perché rallentano la velocità del vento.	0	1	2
L'aumento delle ondate di calore con elevata umidità è un fenomeno che non interessa le regioni costiere perché beneficiano della brezza del mare.	0	1	2
Visto che la Sardegna ha il più basso rischio sismico in Italia, il pericolo dei terremoti è di nullo sull'Isola.	0	1	2
Le attività industriali e agricole emettono enormi quantità di gas serra, tra cui vapore acqueo, anidride carbonica e metano nell'atmosfera.	0	1	2
L'erosione costiera è un processo molto lento che richiede centinaia di anni e non è correlato all'aumento del livello del mare e alla frequenza delle tempeste.	0	1	2
Si stima che la maggioranza degli incendi siano causati da fulmini e altri eventi naturali.	0	1	2
Brucciando combustibili fossili aggiungiamo sempre più gas serra alla nostra atmosfera, il mondo diventa sempre più caldo e il livello del mare continua a salire.	0	1	2

14. Nella seguente tabella, troverà diversi elementi che contribuiscono a ridurre o evitare le calamità.

Indichi quanto si fida di ciascuno di essi utilizzando la scala da 1 a 5:

1	2	3	4	5
Per niente	Poco	Mediamente	Abbastanza	Totalmente

Scienza e teorie scientifiche	1	2	3	4	5
Governo regionale	1	2	3	4	5
Nelle istituzioni pubbliche coinvolte nella gestione di questi eventi (Regione, Protezione Civile...)	1	2	3	4	5
Negli scienziati	1	2	3	4	5
Nei media	1	2	3	4	5
Associazioni ambientaliste (Legambiente, Gruppo d'Intervento Giuridico onlus,...)	1	2	3	4	5



Governo nazionale	1	2	3	4	5
Istituzioni di ricerca e Università	1	2	3	4	5

15. Secondo Lei, l'UOMO quanto è responsabile delle occorrenze di fenomeni naturali? Risponda in base alla scala seguente:

1	2	3	4	5
Per nulla	Poco	Mediamente	Molto	Completamente

Siccità	1	2	3	4	5
Inondazione	1	2	3	4	5
Frana	1	2	3	4	5
Tempesta costiera/mareggiata	1	2	3	4	5
Ondata di calore	1	2	3	4	5
Terremoto	1	2	3	4	5
Cambiamento climatico	1	2	3	4	5
Erosione costiera	1	2	3	4	5
Incendio boschivo	1	2	3	4	5
Sollevamento del livello del mare	1	2	3	4	5

16. Secondo Lei, l'Uomo è in grado di intervenire per ridurre i danni causati dai fenomeni naturali?

1	2	3	4	5
Per nulla	Poco	Mediamente	Molto	Del tutto

17. In questa tabella sono indicate alcune affermazioni che riguardano "il cambiamento climatico". Dopo aver letto ogni affermazione indichi il suo grado di accordo/disaccordo utilizzando la scala da 1 a 5.

1	2	3	4	5
Completamente in disaccordo	Abbastanza in disaccordo	Né d'accordo né in disaccordo	Abbastanza d'accordo	Completamente d'accordo

Ho sentito parlare spesso di cambiamento climatico	1	2	3	4	5
Non credo che il cambiamento climatico esista e sia un problema serio	1	2	3	4	5
Sentiamo già gli effetti del cambiamento climatico in Sardegna	1	2	3	4	5
Non abbiamo bisogno di preoccuparci troppo del cambiamento climatico perché viviamo in Sardegna	1	2	3	4	5
Nei prossimi decenni molti animali e piante che vivono nei mari e nelle coste saranno estinti a causa dei cambiamenti climatici	1	2	3	4	5

Le attività economiche dei Paesi sviluppati non influenzano il cambiamento climatico	1	2	3	4	5
Gli effetti dei cambiamenti climatici nella mia Regione si verificheranno nei prossimi 25 anni	1	2	3	4	5
Credo che l'uomo con le sue attività abbia una grande responsabilità per quanto riguarda il cambiamento climatico	1	2	3	4	5
I cambiamenti climatici sono un problema solo nei Paesi in via di sviluppo	1	2	3	4	5
Penso che il cambiamento climatico sia dovuto esclusivamente a processi naturali	1	2	3	4	5
Ritengo che non si verificherà nessun effetto dannoso dovuto al cambiamento climatico	1	2	3	4	5

18. Quanto ritiene i seguenti fenomeni naturali causati dal cambiamento climatico? Risponda seguendo la seguente scala da 1 a 5:

1	2	3	4	5
Per nulla	Poco	Mediamente	Molto	Completamente

Siccità	1	2	3	4	5
Inondazione	1	2	3	4	5
Frana	1	2	3	4	5
Tempesta costiera/mareggiata	1	2	3	4	5
Ondata di calore	1	2	3	4	5
Terremoto	1	2	3	4	5
Erosione costiera	1	2	3	4	5
Incendio boschivo	1	2	3	4	5
Sollevamento del livello del mare	1	2	3	4	5

19. Quali soluzioni sarebbe necessario adottare per ridurre i danni provocati dai fenomeni naturali nel suo Comune? Risponda, indicando quanto ritiene utili le soluzioni proposte, seguendo la seguente scala da 1 a 5:

1	2	3	4	5
Per nulla	Poco	Mediamente	Abbastanza	Molto

Aumentare gli spazi verdi	1	2	3	4	5
Ridurre le minacce sugli ecosistemi marini	1	2	3	4	5

Cambiare il comportamento dei cittadini	1	2	3	4	5
Costruire argini e dighe	1	2	3	4	5
Migliorare i sistemi di identificazione delle zone a rischio	1	2	3	4	5
Realizzare una gestione integrata delle zone umide costiere	1	2	3	4	5
Applicare le norme sismiche agli edifici	1	2	3	4	5
Proteggere le zone umide marino costiere	1	2	3	4	5
Migliorare le leggi e i regolamenti sulla tutela ambientale	1	2	3	4	5
Creare più enti come la Protezione Civile per un maggiore controllo degli eventi	1	2	3	4	5
Aumentare le Campagne informative per “la sensibilizzazione”	1	2	3	4	5
Gestire ed utilizzare in maniera efficiente le risorse idriche	1	2	3	4	5
Altro:	1	2	3	4	5

20. Quali misure è personalmente disposto a prendere per combattere i fenomeni naturali?

1	2	3	4	5
Per nulla	Poco	Mediamente	Molto	Completamente

Trasferirmi in un altro comune	1	2	3	4	5
Ridurre la quantità di rifiuti prodotti e differenziare tutti i giorni	1	2	3	4	5
Utilizzare più spesso i mezzi pubblici	1	2	3	4	5
Mangiare più cibo biologico e meno carne	1	2	3	4	5
Trasferirmi in un'altra regione	1	2	3	4	5
Nessuna misura, perché penso che le mie azioni non possano influire sul verificarsi dei calamità futuri	1	2	3	4	5

21. Immagina che l'Unione Europea promuova nei prossimi anni una politica di protezione contro il cambiamento climatico. Quale opzione sceglierebbe per la sua protezione personale?

A	B	C	D	E	F
Nessuna, mi accontenterei del risarcimento pubblico anche se ridotto	Preferirei investire in infrastrutture che proteggano maggiormente le mie proprietà e la mia persona	Sceglierei un'assicurazione da stipulare al momento del mutuo per l'acquisto delle proprietà	Poiché il cambiamento climatico è causato dal comportamento di tutti, ci dovrebbe essere un'assicurazione obbligatoria per tutti	A quel punto preferirei andare a vivere in un luogo più sicuro	Sceglierei un'assicurazione che protegga i miei beni, me stesso e i miei familiari, valutando sul mercato l'opzione migliore

Le chiediamo infine alcune altre informazioni socioeconomiche

22. Genere <sub>0</sub> M <sub>1</sub> F

23. Quanti anni ha? \_\_\_\_\_

24. Quale titolo di studio possiede?

- <sub>1</sub> Nessuno <sub>2</sub> Scuola elementare  
<sub>3</sub> Scuola media inferiore <sub>4</sub> Diploma  
<sub>5</sub> Laurea Umanistica <sub>6</sub> Laurea Socio-Economica  
<sub>7</sub> Laurea in Ingegneria o Scientifica <sub>8</sub> Titolo Post Lauream

25. In quale categoria rientra la sua professione?

- <sub>1</sub> Lavoratore autonomo <sub>2</sub> Lavoratore dipendente  
<sub>3</sub> Lavoratore atipico <sub>4</sub> Casalinga  
<sub>5</sub> Disoccupato <sub>6</sub> Pensionato  
<sub>7</sub> Studente <sub>8</sub> Altro (specificare) \_\_\_\_\_

25a. In quale settore lavora o ha lavorato?

- <sub>1</sub> Agricoltura <sub>2</sub> Pesca  
<sub>3</sub> Gestione forestale <sub>4</sub> Gestione delle risorse idriche  
<sub>5</sub> Turismo <sub>6</sub> Settore energetico  
<sub>7</sub> Altro (specificare) \_\_\_\_\_

26a. Da quante persone è composto il Suo nucleo familiare, Lei compreso? \_\_\_\_\_

26b. Ha figli? <sub>1</sub> Sì <sub>0</sub> No

26c. Nella Sua famiglia vi sono bambini fino a 12 anni? <sub>1</sub> Sì <sub>0</sub> No

27a. In che zona del Comune ora vive?

- <sub>1</sub> Centro Storico <sub>2</sub> Centro  
<sub>3</sub> Periferia <sub>4</sub> Zona residenziale/Zona di nuova edificazione  
<sub>5</sub> Frazione campestre o a mare <sub>6</sub> Altro (specificare) \_\_\_\_\_

27b. A che distanza dal mare vive? \_\_\_\_\_ m dal mare

28. Il reddito netto annuo del Suo nucleo familiare è compreso tra:

- <sub>1</sub> 0 e 15.000 euro <sub>2</sub> 15.000 e 30.000 euro <sub>3</sub> 30.000 e 45.000 euro  
<sub>4</sub> 45.000 e 60.000 euro <sub>5</sub> 60.000 e 75.000 euro <sub>6</sub> oltre 75.000 euro



29. Immagina che Lei obbligatoriamente debba stipulare un'assicurazione contro i calamità derivante dal cambiamento climatico (ma non dagli altri rischi naturali visti in precedenza) per tutelare l'abitazione in cui vive. Ipotizza che questa assicurazione si paghi una volta all'anno in base alle caratteristiche della sua abitazione e che anche chi vive in affitto si debba assicurare.

29a. In che tipo di abitazione vive?

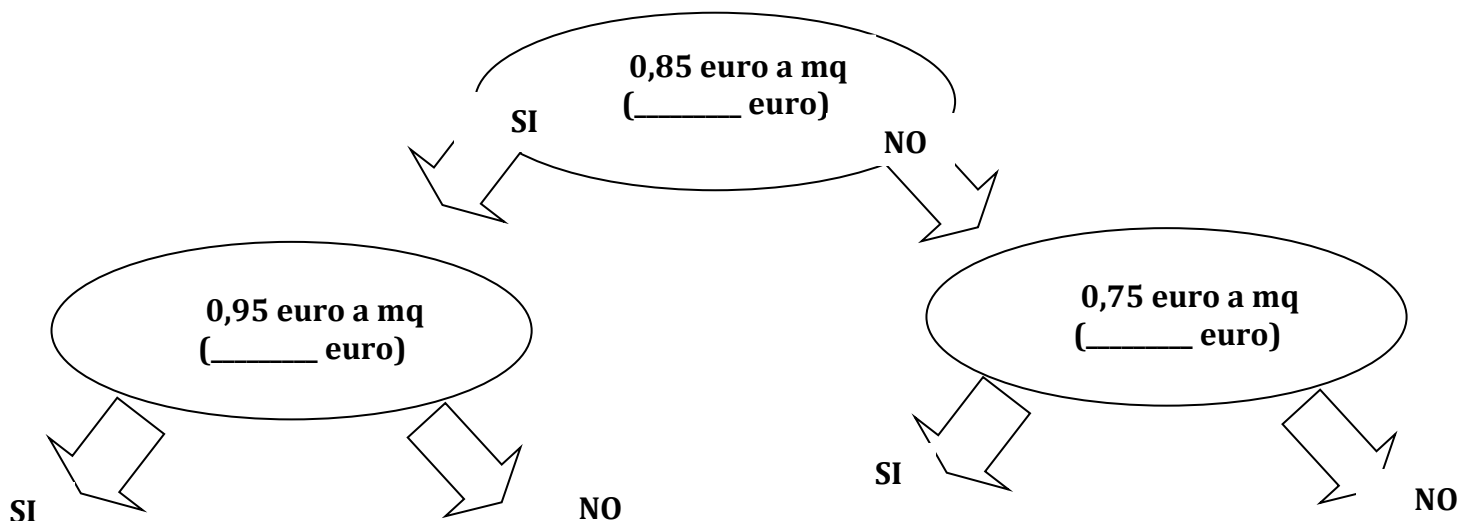
- <sub>1</sub> Appartamento in condominio <sub>2</sub> Casa bifamiliare (semi indipendente)  
<sub>3</sub> Casa a schiera <sub>4</sub> Casa singola  
<sub>5</sub>Altro (specificare)\_\_\_\_\_

29b. Vive in affitto? <sub>1</sub> Sì <sub>0</sub> No

29c. Quanti metri quadri occupa la sua abitazione? Circa\_\_\_\_\_

29d. Quanti anni ha la sua abitazione? \_\_\_\_\_

Se dovesse pagare un'assicurazione pari a: ... al metro quadro sarebbe disposto a pagare? E si vi propongono...saresti disposto a pagare...?



29e. (Se ha scelto NO due volte) Per quale motivo ha rifiutato entrambi i prezzi proposti:

\_\_\_\_\_

30. Qual è la cifra più elevata che sarebbe disposto a spendere all'anno per assicurare la sua casa contro le calamità derivante dal cambiamento climatico? \_\_\_\_\_ euro all'anno

## C. Verbatim records

### 1. *Male Administrator, 55, Oued Laou*

Orsec est le program provincial et leur seul cadre prévu, pour les urgences, surtout pour les inondations. En réalité les partenaires de terrain ne respectent pas quand la commune se met en alerte par le message de ministre d'intérieur. Le centre de protection civile (ouvert il y a 2 mois) les pompiers intégrés. Ils ont les relations avec ABHL, ils font partie de travail commun selon l'urgence (d'Orsec), mais les urgences sont un champ délicat/précis. Dans leur proximité il y a une rivière et un barrage donc ils ont un risque. Les inondations n'étaient pas récemment, il y a quelques années pour la dernière fois. Quand ils voulaient construire un port d'embarquement juste à côté de la plage et ABHL a refusé. Il y a message, alerte, intervention. A l'école il n'y a aucune sensibilisation. Même à la mosquée, qui est une vitrine, dans le discours de vendredi, jamais un discours sur les risques était évoqué. Donc il n'y a rien, absence totale. Ils dépendent d'agence d'urbanisme de Tétouan et contrairement aux eux il dit que dans les constructions ils relativement obéissent la réglementation (suivent la loi après le tremblement de terre d'Al Hoceima). La commune est très touristique et l'année quand ils ont déclaré l'urgence sismique la saison estivale était la plus basse. Une année pour le festival estival ils ont fait les urgences (boa sur la plage) La population s'informe que sur Facebook, il n'y a pas de site officiel pour l'information. Ils sont 4 fonctionnaires pour 9665 habitants (2014) et pendant été se triple. Pour dynamiser la gestion des risques il faut : on laisse à Dieu. il faut que quelque chose arrive qu'ils réagissent. Ils n'ont pas la grande chose dans leur mémoire même si Orsec les rappelle que l'urgence peut arriver. Dans les années '80 la rivière a débordé, mais sans victimes, donc ce n'est pas une grande chose, alhamdulillah peut arriver ou pas. Mais concernant la construction il pense que les règles sont obéit. On trouve des cas de construction dans la zone inondable. Mais pour ce cas-là les autres, membres d'associations se plaignent et déclarent, sont des cas soulevés et un peu politisées et surtout ne sont pas ici pour le but de sensibiliser. Indicateurs : Wilaya produit l'Orsec et donc il n'a pas d'idée sur les inondations. On peut aller aux gens et leur communiquent que le risque est là, pour qu'ils voient à qui il faut s'adresser. Ils sont les techniciens et ont le message mais c'est vide la stratégie de lien entre la population et eux.

### 2. *Male Administrator, 40, Martil*

Comment il voit le problème du risque : Ils ont vraiment besoin de ces études. Martil est entre deux rivières (deux oueds), existait aussi un port sur la rivière et aujourd'hui le port est disparu. Problème d'immigration anarchique dans le quartier Diza, tout près de littoral > dégradation d'environnement. En 2015 est paru la loi de littoral, avec l'urbanisme et la gestion des risques de littoral en général. Société Amendis fait le prétraitement des eaux usées (déchets liquides). Comme Martil est très basse et plat c'est difficile de gérer les eaux mélangées avec des eaux usées. 'La commune a une convention avec les sociétés et avec l'état donc ce sont eux qui font la suivi et le réaménagement.' Ils ont même réfléchi (années 90) d'augmenter, d'enlever la partie plate et basse de la ville ? Actuellement il y a un grand projet géré par la société Stavom de 166000 ha de terrain d'oued Martil pour réaménager, avec la barrage et les digues pour la lutte contre les inondations. Aussi, le projet d'aménagement de toute la préfecture contre la dégradation du littoral. 'Ici à Martil il n'y a pas de grande risque concernant les inondations'. Dernière inondation à Martil était en 2000, mais sans noyade et sans trop de dégât, donc l'inondation n'est pas trop grand risque. Stavom vise à protéger la population contre les possibles inondations (surtout de quartier Diza) et ABHL lutte contre petite inondation et c'est bien fait. 'Donc la population est sensibilisée, mais sait qu'il ne s'agit pas d'un très grand risque'. Qu'est-ce que manque de point de vue technique pour mieux gérer ? > Il n'y a pas de grande compétence concernant la commune parce que cette grande compétence est d'ABHL donc pour eux ce n'est pas très important. 'La commune n'a pas le budget nécessaire pour faire face de ce grand problème de littoral et d'inondation.' Ils ont très bonne collaboration avec l'université, mais ils ont besoin d'études. La perception : la population est sensibilisée de cette problématique-là, en tout cas 'les communes sont obligées selon la loi (charte communale) et même selon la constitution de sensibiliser la population pour la prévention de différents risques'.

### 3. *Male Administrator, 60, M'Diq*

L'agence d'urbanisme est en train de réaliser une étude sur les risques de province et cela est la nouveauté. Les risques principaux chez eux sont les risques d'inondation et le glissement de terrain (un quartier en haut où la construction est interdite), les tsunamis sont un peu loin d'eux. Il n'y a pas un service spécial pour la gestion de risque, c'est qu'une des tâches. Ils travaillent en collaboration avec les autres institutions, la préfecture de M'Diq-Fnidaq a un bureau spécifique pour les risques, avec la préfecture de Tétouan font partie de wilaya en Tanger. La population concernée par le risque potentiel par ex. glissement ils leur expliquent les risques. Les gens sont conscients d'inondation et ils évitent l'oued parce qu'ils savent ce que se passe là-bas. Récemment quelques constructions étaient démolies et les gens ont compris la gravité. Les inondations sont mieux gérées maintenant avec l'infrastructure avancée et les ouvrages. Il a commencé à travailler ici en 1992 et dans ce temps-là n'était pas possible de venir de Tétouan pendant la pluie forte (route inondée). Aujourd'hui, même avec la forte pluie il n'y a pas d'inondations, c'est la grande différence d'avant. Les gens ne s'intéressent pas aux risques, il y a peu de réclamations à la mairie. 70% de population sont 'pauvres' et pensent même pas aux risques et veulent que leur foyer. Ils ne font pas de réunions avec la population. Par contre, le complexe touristique est bien protégé et bien construit, ~54000 habitants et ça triple pendant l'été. Ils n'ont plus les problèmes avec d'eau, même si l'année dernière ils avaient un peu de coupure d'eau, mais c'est réglé avec les barrages de Smir et deux barrages plus de Tanger. Cela est la tâche de ministère d'équipement. Maintenant très efficace, il est ici pour 25 ans et c'est beaucoup mieux qu'à l'époque, le grand changement dans l'administration marocaine. Quand il souffle le vent fort du nord la marée est haute et s'il pleut, les côtes sont inondées, les eaux montent. Le changement qu'il a remarqué est que la saison de pluie commence à tarder (avant était décembre-janvier, maintenant février-mars). La commune a fait quelques programmes avec les écoliers, nettoyage des côtes, ordures ménagères, il y a quelques programmes. Les indicateurs : pas utilisés, il y a le service spécialisé qui fait ça.

#### 4. *Female Administrator, 60, Al Hoceima*

Elle est à la ville depuis 30 ans et garde très bien les séismes dans sa mémoire. L'histoire des séismes dans la ville est longue, en 1994 de magnitude 4.6, en 2004 la catastrophe en 2:25 de nuit, et en 2016 de magnitude 5 qui était dans la mer et senti dans la ville. 'Après la catastrophe de 2004 la moitié de la population ont demandé l'aide de psychologue.' Elle-même restait avec sa famille pour 1 mois dans la tente ! Concernant les risques, la commune a gaspillé pas mal d'argent sur la falaise de Quemado, pour essayer de gérer l'effondrement future, ils avaient déjà l'effacement d'une partie de la falaise selon l'eau qui coulait. 'Ils travaillent secrètement parce que la population ne s'intéresse pas aux travaux publics de risque, c'est la tache de municipalité.' Ils n'ont même pas communiqué les risques aux habitants de la falaise. Personne n'est conscient de risque de château d'eau potable qui est mal placé et qui pourrait provoquer l'inondation des maisons en bas si un séisme le fera tomber. Les associations ne s'intéressent pas aux risques, après 2004 s'était une quantité énorme des nouveaux ONG, mais qu'ils sont changé leurs orientations vers les sujets socioculturelles après 1-2 années. Parfois il y a la sensibilisation, en gros 1 fois par an, organisée par les bénévoles. C'est la protection civile, qui fait partie de ministère d'intérieur, qui travaille sur le plan technique d'Orsec. En 2016, une heure avant le séisme les mouettes, les chiens et les chats étaient très inquiets. Au niveau scolaire, ils ont un plan d'exécuter au cas de séisme. Ils ont les autocollants indiquant comment agir pendant le séisme. Ils ont les directives à suivre selon le ministère, ex les élèves de 3eme étages doivent rester dans les classes et sous les tables, pour la 2eme et 1ere étage il y a des autres consignes. A part de ça il n'y a pas la sensibilisation avant/après la catastrophe. 'On ne sait pas quand un séisme va arriver, c'est la volonté de Dieu, mais on fait ce qu'on peut, chacun dans son domaine, on suit les normes de construction.' Pendant la catastrophe, il y a toute une équipe de commission provinciale d'intervention d'urgence qui se regroupait. Pour donner l'avis sur l'état des maisons c'est Laboratoire Public d'Essais et d'Etudes qui était en charge de constater le dégât et décider l'aide, c'était l'aide de 30 000 DH pour les maisons détruits, donc ils connaissent bien les points noirs. 'La sensibilisation par la municipalité est le point essentiel.' Ils donnent la notice publique sur le Facebook et le radio. C'est le même niveau de la population de la ville et de campagne, comme la ville d'Al Hoceima est la nouvelle ville de 1925.

#### 5. *Male Administrator, 45, Rabat*

Le développement durable est partout, mais c'est que ajouté. 'Smart cities' par exemple peuvent marcher en Scandinavie, mais pas au Sud, il y a trop d'autres problèmes et cela n'est pas une priorité. La question que se pose est si on peut parler de développement durable face aux puissances mondiales qui polluent trop ? Les priorités sont les risques qui influencent la qualité de vie aux citoyens, comme par exemple à Tétouan le risque de manque d'eau potable pendant l'été. A côté de Larache, sur l'Atlantique, à la sortie de la ville, à côté des vestiges historiques Lixus est une grande complexe touristique avec des villas et du golfe, et on va l'impact du tourisme sur l'équilibre de la biodiversité et du sol déjà fragile. Mais ce sont des phénomènes que les autorités ne savent pas à vulgariser pour ne pas créer la frustration. La zone de Larache est très importante pour le secteur agricole. La zone se consiste de deux

volets, littoral septentrional avec des sols très fragiles, et intérieur relief très fertile. Le sol fragile au littoral peut même produire un risque pour l'aménagement touristique. Les actions sur les risques et sur la sensibilisation aux risques : le Maroc s'est positionné comme l'élève assidu pour la lutte contre le changement climatique et pour la protection de l'environnement au sein du COP21. L'Etat est bien impliqué, les pavillons bleus, les institutions,... avec les formations spécifiques à la sensibilisation, les ateliers organisés, même les initiatives de construire les écoles écologiques, construction de pierre local, comment mieux utiliser l'énergie. Donc la prise de conscience est là et il ne faut pas la négliger, en plus avec l'installation de Fond de lutte contre les risques naturels. Mais il ne faut pas frustrer les populations, les gens qui ont besoin d'un traitement particulier. Il faut pas être très direct, il faut même pas leur communiquer les enjeux. Il faut aller doucement avec la sensibilisation, d'abord c'est l'école. L'Etat n'a pas d'argent pour un plan B. Le Maroc est en pleine mutation démocratique et institutionnel et ils sont en train de développer les plans de développement régional pour chaque région, dans tous les niveaux, et tout doit aller progressivement au niveau du territoire. La mosquée est le premier centre de sensibilisation, c'est un synonyme pour la sensibilisation, avec les points de déblocage pour la population. Mais il faut revoir la législation car il y a encore des lois du temps de protectorat. Et bannir les constructions des zones au risque. Mais où on va mettre la population quand on la déloge ? Mais Maroc n'a pas des moyens. Il faut protéger les forêts et les espaces naturelles et la population, mais avec quels moyens ? Il faut que l'Etat intervienne plus en terme de réglementation, développement urbain et en terme de protection de l'environnement, mais il faut des moyens. La région du Nord, avec la côté littoral et côté relief avec de la culture du cannabis. Il y a des petits résultats de convertir cette culture vers l'agriculture. Mais les difficultés sont économiques car au lieu de gagner 50€ par jour en produisant du cannabis, les gens ne peuvent pas gagner ça en produisant des tomates, mais quand même il y a de progrès. Et il y a du tourisme et le développement du littoral bétonné. Est-ce que la population va accepter les changements au pas, pour cela l'Etat préfère de freiner un peu pour voir l'évolution des choses dans le futur. Déjà le port de Tanger Med a changé beaucoup la région. Mais il faut attendre des années pour voir des résultats et de les lire et de déchiffrer, avec les indicateurs officiels. « Tout ça est encourageant, il y a d'effort, mais ce n'est pas encore suffisant, il y a encore de travail à faire. » Nous ne travaillons pas encore sur les risques au sein de développement digitale, il y a un peu pour les orages au niveau d'Atlas et les incendies, parce que Maroc est rarement touché par les incendies de grande superficie, l'espace forestier n'est pas tellement large, c'est encore gérable. Mais ça viendra un jour. Nous travaillons dans l'administration, en développant le gouvernement digitale, en économie et en inclusion sociale, en formant des nouvelles générations.

#### 6. *Male Administrator, 55, Tetouan*

L'agence urbaine prend en compte la question des risques dans le cadre du schéma directeur, et d'autres documents d'urbanisme, ainsi que pour les avis de conformité. Cette question du risque est prise en compte seulement depuis quelques années (dernières 5 ans) sous deux formes : aptitude à l'urbanisation et zonage (donc interdiction). Une étude sur l'aptitude a en particulier été réalisée sur le terrain montagnard de Chefchaouen. Il faut comprendre que la ville se développe hors plan, de manière non réglementaire, donc certains zones ont un développement très vulnérable. Mais cette question du risque n'est pas un problème réglementaire, ni institutionnel, ni scientifique, c'est un problème de sensibilisation des populations. La population n'est pas susceptible, elle veut construire. Les urbanistes n'ont pas d'expérience dans ce thème de la sensibilisation. Les associations de quartier l'ont beaucoup plus, l'accompagnement au niveau des quartiers serait plus efficace. Et le fondamental c'est l'éducation à l'école, c'est un problème pédagogique. Il n'y a pas de sensibilisation donc la population ne comprend pas la nécessité de délocalisation. Les marocains sont très attachés à leur territoire. Il faut donc un accompagnement social et économique (expérience de la construction d'un barrage par exemple) mais cet accompagnement n'existe pas, vous avez que la décision administrative et un délai pour vous déménager de la zone inondée. Nous travaillons seulement du point de vue réglementaire. Les enjeux sont très forts dans la région, Tétouan est proche de faille, d'inondation (Martil) et avec les plusieurs glissements de terrain. Mais il n'y a pas de mesures engagées sauf sur les documents d'urbanisme. Alertes précoces : le seul dispositif se situe sur les zones inondables, fait par ABHL. Urgences : centralisé, c'est le gouvernorat de Tétouan, les plans inclus. Indicateurs/Variables : les études sont faites par des bureaux d'études et des consultants : il n'y a pas de norme nationale, chacun développe sa propre méthodologie. Séismes et glissement de terrain : il n'y a pas de critère ni d'orientation dans les cartes d'aptitudes. Nous sommes au début de la réflexion dans les documents d'urbanisme. Il faudrait superposer cette carte d'urbanisme avec une carte générale des risques, ce qui n'a pas encore été fait. Sur les constructions : l'antisismique coûte cher, donc il est réservé à certains types d'immeubles. Il est difficile de faire appliquer la réglementation. Les matériaux ne sont pas normalisés au Maroc, donc on ne sait pas avec quoi on construit, on construit avec ce qu'il est sur le marché. Le passage par un architecte ou un ingénieur (béton) est obligatoire, mais le matériel utilisé peut être hors norme. La Protection Civile fait un contrôle sur la sécurité extérieure des bâtiments. Les politiques internationales (UNDRR) ne sont pas connues, ou « ne sont pas encore arrivées jusqu'à la commune ou échelle régionale ». Cadre très général, nécessitant une contextualisation. Les enquêtes : faire d'abord au niveau de l'administration et les institutions pour voir s'ils sont sensibilisés à leur tâche



quotidienne, avant de les faire auprès de la population. La prise en considération est très récente, et il est nécessaire de connaître le point de vue des techniciens, avant celui des populations.

#### 7. *Female Administrator, 35, Al Hoceima*

Madame est dans la ville depuis 6 ans, en parlant de travail d'agence elle se servait avec une présentation, en montrant les cartes pour mieux expliquer. Les risques principaux dans la province sont le risque sismique, le glissement de terrain et l'inondation. Après le séisme de 24 février 2004 la carte d'aptitude est élaborée par un institut français : IMS RN (Ingénierie des mouvements de sol et des risques naturels) et ici ils travaillent avec ça. C'est pareil au PPR français (Plan de Prévention des Risques). Le terrain de la province est coloré selon l'aptitude à la construction (rouge : terrain inconstructible ; violet : les constructions sont autorisées, mais avec l'aménagement stricte ; bleu : les conditions plus soft ; blanc : aucune restriction). Le risque d'inondation aussi existe, en 2008 ils ont eu une inondation sévère, les oueds sont pris en considération et la construction n'est pas autorisée sur les côtes non aménagés. Le risque côtier et le changement de trait de côte est visible dans la région, surtout connu à Azla. Ils diffusent les notices d'information de risque aux gens, 'comment vivre avec le risque, parce qu'on ne peut pas le négliger, mais on peut vivre avec, on peut construire selon le code parasismique'. Le code parasismique est donné pour chaque zone, avec les vitesses, les accélérations. La population garde dans son histoire le grand séisme avec les dégâts considérables. 'C'est pas nouveau, ils commencent de s'habituer avec le code parasismique.' Elle ne voit pas la différence entre les communautés rurales et la commune urbaine parce que le séisme a détruit pas que la ville, mais plus autour. Il y a des cas quand les gens viennent et ne peuvent pas comprendre pourquoi leur terrain n'est pas susceptible à la construction et par contre le terrain de leurs voisins juste à côté est. 'Mais ils acceptent avec le temps, si on fait bon aménagement on peut tout changer'. La sensibilisation est organisée aux communes et aux décideurs, pour les écoles ce n'est pas aux eux. Les indicateurs sont fournis par l'étude, c'était un concours quand on a fait l'appel d'offre, ~50 chercheurs collaboraient dans la production de ce document, carte d'aptitude ensemble avec le plan d'aménagement et d'urbanisme, c'est très clair.

#### 8. *Female Administrator, 40, Rabat*

Pour ne pas être prétentieux, on est réellement dans la prévention. Je suis architecte, qui chapote une grande action de prévention de risque au sein de ministère, dans un service vraiment dédiée à la prévention du risque, pour ne pas être à chaque fois des morceaux. C'est une nécessité incontournable suite à une très grande stratégie au Maroc, la stratégie nationale de gestion intégrée des risques, lancé par le ministère d'intérieur depuis 2008. Oui, elle a pris beaucoup de temps, il fallait faire une belle stratégie qui est au niveau d'hautes attentes internationales, monté sur des vrais piliers, construite doucement mais sûrement, pour être évolutif. Inchallah elle sera adoptée en décembre 2019. Il y a des structures dédiées, chapoté par le ministère d'intérieur, soutenu par le ministère des affaires générales du gouvernement, très à niveau, priorité nationale, il faut des efforts intégrés et intégrale dans les vrais sens du terme. Il y a des départements clés qui sont tout le temps inclus et il y a des départements qu'on appelle au fur et à la mesure. Dans le cadre de cette stratégie, la nôtre structure a réellement démarré que en 2015. Pourquoi la nécessité de créer la structure dédiée? C'était un appel au projet national qui préserve les villes et les biens matériels. Pour s'inscrire dans cet appel à projets, très incitatif par le Fond de lutte contre les catastrophes naturelles, qui pouvaient attendre à la hauteur de 50% de financement du projet, donc il fallait saisir cette opportunité des appels au projet. Et donc, le ministère, comme il y a un programme gouvernemental de 2016 à 2021 de couvrir l'ensemble de territoire par les cartes d'aptitude à l'urbanisme, par les 31 cartes d'aptitude à l'urbanisation, donc déjà il y a un engagement gouvernemental, après la stratégie de financement de 30 à 50% des projets et la troisième, une nécessité vitale dans la vision stratégique de résilience du territoire, et cela doit converger pour la prévention et après outre la prévention. Pour l'instant on est dans la prévention, donc on a lancé 10 cartes d'aptitude depuis 2015, et 21 autre depuis 2017 et ce sont des références incontournables pour la planification urbaine. Ce n'est plus un luxe, c'est une nécessité vitale. Premières 10 cartes était pour les préfectures et régions de tout royaume et après on a décidé de cibler mieux l'échelle pour les zones plus vulnérables, on est allé dans les aires urbaines pour changer l'échelle, peut-être la superficie n'était pas vraiment un très bon indicateur, justement c'est l'échelle. On a 12 régions au Maroc, on est en train de couvrir 9 régions pour l'instant, et parmi les régions que seraient prochainement déclarés résilientes est la région de Nord du Maroc, Tanger (Tétouan) Al Hoceima. Les cartes sont réalisées par les appels d'offre ouverts. Les cartes sont très coûteuses, d'abord la carte d'Al Hoceima était sur l'instruction royale, car l'enjeu était très élevé, et l'expertise était très rare. Alhamdulillah l'expertise devient avec du temps de plus en plus élargie, des experts internationaux et marocains. Vue l'importance du projet, l'élaboration de 21 cartes, après les 10 initiales, est passé par voie direct sans appel de projet. Lors de la sélection on sentait que la priorité de priorité étaient les projets non structurels, comme la mesure préventif. Donc entre 2015 et 2019 avec 31 carte on a bien avancé avec les cartes et oui, maintenant, le suivi... On est un petit peu vraiment dans alhamdulillah, on essaie, on a un comité restreint technique

qui est en train de suivre, avec des personnes qui ont déjà l'expérience dans la suivi, donc on essaie au niveau du ministère. Normalement les cartes sont faites, logiquement, elles ne sont pas opposables, c'est du référentiel technique incontournable, soit on les intègre dans les documents automatiquement, soit les documents sont actualisés en fonction de la carte. C'est la seule option. Étant donné que pour les rendre opposable il faut passer des années et des années. Donc elles sont intégrées à travers des documents d'urbanisme directement ou en actualisant des documents existants. Donc c'est très jouable et faisable. Elles sont prises en considération lors de l'élaboration des documents. En attendant il y a des cartes d'ABH, des agences des bassins hydrauliques, qui sont très prises en considération, et lorsque la carte existe elle est automatiquement intégrée. Alors, les indicateurs, le mot indicateur, selon le MOP, le manuel opérationnel de programme de gestion des risques, qui a été imposé par le ministère d'intérieur, qui décline l'ensemble de modèles, pour élaborer les projets, et parmi les lignes était de s'inscrire dans les 4 aléas : sismique, inondation, submersion marine (phénomène côtier) et le mouvement du terrain. Donc on essaie de répondre à 4 aléas qui sont concernés par les appels aux projets. C'est vrai que pour les premiers 5 projets on n'a pas considéré la submersion marine, mais on s'est rattrapé pour les autres. En traitant des aléas on peut effectivement parler des indicateurs, c'est vrai ? Pour nous la phase des indicateurs ça serait la troisième phase, nous ne sommes pas encore arrivés là. Quand vous parlez d'indicateurs, est-ce que vous les liez à un impact ? La récurrence d'impact est très importante, fondamentale. On est vraiment dans la cartographie. Par contre, l'idée est que les cartes d'aptitudes restent, je ne peux pas dire, insuffisantes, l'idée est de les utiliser pour la carte de constructibilité, ce qu'est bien différent, et qu'est un outil réel de prise de décision. Je ne sais pas si c'est lié aux indicateurs, mais pour nous c'est l'étape suivante inshallah. Parce que, pour notre étude pilote d'Al Hoceima, il y a la carte d'aptitude qui existe, elle est opérationnelle, mais la carte est là et les gens quand même construisent. La constructibilité est un indicateur. L'OCDE a préparé une très belle étude au Maroc, publiée en 2016, qui a traité l'ensemble de 4 cycles de gestion de risque, avec 31 recommandations à faire. Réellement, la lacune de carte d'aptitude est l'indicateur de constructibilité. Pour cela, le 1er novembre, nous allons accueillir les experts de Banque mondiale pour discuter la normalisation et l'évaluation de constructibilité. Maintenant les cartes sont là, est-ce qu'on les applique, est-ce qu'on les considère dans les cartes de constructibilité réellement, on a des règlements parasismiques et est-ce qu'on les applique, la contrainte, est-ce qu'on contrôle juste après, les autorisations de construire, est-ce qu'elles sont vraiment exigeantes. Beaucoup de questions à traiter, et ce sont des indicateurs. Il y a de la matière à faire, mais on est dans la bonne voie. De notre part c'est la cartographie de risque et on compte inshallah très prochainement sur une étude de vulnérabilité liée au changement climatique et pour les mesures d'adaptation au changement climatique. Lors de la réunion en Suisse au mois de mai on a vu l'état d'avancement de stratégie de Sendai, et le Maroc est placé dans la position de force parmi les pays arabes. Oui, on travaille dans la très étroite collaboration avec la politique d'engagement international de Sendai. C'est lié dans tout les sens, sauf que les indicateurs de Sendai sont dans l'échelle macro, les politiques publiques et les stratégies, mais là on n'entre pas dans le détail. Les événements, 3 ou 4 par la suite, au sud du Maroc, ont provoqué la rage auprès l'ancien ministre, et il leur a demandé le rapport pourquoi cet événement, par la faute d'agence d'urbanisme de donner l'autorisation ou parce que les gens n'ont pas suivi la procédure et les règles. Et le changement climatique qu'on ressent sont qu'on n'a pas plus 4 saisons mais chaude-froide, concernant cela est le logiciel Mhnpa pour détecter les zones les plus vulnérables, pour nous c'est le référentiel. Surtout le Nord, notre cas partenariat, la convention avec le ministère d'intérieur pour la suivi de cette carte, avec le comité local du suivi gouverné par le wali et le gouverneur qui sont des vrais porteurs de ces cartes d'aptitude, les réunions de restitutions locales, tout, vraiment tout est au niveau local, sous la présidence locale et avec l'ensemble des acteurs locaux, rien ne se passe au niveau central qui juste lance et qui est le maître d'ouvrage. Des fois pour déclencher un comité local il faut attendre des mois, mais ça n'empêche pas d'avancer avec ce qu'on a.

#### 9. *Male Scientist, 50, Martil*

La gestion des risques est le thème d'actualité, surtout le 3200 km de littoral marocain. Le problème est que plusieurs ministères gèrent le littoral ce qui constitue un problème : public, intérieur, pêche, commune, et donc eux ils gèrent ce qu'ils peuvent (ils agissent ensemble avec la préfecture ou wilaya s'il faut). Il y a beaucoup de problèmes concernant le littoral, surtout l'impact de changement climatique et la pression démographique. Martil est la petite commune qui n'a pas des moyens pour mieux gérer le risque d'inondation. L'autre problème est la pollution. La qualité d'environnement est influencée par des déchets liquides et solides, leur partenaire est Amendis qui fait l'assainissement des liquides car la région est connue pour l'industrie et habitats libres où les déchets liquides ne sont pas traités et cela influence la qualité d'environnement et du littoral. Société Techmed fait la gestion des déchets solides. Ils coordonnent avec leur préfecture M'Diq-Fnideq au jour d'inondation, les données sont chez les universitaires, mais ils s'intéressent à la gestion quotidienne. Aussi un grand problème est l'exploitation anarchique du sable qui provoque la fragilisation du littoral (quartier au sud, Diza, 12000 habitants, une partie de quartier est au-dessous de la mer et régulièrement inondée). La forte pression sur littoral est l'érosion, la salinisation du sol, la pollution, et l'impact de changement climatique avec les fortes pluies ils ont les inondations, avec le risque que les

gens se noient, ex quartier Diza qui est au-dessous de niveau de la mer. La forte immigration de partout de Maroc > la pression démographique donne l'habitat anarchique que provoque la manque d'assainissement et la manque d'urbanisation ! Ils au niveau de la commune ne travaillent pas sur les documents mais la gestion quotidienne. Les gens sont conscients aux risques car il y a des associations qui agissent sur la sensibilisation et ils font ce qu'ils peuvent, au niveau d'école, lycée, dans les bibliothèques ils organisent les séminaires. 'Lorsque il n'y a pas de dégâts (de séisme) on fait rien, lorsque il y a de dégâts on fait mais que ce jour-là'. Azla : La mer a déjà envahie dizaine de mètres de plage qui sont disparu avec l'exploitation du sable et après la mer fait l'érosion plus simplement). Ici chez nous on ne fait pas la maîtrise d'urbanisation, il n'y a pas un service en hauteur de la pression d'immigration, la population n'accepte pas la dynamique de la mer, et le point le plus important est que ils ne respectent pas la loi. Il faut faire les gens respecter la loi.'

#### 10. *Male Scientist, 50, Tetouan*

La gestion des risques est dispersée entre les différents services/bureaux mais ils dans leur division font la grande partie de gestion d'inondations. Travaux d'aménagement d'oued : nouvel organisme d'état crée que pour cette tâche : Société d'aménagement de la vallée d'oued Martil (Stavom) et la commune est partenaire. Commune travaille que dans le périmètre urbain, leur premier problème sont les inondations, après c'est le glissement de terrain, finalement le séisme. Pas mal d'actions sont pris pour se protéger et chaque année c'est mieux. Avec la construction du barrage on est arrivé sur presque 0 risque : 500 m<sup>3</sup>/s était avant, maintenant on va élargir pour 5 fois avec le barrage qui est en construction, étape finale. C'est pas leur rôle de produire les cartes d'inondations, c'est à ABHL. Ils ne donnent pas l'avis pour construction sans l'avis d'ABHL, le même pour le séisme et le glissement, tout est dans ce carte. Les gens sont sensibilisé car ils ont d'expérience, les gens reprochent, ils veulent les simulations et la situation idéal. Maroc a beaucoup d'associations (ils sont obligés selon la loi) : l'approche participative, la vision de la commune pour 6 ans. Le PCD (Plan communal de développement) est la vision de commune en concertation avec la population (fiches, rencontres...) > maintenant ils ont introduit le PAC (Plan d'action communal) qui réunit les projets ensemble, en 2016 le PAC était fait dans la concertation avec de la population. Donc les associations sont sensibilisées aux inondations (et pas aux séismes). Oui, ça arrive de déménager, avant était par l'obligation, maintenant les gens se déplacent seuls. Avec wilaya ils travaillent en concertation, wilaya ressemble tous les communes avec leurs risques et produit un PCO (Plan communal opérationnel) et elle est en charge d'alertes. Le problème est que les gens oublient, il faut plus de sensibilisation, il faut former les gens au niveau institutionnel. Aussi, tout ce que marchait en théorie pendant la catastrophe sur le terrain tombe. Donc la culture de risque doit être développée. En école il n'y a pas de formation sur les risques ! On donne aux gens les permis de construire avec les restrictions mais les gens ne les obéissent pas. UNDRR : jamais entendu parler. indicateurs : oui, ils suivent les actions (travaux) : première expérience de construire les indicateurs de départ et après voir leur suivie. Par contre, les politiciens veulent les indicateurs d'impact et ils ne peuvent pas encore les fournir (c'est cher et ils ne savent pas). Ex. 40 écoles sensibilisées, mais finalement ils ne savent pas le taux de réussite de scolarisation. La formation des gestionnaires de risque : variée, chacun fait son parti de travail, à côté de leur travail principal ils font un peu la gestion de risque pour chaque projet.

#### 11. *Male Scientist, 30, Tetouan*

Présentation d'ABHL : gestion intégrée de ressources en eau : la sécheresse, l'inondation, les barrages, la distribution d'eau potable. ABHL est un établissement public régi avec son propre conseil d'administration (parmi eux aussi le représentant de roi). Ils travaillent dans la collaboration étroite avec wilaya et avec wali (gouverneur de tous les gouverneurs de la région, il est le représentant direct de roi). Pour les grands travaux : Stavom est en charge d'aménagement d'oued, c'est une entreprise d'état, et après pour la mise en œuvre pour la vocation touristique mais c'est ABHL qui fait l'assistance métrique et ils ont aussi fait l'étude avant les travaux. Tous les ans il y a d'inondations, surtout pendant la période février-avril plus de mm que pour toute l'année (selon climat) avec une intensité élevé, associé avec une marée exceptionnelle, toujours avec la vallée inondée. Les vents de l'est > les vagues élevé et évacuation. Ex. année 2016 était année de grande sécheresse mais 367 mm sur 2 jours (20 février 2016). 3 aspects : prévision, prévention, protection. Prévision : il faut être prêt, analyser le bulletin météo, au moins pour avertir les autorités. Ils n'ont pas une carte réglementaire. Ils travaillent avec le niveau d'eau, avec les cartes centennales (selon la crue de centennal) même il y a pour 5 ans, 10 ans. Il y a même une pétition par les propriétés du terrain contre l'aménagement d'oued car l'indemnisation n'était pas suffisante. Le terrain était exproprié pour non-construction, mais maintenant selon le plan d'aménagement il n'est plus. L'état a décidé quand même construire pour les projets d'hôtel et touristiques. La vision est d'exproprier de zone d'oued, mais si le terrain entre dans le projet touristique les propriétaires veulent avoir la possibilité de réaliser eux même les travaux et investir. Les gens sont bien sûr très conscients aux risques (depuis année 2000), toute la pleine était envahi en 2000, 2018 aussi, février 2016, décembre 2016, mars 2018, 2014, 2010, 2008, 2004, mais quand il s'agit d'intérêt économique, tout le monde oublie aux

risques ! 'L'inondation de vallée est très connue dans la population, tout le monde sait et pourtant tout le monde l'oublie lorsque il s'agit d'un intérêt économique. 'ABHL essaie de protéger contre les inondations mais aussi essaie de préserver le cours d'eau contre l'empiétement, construction jusqu'au cours d'eau. Chaque année ils réalisent trois projets d'études pour mieux protéger les sites les plus vulnérables et surtout ils priorisent l'enjeu humain ; participent aux projets avec leur petit budget (10%). Les indicateurs : taux de réalisation, de traitement de points noirs. Pour eux est indispensable de voir combien de points noirs ils réussissent à identifier et à traiter (partiellement ou totalement). 70% de budget d'investissement vient pour le budget d'inondation. Les élus par contre ne demandent pas pour les indicateurs mais demandent les études. Déjà 90% de sites sont complètement étudiés et 1,8 milliard € de 4 milliard € d'investissement est déjà dépensée pour l'aménagement (sans compter les barrages). Les limites principaux de mieux gérer les risques sont : le budget, le limite humain (manque de ressources humaines par leur formation et par leur nombre, gestion de 10 barrages dans la province avec que 4 ingénieurs, et où la cartographie n'est pas séparée, chacun gère sa cartographie), l'adhérence des autres partenaires qui ne comprennent pas le rôle d'ABHL, les élus et l'administration qui leur jette plus de responsabilité qu'ils ont le droit. En plus, l'ambiguïté au niveau de la loi, surtout au terme de la responsabilité juridique. Pour ajouter, parfois il y a la manque de données (manque historique, perte d'archives). Finalement, la dégradation d'ingénierie : trop de concurrence entre les bureaux d'études, on baisse les prix et la qualité tombe (les mêmes méthodes d'années '80-'90, tout est privé). Autorisation de construction est donnée par le conseil mixte et comme il n'y a pas de claire hiérarchie et celui qui décide ; si ce n'est pas complètement claire on manque d'effort pour faire un bon travail. ABHL n'est pas toujours convoqué dans ce conseil mixte et c'est quand les autres peuvent oublier. Ce conseil mixte est basé sur un plan d'aménagement de ville que peut tarder beaucoup pour la version finale (circa 10 ans pour certains partis de plan) et quand même il faut se prononcer sur le projet actuel. Il n'y a pas d'accompagnement pour les grands plans d'aménagement par un grand bureau d'étude. En plus, la délimitation de domaine public hydraulique (vient de ministre) n'est pas claire, les élus tirent d'un côté, l'ABHL d'autre et de 80 km de ligne hydraulique que 6 km est défini avec un décret de ministre, de délimiter le domaine privé et public ! En plus, parfois les délimitations ne sont pas réalistes. La méthodologie de calcul de crues n'est pas au courant de changement climatique : la pluie 'centennale' qui se répète 3 ans successifs n'est plus la pluie centennale mais annuelle. Ils ont remarqué le changement climatique depuis 2000 : la récurrence, 3-4 ans de sécheresse suivis par 1 an de crue et de nouveau 3-4 ans de sécheresse, les effets extrêmes, avec soit la sécheresse extrême, soit l'inondation extrême. 0 mm dans la barrage et la crue dans la ville et les gens ne croient pas ! Février 2018 : inondation dans la ville et à barrage ~15 km plus loin 0 mm !! Ou bientôt inverse, 0 mm ville, barrage inondation et les gens pensent qu'ils ne font pas leur boulot, qu'ils ouvrent. La sensibilisation auprès la population (écoles, associations) non-réglémentée ne sert à rien, elle doit être dans la loi. Pour faire une intervention il faut avoir une autorisation et en gros ABHL était déjà refusé pour éviter la polémique. En 2016 ils ont participé auprès la wilaya sur la sensibilisation mais c'était médiocre. Officiellement dans l'éducation il y a aucune notion sur les risques, qu'un peu les initiatives individuelles faits volontairement.

## 12. *Female Scientist, 50, Tangier*

Son travail quotidien est l'enregistrement des événements sismique dans l'échelle nationale. Ils ont un réseau de surveillance au Maroc et récemment ils ont ajouté un nouveau volet pour tsunami (depuis 2-3 dernières années). C'est la mode de travailler sur tsunami, après les événements de 2004 et surtout après Fukushima de 2011 et comme Maroc à le longue trait de côte sur Atlantique et Méditerranée, ce logique de travailler sur tsunami. Ce qu'elle a retenu en travaillant avec les gestionnaires à Tanger sur la simulation de tsunami est qu'au départ en parlant avec eux ils sont très compréhensibles et qu'ils vont suivre jusqu'au but, qu'il suffit de faire une demande, et lorsque le Jour J vient ils sont réticents et ils ont peur de parler. Les gestionnaires ont peur d'effrayer les touristes et la population résidente de la ville. L'économie de Maroc est basé sur agriculture et sur tourisme et Tanger est très touristique (4ème au niveau national). Ils ont peur que si les touristes regardent les panneaux sur tsunami dans la ville qu'ils vont penser que c'est éminent qu'un tsunami va venir et donc pourquoi se casser la tête avec tsunami ? Son expérience d'enquête auprès la population à Tanger : Ils y a peu de gens qui voulaient discuter avec eux sur le risque de tsunami. Surtout les personnes âgées sont très réticentes et pour eux c'est impossible qu'un tsunami arrive, 'tsunami, c'est un châtiment de Dieu et si on doit mourir on meurt'. Mais les jeunes sont plus ouverts. Les jeunes s'informent de média, surtout des réseaux sociaux. Ils ont préféré que l'alerte tsunami leur arrive par les réseaux sociaux ou par sms. Chez eux au Maroc on manque les études spécifiques de séismologie, elle a fait la géophysique et elle a appris la séismologie en travaillant, dans CNRST ils ont un géographe (SIG), ils ont surtout la côté technique, les techniciens et les ingénieurs électroniciens, pour les sismomètres dans toute échelle nationale (pour partir sur le terrain, pour installer). Les indicateurs de séisme : la magnitude, le degré d'énergie libéré, est essentielle mais ça c'est la physique, les gens ne la ressentent pas, pour cela on utilise l'intensité, l'échelle de dégâts, entre I et X de Mercalli, utilisé après le séisme, quand tout est déjà passé. Pour la prédiction, pour éviter qu'un séisme arrive, sont les études d'alea. Ils estiment l'accélération que pourra détruire le bâtiment. En plus, les gestionnaires ont le code de construction parasismique, les

chercheurs ont produit et validé ce code qui existe pour chaque région, mais son usage augmente le coût de construction. Le code donne pour chaque région l'accélération en pourcentage de g, Al Hoceima est 2% de g, Rabat 0,2% de g et ensuite. A partir de cette estimation d'accélération ils ont produit le code parasismique mais il est obligatoire qu'à Al Hoceima et à Agadir, car là les gens sont sensibilisés avec l'expérience de séisme. La sensibilisation n'est pas obligatoire, il y a quelques associations qui travaillent là-dessous et le CNRST essaient de sensibiliser les élèves. Ils reçoivent les visites scolaires et eux expliquent qu'est-ce que c'est un séisme et comment agir quand il y a un séisme, qu'est-ce que il faut faire, en les encourageant de transmettre l'information quand ils rentrent chez eux dans leurs familles. Au niveau de 'avant et post séisme, ce qu'il faut faire est construire selon le code parasismique, c'est clair et net'. Et quand la catastrophe arrive cela dépend de comportement de la population. Ils leur expliquent qu'il faut mettre à côté une trousse avec de l'eau, biscuits, les soins, mais après quand ils demandent la population s'ils ont fait ça, la réponse est jamais oui, 'c'est du gâcher'. Le séisme de 2004 était un choc énorme, les gens ne voulaient laisser leurs tentes et rentrer chez eux pour des mois et des mois. Les indicateurs de tsunami : on se base d'abord sur les données historiques comme ils ne l'ont pas vécu. Le tsunami de 1755 a laissé le dégât dans la côte Atlantique, même à Rabat, il était senti d'abord comme un séisme et après l'onde. 'Pour les indicateurs de tsunami il faut installer des marégraphes !' Avec les marégraphes dans les ports on peut enregistrer la hauteur de la vague et raffiner les modèles. Lorsque de chaque rencontre de système d'alerte NEAM (*North East Atlantic and Mediterranean Sea*) ils leur dit d'installer les marégraphes. Ils ont qu'un marégraphe, côté est, proche d'Algérie, et l'autre à Casablanca était récemment détruit par un bateau. En plus, 'si le tsunami arrive en Méditerranée la vague ne va pas dépasser 1 m car le bassin est clos, et sur la côte Atlantique minimum 11-12 m.' Selon les sources historiques de Tanger, la vague est arrivée à 15 m, peut-être ils ont exagéré mais son modèle donne 11 m, donc c'est réaliste.

### 13. *Male Scientist, 35, Tangier*

Le point clé est le séisme de 2004 et la nouvelle loi après sur l'échelle nationale, avec la carte de micro zonage sismique qui détermine si la construction est autorisée ou pas. Les agences qui sont en charge de donner le permis de construction prennent les normes parasismiques nationales en considération. Sur les normes parasismiques nationales ils ajoutent les cartes de micro zonage sismique pour affiner le terrain et cela donne les normes plus précisées à suivre. Au niveau de la loi tout existe, ce que c'est le problème est si on respecte la loi. La réglementation existe mais ils n'ont pas le suivi assez sévère pour faire obéir la réglementation. A Al Hoceima les gens ont vécu le séisme et donc ils sont plus conscients de risque que leurs compatriotes. 'La loi est plutôt obéie dans la ville où les contrôles sont plus fréquents et où les sanctions sont plus sévères.' La différence entre la ville et la campagne existe car les gens de ville sont plus sensibilisés et il y a encore des analphabètes autour de ville. A Al Hoceima à part de risque sismique, les autres risques d'importance sont l'intrusion marine et les inondations. Par rapport de changement climatique ce qu'on remarque c'est la disparition de quatre saisons, maintenant l'été vient directement après l'hiver, et aussi avec le décalage des précipitations de décembre-janvier à février-mars. La région est petite et le seul dégât économique sont les constructions, s'il n'y a pas de constructions ni d'infrastructure il n'y a pas de risque. En plus, dans la région il y a d'érosion et de glissement de terrain. A Tanger aussi il y a de risque d'inondation mais de moins en moins par rapport de l'infrastructure améliorée, et le risque sismique est aussi négligeable. La première zone industrielle de Tanger a été construite au-dessous de l'eau et lors de l'inondation de 2008 toute la zone était inondée, donc les gestionnaires n'ont même pas pris ce risque dans la considération. Si le risque n'est pas réel et si le coût d'investir est plus élevé que le coût de dégât, ils n'investissent pas et la commune ne prend pas en considération le risque du tsunami qui était la dernière fois en 1755. Le tsunami est un risque inutile, comme si on fait une étude sur le risque d'un météorite. Les risques côtiers plus importants et réels que tsunami sont les vagues des houles (=sea swell) et l'augmentation de niveau marin. Les derniers 5-6 années ils ont eu beaucoup de remontés de mer et des tempêtes. La baie de Tanger qui est en plein réaménagement a été dernièrement complètement inondée par une tempête. 'Avec tous les bars, restaurants et hôtels et avec la récurrence de chaque 2-3 ans les tempêtes sont un risque réel, en plus avec l'augmentation de niveau de la mer, parce que le climat se change.' Pour la gestion de risques il faut faire les études probabilistes. La fréquence d'un événement est un indicateur important. 'Le niveau de probabilité, quel seuil à prendre, ça reste aux gestionnaires, s'ils choisissent d'être plus prudents, s'ils sont plutôt pessimistes ou optimistes.' La notion de probabilité reste un peu vague et est donné dans le titre indicatif.

### 14. *Male Scientist, 30, Al Hoceima*

La plupart de risques naturels se passent dans cette région de Rif : le glissement de terrain, le risque sismique, les inondations, la liquéfaction (le sol sableux). Depuis 2006 il y a une loi, la charte environnementale qui exige les études d'impact sur l'environnement pour chaque projet, surtout les grands projets d'aménagement. Après, aussi existe la réglementation parasismique. La réglementation est appliquée partout, surtout dans la région d'Al Hoceima. Ce sont les experts scientifiques qui ont produit ces documents. A part des vitesses et des accélérations existe aussi le facteur

d'amplification dynamique pour la construction des bâtiments. Selon le concours de marché ce sont les bureaux d'études qui ont produit les cartes d'aptitude pour indiquer les zones susceptibles aux risques majeurs. Toute l'information scientifique est projetée dans les plans d'aménagement et de la construction de la ville et cela est le guide pour l'administration. Monsieur travaille comme l'appliqueur de la réglementation dans une administration, dans une agence nationale 'Agence pour l'aménagement du site de la lagune de Marchica' (Nador, au sud du Melilla). Ils travaillent sur les grands projets d'aménagement autour de lagune, ex. ville de Déjà pour restaurer les quartiers anarchique, la vision touristique de lagune, ils ont refait la canalisation et maintenant font l'épuration de l'eau, en gros la dépollution de 25 km fois 7 km de lagune, l'installation de parc ornithologique (les flamands roses), le terrain du golf : *atalayun golf resort* qui à l'époque était le lavage de fer, et maintenant les résidences et l'académie du golf. Son travail sont les autorisations pour les projets. Pour un grand projet et le volet environnemental les investisseurs doivent passer les négociations avec plusieurs partis, commune, province, région. Autant que chercheur, il travaille sur le micro zonage sismique, sur le phénomène déficit. Le séisme de Mexique 1986 a provoqué 11 fois plus de perte humaine 400 km loin d'épicentre que dans l'épicentre lui-même. Pareil, en 2004, Imzouren a subi beaucoup plus qu'Al Hoceima. Cela provient de structure de roche, la vague sismique S peut rester piégée dans la couche sédimentaire qui se trouve au-dessus de la couche rocheuse (donc les densités beaucoup différents). Les gestionnaires comprennent et prennent en considération les probabilités ! 'La population est consciente de risque sismique en construisant, mais dans la zone pauvre ils réfléchissent économiquement. Beaucoup de fois on trouve les différences entre la construction construite et ce plan autorisé. On manque le contrôle, la suivi de travail et la qualité des matériaux utilisés. Tout fonctionne économiquement. Il y a des laboratoires qui donnent les normes des matériaux, mais puisque tous les laboratoires et bureaux d'études sont privés.' Les grands projets en général sont bien faits. La sensibilisation existe, mais il y a le taux d'analphabétisme encore élevé donc ils font le grand effort à expliquer à tous. 'La séance publique d'un-deux heures manque ! De 5 jours de la conférence nous n'avons pas fait aucune sensibilisation auprès de la population. Si on a touché la côté sponsoring on aura bien organisé la séance auprès de la population. De côté scientifique on a fait beaucoup, mais de côté sensibilisation rien.'

#### 15. *Male Scientist, 45, Tetouan*

Il n'y a pas un cours ou séminaire d'enseignement systématique sur les risques à la faculté, mais oui de point de vue technique, dans les ateliers d'architecture. Comme maintenant par exemple, ils travaillent sur la rivière Martil et le quartier Diza, qui se trouve entre le bras mort et la mer, à l'époque ils ont ouvert une ligne directe vers la mer, petit île s'est créé, problème de remonte des eaux, gestion des déchets et de l'eau, cela est la risque sur laquelle nous travaillons. La quatrième année des études est la formation concernant l'urbanisme. Nous travaillons aussi sur les matériaux. Cela n'est pas un problème lié aux risques, mais à la situation de fabrication des matériaux au Maroc, quand on passe d'une ville au Maroc à l'autre. Tout ce qui est industriel n'a pas une influence sur la fragilité des maisons, les quartiers informels compris. La question est quand on commence d'utiliser la terre ou autres matériaux, en plus le savoir-faire des artisans. Dans la construction la responsabilité est à l'architecte. Mais tout le monde ne passe pas par l'architecte et tout le monde ne respecte pas les normes, même si l'architecte est là. Par contre là oui, ça pose des problèmes. Mais ce n'est pas due au mal façon, mais due à la mentalité de l'habitant lui-même. Je ne pense pas qu'il y a une prise de conscience chez les habitants. Ce qu'on voit est que les clients veulent le maximum d'espace. Par exemple un poteau doit descendre d'haut en bas et ça on ne respecte pas. Dans les projets de restauration c'est la même chose, par exemple quand ils rajoutent les structures. Après le séisme d'Al Hoceima la réglementation est partiellement remontée et appliquée en partie. La réglementation est appliquée de la manière systématique quand il s'agit de projets de l'Etat. La particularité est le contrôle, de manière que je contrôlerais dès qu'ils voient et après on fait ce qu'on veut. Parmi les éléments de risque est l'élévation quand ils ajoutent un étage de plus, avec le risque de mal façon et même de la pluie. Mais en général un citoyen n'a pas une prise de conscience, ils construisent sur les berges de la rivière et là on sait très bien que c'était toujours une zone inondables. Il y a la pression foncière, ils s'installent même dans les zones marécageuses. Je crois qu'au niveau de la construction, le problème ne se pose pas, surtout quand on construit en béton. En 1994 on a fait une étude sur les constructions dans les quartiers informels, et on était surpris comment cette auto-construction était assez solide. Je ne suis pas au courant aux cartes d'aptitude aux risques. L'architecte est en contact avec la commune et l'agence urbaine qui donne son avis, qui dit commune dit wilaya car le dossier de construction passe par wilaya. Il y a des contraintes foncières, comme par exemple la gare routière à Tétouan, tout va être bétonné, là ne va pas être un parc. Là on voit justement, on est dans une zone inondable, mais avec une pluie déjà la gare est inondée. En plus, notre nouvelle bâtiment d'école d'architecture va se construire en face, dans la même zone, sur un terrain qui n'est pas très stable, le sol composé d'alluvions. Ils sont obligé d'entrer 6 m profond, pourtant l'école est petite. Je ne suis pas au courant de politique internationale de Sendai. Nous, autant que technicien, on n'a pas une approche systématique pour la gestion ou la prévention des risques. Ce sont des contraintes qu'on a dans les têtes, mais pas de plus. La question est si un risque entre dans l'informel, comme c'est le glissement du terrain. Concernant le changement climatique, le risque pour les constructions ont qu'eux, et pas

la population, dans les têtes et le traitent au sein des ateliers, comme cette année académique le quartier Diza. Après l'indépendance, même le conseil de banque mondiale était de leur diriger vers l'agriculture et le tourisme, mais rien ne marche. Donc la politique est de se diriger vers les particuliers et c'est la construction, comme le cas de projet à M'Diq, où l'habitat du flamand rose est détruit pour marina, mais c'est trop cher et lagune ne marche pas.

16. *Male Scientist, 65, Tetouan*

Moi je travaille dans ce projet des cartes d'aptitude à l'urbanisme, de Chefchaouen, Tétouan, Fnidaq. L'objectif est de donner dans le fin une carte avec des couleurs, le vert, jaune, rouge. Mais il y a le grand problème sur le terrain parce qu'il y a un conflit d'intérêt entre les élus et les techniciens, soit disant nous les techniciens du terrain. Et les élus, surtout les présidents, ils ne veulent pas que ça arrivera un jour que une zone soit jaune foncée, c'est dans leur intérêt que ça restera toujours flou. Et si c'est flou, il y a du bakchich qui tourne de droit à gauche. Donc sur le terrain on a trouvé beaucoup de problèmes, on a souffert, avec les présidents, car les gens ne veulent pas nous recevoir. Nous on essaie de caractériser plus ou moins géologiquement, lithologiquement, on s'en fou de population, on s'intéresse de milieu physique, et là il y a des risques, c'est spectaculaire, les mouvements du terrain. Et ils nous disent qu'il n'y a pas du mouvement du terrain chez eux, que ce n'est pas la peine, et pourtant nous sur Google Earth on voit bien le mouvement du terrain et on aimerait bien avoir un peu la historique, on aimerait de s'approcher à la population pour remonter l'histoire. Mais la population...lorsque on commence de demander certaines questions qui sont un peu problématique, pas de réponse claire, quand on demande pour combien de temps ils ont construit là-bas, pourquoi il y a toujours de fer qui ressort sur la terrasse, donc c'est pour le future, pour la deuxième ou la troisième étage. Donc ma conclusion, nous, pas les Arabes, mais certains, veulent la marché, ils veulent grille au sens interdit en reculant au marche arrière. Les cartes d'aptitude à l'urbanisation, bon, c'est dommage, moi je travaille sur ça comme l'expert, mais franchement ce n'est pas...car on a pompé une idée et on essaie de l'adopter et pourtant ce n'est pas la même mentalité. C'est comme le PPR en France lors de prévention de risque et bien sûr, au niveau culturel et intellectuel, ce n'est pas la même chose un français et un montagnard dans le Rif. Bientôt on aura les cartes et lorsque on descend sur le terrain quand on les essaiera à appliquer si c'est jaune claire ou jaune foncée, il faut attendre d'ici un-deux ans quand chaque province aura sa carte. Mais avant qu'on a commencé avec ces cartes il fallait commencer par le terrain, avec l'état de lieu, la mentalité, et à partir de la mentalité on essaie de voir comment faire ces cartes. Donc, je suis vraiment... La carte d'aptitude d'Al Hoceïma n'est pas la même carte comme pour la région de... Kenitra. Si c'est jaune foncé pour une région, ça doit être moins foncé pour l'Al Hoceïma. Le Maroc est un mosaïque et tu ne dois pas faire une loi pour tout le monde, tu auras de problème pour appliquer cette carte, il faut s'adapter, jouer avec. Pour ça je dis toujours dans les enquêtes, il faut prendre la mentalité des autochtones en considération. Par exemple, à Fnidaq, là-bas est tout le Maroc, je m'en fous de cette perception. Il faut prendre en considération les mini-cassettes. C'est simple, tu regardes Tanger dans Google Earth, et tu regardes l'historique, tu peux descendre jusqu'à 2003, et pourtant il avait des lois entre 2003 et 2019, mais tu regardes l'évolution, c'est rouge rouge, que des briques rouges. Terminons avec ces cartes, je suis pour ces cartes, mais il fallait commencer travailler sur la société. Plus au moins, notre travail devait être le départ, avant le lancement de ces cartes. D'ici 6 mois la carte Tétouan-Fnideq va être prête, et par la suite c'est la sensibilisation et le marketing de la carte, et là ça va être compliqué. La sensibilisation sera avec les élus et les décideurs, les utilisateurs de la carte. Car ils doivent savoir pourquoi cette carte et comment l'utiliser. Et s'ils ne veulent pas l'utiliser, c'est leur responsabilité. S'ils vont considérer que jaune claire est vert, c'est à eux de prendre cette décision, il est responsable. Comme par exemple le parasismique qui ne marche pas au Maroc. Maintenant pour construire une maison ou n'importe, il faut avoir le plan d'architecte et le plan de béton armé. Et il n'y a pas le suivi. Un ingénieur te fait le plan avec ce que tu dois faire, et l'autorité te donne l'autorisation. Tu commences à construire, l'ingénieur est quelque part, et tu fais ce que tu veux. Tu peux économiser. L'ingénieur te dit par ex. que le plan de béton armé te coute 300€ et au revoir. Et si tu veux le suivi ça fait 600€, donc moi je fais le calcul. Donc je vais économiser 300€ et plus x euros pour les matériaux. Pour ça je vous dis que c'est la mentalité. [Le directeur d'école n'est pas au courant] et pourtant il y a un prof de cette école d'architecture qui participe au projet de carte d'aptitude. Et les théologiens, bon, il y a un surah qui dit « Il ne faut pas se jeter dans la gueule de lion ». Si tu vois la tempête tu ne vas pas te baigner, il faut réfléchir. Lorsque on se rapproche aux religieux on voit qu'on n'a pas trop ce que nous relie. Par exemple, les mosquées sont les lieux de rassemblement, il y a un risque, ils nous demandent pourquoi vous faites ça, pourquoi, c'est la perte de temps. Et nous, la prévention, on est monté jusqu'en haut du minaret pour mesurer la fréquence et les imams demandent pourquoi, pourquoi. Il faut expliquer la fréquence et la résonance, donner les exemples, c'est difficile de convaincre les religieux et du milieu rural. Aller à Ceuta c'est une sortie de famille pour les gens avec un peu des moyens, pendant la sécheresse des années '90, avec l'exode rural vers les villes, ils ont vu qu'il y a toujours les produits étrangères de bon prix, moins cher, qu'il n'y a pas, même Danone de là-bas c'est de meilleure qualité. Et c'est toujours la contrebande, à Fnideq tout Maroc est là.

17. *Male Associate, 60, Tangier*

L'observatoire est la société civile, un cas marocain particulier, ils ont devenu un observatoire d'un mouvement pour protéger le forêt, surtout la gestion de forêt. Les incendies avec le changement climatique. Le vent d'ouest aggrave la situation. Concernant les indicateurs, actuellement, la fréquence d'incendies reste toujours le même, mais la zone d'incendies diminue (alertes, prévention). Les incendies sont les risques majeurs. Aussi, les inondations urbaines : la mauvaise gestion d'eau et de déchets (qui bloquent les égouts et les oueds), l'infrastructure. En plus, le transport maritime : risque de pollution maritime ; aussi dégazage ; l'indicateur : le nombre des bateaux qui passent. Question de moyens : ils ont organisé les jours-observateurs ; ils font des petits projets, parmi eux le projet pour le droit à l'accès à l'information : 'Si il y a un risque est-ce que la population est au courant de la gravité de ce risque ?' Il ne peut pas répondre à la question si la population est sensibilisée aux risques. (!) 'La sensibilisation a un coût, la sensibilisation doit être budgétisée.' La recherche a un intérêt national : dans leur société civile il y a les membres de partis politiques et la communication avec les différents acteurs (syndicats, politiciens) est essentielle, mais ils ont une certaine autonomie. Les décharges peu contrôlés peuvent être un risque naturel. Risques littoraux sont présents grâce à la pollution, l'urbanisation et la grande érosion côtière (la ligne de côte a bougé) Depuis 2009 il suit le COP, dimension climatique mais ils s'intéressent surtout pour la production d'agriculture suite à la sécheresse. Autre question climatique d'intérêt est la gestion de méduses ! Gestion déléguée d'eau : pour changer un peu le calibre des égouts. La paléocologie est importante pour la reconstruction d'histoire. Education à l'environnement : Association d'enseignants de Science de Vie et Terre (AESVT).

#### 18. *Male Associate, 25, Tetouan*

J'ai 25 ans, je suis étudiant de master 2 avec la spécialité l'ingénierie en gouvernement territorial et développement spatial, ici à la Faculté des lettres à Martil. A mon avis, la gestion de manière générale dans notre région a des progrès et les insuffisances. Par rapport aux progrès on voit que l'état d'infrastructure est amélioré. Concernant les insuffisances on voit un déséquilibre entre le développement démographique et entre les besoins de se situer. Par exemple, dans le domaine de santé, il y a qu'un seul hôpital public à Tétouan. A la faculté on voit que les étudiants sont plus nombreux que la place dans les salles. Pour la gestion de risque il faut d'abord mettre une culture de gestion de risque chez la population, car la population ne prend pas ces catastrophes en considération. On fait la gestion au moment, pas de gestion prévisionnelle, la gestion sur place et pas la prévention. Par exemple, pendant le séisme d'Al Hoceima, plusieurs personnes était bloqués dans les immobiliers, parce qu'il n'y avait pas des outils de communication, mais aujourd'hui ça est amélioré. La ville de Tétouan a subi des inondations, mais pas mon quartier, je me souviens des inondations dans la ville. Je me souviens en 2016 d'une forte pluie, la route pour Martil était inondée, il n'y avait les moyens de communication et il n'y avait pas des outils de gestion. Sincèrement, ma confiance à la gestion que fait la commune de Tétouan est assez basse. Il faut faire les séances de sensibilisation à la population, pas lorsque il y a l'inondation, mais en général, les simples gestes, comment faire, les cours de sécurité. Pour que s'il y ait l'inondation ou n'importe quel problème la population elle-même doit gérer ces risques. Donc, à travers d'éducation et de sensibilisation qu'on gère ces risques, ça donne la culture. Je me sens vulnérable, parce que nous sommes dans la région où il y a des séismes, n'importe quand il peut arriver, les séismes, les inondations. Si les étudiants ont étudié ça, ils ont de la chance, mais si quelqu'un n'a pas étudié ça, il ne sait pas. C'est la sensibilisation que manque et la pratique, malheureusement on étudie ça théoriquement. Les acteurs qui sont impliqués dans la gestion de risque doivent coordonner leurs actions parce que la gestion de risque est transversale, il y le ministère d'éducation, des ressources d'eau, il y a plusieurs ministères qui gèrent ça donc il faut faire un plan au terme moyen. Ce plan fait objet de définir comment faire la gestion. Le plan déjà existe, il faut faire l'évaluation et l'amélioration. Pour les étudiants il faut faire une matière qui traite ce sujet des risques et les étudiants eux même partagent les idées avec leurs familles. J'insiste sur la pratique, ce n'est pas que la théorie, mais la pratique comment nous peut nous gérer dans ces situations. Je suis attaché à Tétouan. Maintenant je voudrais déménager, n'importe à quelle ville, pour le travail, mais si je trouve un travail ici je reste. Notre région a un haut taux de chômage. Qui est attaché à sa ville il fait plus de travaux pour mieux se protéger. Pour faire une bonne gestion de risque il faut d'abord faire un état de lieu, quels sont les risques fréquents dans ce territoire et comment on peut interagir et en fin on fait un bilan pour connaître nos erreurs et pour améliorer. Il faut d'argent, il faut avoir le financement. Il faut faire un fond national pour la gestion de risque. Un fond national, régional et local, tous les ministères participent dans le financement et bien sûr les opérateurs privés, il faut faire des partenariats parce que tout territoire est concerné. Je pense que les constructions font objet contre les séismes et c'est le rôle de la commune que doit gérer ça, les normes de construction. C'est au niveau local et conformé avec la préfecture. Bien sûr que le changement climatique existe. Par exemple les précipitations, la sécheresse, en 2015 la pluie était très en retard, juste arrivé au mois de février, les précipitations sont très variées. Il y a des gens que ne croient pas au changement climatique. Par l'éducation et nous-mêmes devons discuter sur ce sujet.

#### 19. *Female Associate, 35, Tetouan*



Je suis marocaine, tétouanasse, j'ai un doctorat en tourisme, j'ai fait mes études en Espagne, au Maroc et ici de retour à Tétouan après presque 7 ans et ça fait 3 ans que je suis rentrée. Je cherche toujours mon travail, la bureaucratie pour les diplômés étrangers, presque 1 an et demi a pris la procédure dans le ministère des études supérieures, la traduction des diplômes, le projet ; ça peut prendre 1 an et demi, 3 ans ou 3 mois, c'est relatif. Avant de rentrer j'ai pensé que ça ne serait pas facile, mais abordable de trouver un travail, mais avec la situation j'ai des doutes. Je trouve la situation économique très négative ici. En Espagne pendant ma thèse j'étais une boursière, vers 850-900€ par mois, mais j'ai fait aussi le travail à part de ça, pendant 6 mois j'ai travaillé sur un sujet qui n'avait rien à voir avec mon sujet de thèse, c'était la période de crise et il fallait profiter le maximum. C'était à Tarragone, sujet sur tourisme destination *branding* (les marques touristiques) et le rôle des immigrants, le cas de Maroc. Après 6 mois de recherche bibliographique j'ai trouvé ce trou, entre le tourisme et l'immigration. Tétouan connaît l'immigration depuis longtemps, c'est l'immigration interne, des villages et de Rif vers la ville et ce dernier temps on voit les subsahariens immigrés ici, mais je pense que Tétouan est leur destination temporaire, avant de passer en Europe. Je pense qu'eux, avec le temps passé ici, si ce n'est pas possible de traverser en Europe, ils vont faire leur vie ici, par obligation. Traverser vers l'Europe ce n'est pas facile et après 2,3 ans ici ça devient leur résidence. Parce que je vois des femmes avec leurs petits-enfants, un bébé de 6 mois est un tétouanais. Pendant le Ramadan, je vu une femme subsaharienne, africaine, moi aussi je suis africaine, je ne fais pas cette discrimination, mais avec un bébé de 3 mois, j'ai beaucoup de questions. Qui dirait qu'un jour, une femme de Cameroun, Tchad ou je ne sais pas d'où, va avoir son bébé ici. C'est inexplicable, mais c'est la vérité. Tétouan est une belle ville, mais pas d'opportunité de travail et c'est pour ça qu'on préfère de changer. Moi je suis retourné ici premièrement pour le retour vers mes origines. Je voulais faire mes études, travailler sur un cas de Maroc, développer. J'ai fait les études à Rabat, en Espagne, j'ai une expérience professionnelle, personnelle, et c'était toujours l'idée de retourner au Maroc, faire mon mieux et transmettre ces savoirs aux gens. J'ai choisi un sujet sur le Maroc, c'est toujours avec cette attachement, maintenant c'est la déception. Maintenant je cherche les post-docs, je fais les applications spontanées, que cette année j'ai fait 7 projets, avec la compétition...mais on garde l'espoir. Oui, attachée, j'ai perdu mon papa quand j'étais en train de faire ma thèse, c'était un choc, une crise cardiaque, et j'étais loin de ma famille, je devais être près de ma mère, avec mes sœurs, en Espagne je n'avais pas ma famille, on était un groupe d'amis étrangers, après ils rentrent, après ça devient un peu difficile. Mon objectif là-bas était de faire la thèse et maintenant je suis ici, mais je cherche de partir, donc je ne sais pas... Je suis ouverte à ce qu'arrive. La mémoire sur le risque naturel : ça fait longtemps, je ne me souviens pas la date, mais j'étais au collège, il y a 15 ans, c'étaient des inondations brusques, dans une journée, dans le côté Martil, Fnidaq, et dans cette inondation, une voisine a perdu son mari à Fnidaq, il était prof de karaté dans une salle, et il est mort d'électricité qu'il voulait atteindre dans son lieu de travail. C'était la pluie forte, 2-3 heures et c'est un événement remarquable. Chaque 2 ans, chaque 3 ans et surtout dans les nouveaux quartiers on a des inondations, à côté de la rivière M'hannesh. Avant, ça fait longtemps, les communes donnaient les permis de construire, et il n'avait pas de plan d'aménagement, et je pense qu'il a des gens qui venaient soudainement et commençaient à construire, comme favelas au Brésil. On peut trouver ça à Martil, Diza, les constructions, les gens ont acheté des parcelles il y a 15 ans, ou ils ont juste mis la main et ont construit près de la rivière, pendant l'été c'est faisable, mais pendant l'hiver c'est la catastrophe. Ce sont les communes, ou les ingénieurs, ou les topographes, je ne sais pas, c'est l'autre chose, ça peut être la corruption ou le déni ou la négligence, c'est autre chose. Je n'avais aucune notion sur la prévention à l'école. Pas d'éducation, pas de campagne de sensibilisation, pas de tout, c'est utile que les gens aient cette notion qu'il y a des risques, ça doit être dans le programme d'éducation nationale. Le quartier, 30 min en marchant de centre-ville, je ne suis jamais été là-bas, mais c'est une autre ville, un autre monde, il y a des quartiers qu'on appelle 'les quartiers de 15 min', construit de nuit par les immigrants marocains qui ont venus ici, achetés les parcelles et construit sans autorisation et après un certain temps c'est difficile de...10 000 personnes, détruire les immeubles, ce n'est pas faisable, il y a des facteurs sociaux, économiques, culturels...Un cas de rez-de-chaussée, un four traditionnel et après les 3 étages, où est la logique, ça c'est un grand risque. Ici c'est toujours l'hiver et la forte pluie à Tétouan. Des fois dans les forêts on a des incendies, mais ce n'était jamais proche à moi. Il y a des plans, il y a des communes, agences, il y a des plans sur le papier, mais sur la pratique je ne sais pas. Comme un simple citoyen, j'ai quelque notion comme j'ai fait un stage de trois mois dans l'agence urbaine de Tétouan, avec ma licence de droit, j'étais là-bas pour comprendre l'administration, j'étais dans le département juridique, avec ma meilleure amie géographe on a parlé avec les topographes, les ingénieurs, et dans ce moment-là ou après les ingénieurs ont voyagé au Brésil pour voir les quartiers marginalisés, pour prendre comme un exemple les favelas et pour appliquer la stratégie de favelas ici dans ce quartier de 15 minutes, mais je ne pense pas qu'ils ont fait qqch, ils ont bien vu et rien. Pour la gestion le plus important est de faire un bon travail, de travailler. Ce n'est pas avec chaque élection faire la répétition on va faire, on va faire, on va faire, et après 4 ans le bilan c'est rien et il viendra de nouveau le boucle on va faire, on va faire, on va faire, ce n'est pas la continuation des projets comme c'est ailleurs, ils ne font pas leur travail. Et je pense les citoyens aussi font pas les bonnes élections. Il y a le choix dans les élections, je ne sais pas s'ils achètent les voix ou non, il y a des élections, pour ça le Maroc est un bon exemple en

Europe, parce que c'est la démocratie, on a des élections communales, parlementaires, on a la constitution, on a tout, mais les gens font élections des gens adéquats à leur choix.

## 20. *Male Associate, 50, Al Hoceïma*

J'ai travaillé plus de 15 ans dans le Parc National d'Al Hoceïma, avant l'année 1999 j'étais au sud du Maroc. Concernant mon expérience de travail associatif j'ai travaillé dans un réseau des ONG qui travaillent dans le Parc National, créée en 2000, même avant la nomination de Parc National parce qu'il avait un projet de création de parc et les associations de développement local avaient peur que les activités socio-économiques vont être limités par la création de ce parc national et au même temps ils avaient pensé que c'était plus important pour ces associations de se regrouper et faire un réseau, pour avoir plus de force et pour avoir un locuteur de l'association. Donc on s'est créé en 2000 et en 2004 il avait la nomination officielle avec un décret de Parc National d'Al Hoceïma, mais au début le réseau a passé une phase d'attente car au début il n'avait pas beaucoup de choses à faire parce que ils n'avaient pas de moyens, ils n'avaient pas un local, et les associations étaient répartis au sein de parc national, avec un problème de communication : il n'était pas aussi simple comme maintenant avec le WhatsApp etc. En 2006 ils ont travaillé avec un ONG espagnol « Mouvement pour la Paix » et comme ça ils ont décroché leur premier projet avec un local et certains fonctionnaires et ils ont commencé à travailler sur le terrain. Ils avaient deux axes principaux : le développement local (appuyer la population locale pour améliorer leur situation socio-économique) et les autres associations qui s'intéressaient plus pour l'environnement et le tourisme durable : l'association SVT des enseignants qui s'occupait sur l'éducation environnementale, un groupe sur l'ornithologie de Rif central, l'association des pêcheurs artisans et l'association Rif tourisme durable. Parmi les projets réalisés est un petit centre d'éducation en environnement dans la forêt de parc où ils accueillent les élèves, mais le problème est qu'ils n'ont pas de personnel permanent là donc ils travaillent dans le cadre de volontariat. Lorsqu'il y a une école intéressée à organiser une sortie dans le parc, ils les contactent et l'association organise l'encadrement. Mais le monde n'est pas rose, il y a des problèmes au niveau de parc national et tout d'abord c'est le problème législatif. Les PN au Maroc jusqu'à 2010 étaient créés sur une loi qui date de 1934 de colonialisme et la loi mentionnait seulement les parcs nationaux et parlait pas d'autres types de parcs protégés. Comme le parc national, selon la définition, ne doit pas être ou il y a de la population, et dans ce parc national il y a vers 15000 d'habitants, donc la nouvelle loi de 2010 a classé différents types des aires protégés et PN d'Al Hoceïma va être plutôt administré comme un parc naturel (donc va être renommé). En plus, cette loi de 2010 est une loi cadre, mais il n'y a pas encore le décret d'application. Et ceci nous a causé une certaine frustration. Attendre 8 ans et rien, à partir de décret d'application on peut structurer l'administration, créer le conseil de gestion, conseil consultatif, organiser le gardiennage, on peut contrôler, mais sans ce décret on reste sur une gestion empirique et si qqn maintenant veut construire dans une zone sensible et protégé on ne peut pas l'arrêter car il n'y a pas de loi. Ce n'est pas que le cas de PN Al Hoceïma, c'est le cas dans tous les parcs nationaux au Maroc, tant qu'il n'y a pas le décret d'application on ne peut pas améliorer la situation dans le parc national. En plus, la frustration est créée parce que si j'ai travaillé pendant des années comme l'enseignant et je me sens comme un charlatan parce que les élèves peuvent voir toutes les infractions, déchets partout, toutes les cartouches d'arme de chasse, donc c'était difficile pour nous. La création de PN d'Al Hoceïma est un résultat de Convention de Barcelone avec l'obligation de créer les aires marines protégées et les scientifiques ont décidé que la partie de côte entre Al Hoceïma et Cala Iris c'est la côte méditerranéenne marocaine avec le plus de valeur écologique parce que ce sont les falaises et sans population comme il n'y a pas d'eau. Personnellement je ne suis plus dans ce réseau, mais je suis resté comme un volontaire selon ma disponibilité, parce que j'ai senti qu'il n'y a pas une amélioration au niveau de terrain. Même au niveau des interventions on était frustré. Par exemple, c'étaient les interventions d'Etat qui ont gâché notre travail sur les arbres fruitiers à planter en donnant les arbres en vrac, sans suivi et sans formation que l'association proposait. S'ils avaient adopté le décret d'application ils auraient pu éviter les conflits d'usage et la perte de leur crédibilité auprès de la population. Et sans cette bonne structure ils n'avaient pas des bons résultats. Même parfois ils avaient des conflits entre deux associations ou l'association et l'administration pour la réalisation d'une action sur le terrain, soit le conflit, soit la redondance, la répétition. D'abord pour moi le problème était l'urbanisation anarchique et les sites détruits grâce à ce désordre. Même site archéologique de très grand valeur Bades a de plus en plus maisons construits et d'une architecture qui n'est pas en harmonie avec le paysage. Deuxième problème est la protection au milieu marin, on peut voir de temps en temps les cartouches d'arme de chasse, la plongée des plongeurs d'ailleurs qui viennent pour pêcher, les chalutiers qui s'approchent trop du littoral. Même de fois on organise ici les battus des sangliers quand sont aussi les chacals, les renards, les serpents tués. La régulation des sangliers peut être faite autrement. L'autre problème sont les déchets. Les communes rurales n'ont pas suffisamment de moyens pour gérer les déchets solides, il faut l'appui d'Etat. On ne peut pas ramener un touriste au parc national avec les déchets partout. Encore une autre problème sont les incendies qui pourraient arriver partout, mais est-ce qu'on a créé un plan d'intervention qui pourraient minimiser les risques ? Pendant un grand incendie qui a affecté la zone occidentale de PN on n'avait pas d'accès de piste, les camions n'arrivaient pas. Ils ont proposé d'aménager la piste pour les pompiers et d'interdire le passage aux autres et aussi de

construire les collecteurs d'eau, donc les réservoirs dans les points éloignés. Heureusement il y a ces derniers 4-5 ans la protection civile au milieu du Parc National et ça me rassure un petit peu qu'on pourra intervenir rapidement. Les incendies sont un peu comme les guères, on ne peut pas gagner en utilisant que les avions. Il y a aussi une autre chose, moins visible, il n'y a pas une agriculture très développée au sein du parc parce que il n'y a pas trop de bon terrain, et maintenant on a observé que les gens ont commencé d'utiliser les produits chimiques, les fertilisants. Avec un bon travail une production biologique éco aurait pu être très bien développée dans les vergers, car même si on produit peu, on a de la valeur. Aussi de ne pas mentionner la perte des grains, avant le maïs était modeste, mais il était résistant aux maladies et on n'avait pas besoin de fertilisants, il portait aucune perte aux paysans, on a détruit les sols. Pour les arbres, heureusement pour les figuiers on a encore des variétés locales, mais les amandes et les oliviers on a introduit des nouvelles espèces. Les risques naturels, oui, les gens sont conscients et sensibilisés que cette région est sismique. Un peu la même chose comme pour les déchets, les gens savent que ce n'est pas bien. Mais qu'est-ce qu'on fait ? Est-ce que cette sensibilisation est suffisante pour changer le comportement, les attitudes ? Le nouveau quartier de la ville est construit après le séisme de 2004, mais très proches et sur un sol de dune quaternaire. Donc je ne vois pas qu'on a bien appris de séisme de 2004, à quoi ça sert de construire un bâtiment de 7 étages, selon les normes parasismiques mais sur un sol fragile ? Au niveau des écoles, ça fait quelques années que j'essaie de convaincre la direction pour mettre les panneaux avec les schémas pour secours, mais ça coûte et il y a des autres priorités. Comme c'est un événement ponctuel on oublie vite, car le risque est toujours là. Concernant les autorités, je ne crois pas qu'ils ont les plans d'action, les plans d'intervention au cas où. En 2004, 6 heures après le séisme, la majorité des responsables qui ne sont pas d'ici, ont pris leurs enfants et ils ont fui 300-400 km d'ici. On a resté ici pour deux jours avec l'absence totale d'État. Je crains que si un séisme arrive de nouveau qu'on va commettre les mêmes erreurs. Ce que s'est amélioré de 2004 c'est la construction qui est un peu parasismique, même si on a des problèmes, on a besoin de main d'œuvre qualifiée pour mettre ça en place. Et deux ans après ce séisme à Nador, les maisons construites selon les règles parasismiques étaient inondés par un oued. Donc il faut bien étudier les sites et les risques considérer dans sa globalité. Après, l'érosion est pour moi plus grave que les séismes, seulement que c'est un phénomène lent. Le chaîne de Rif a un des taux d'érosion le plus élevé du monde, ce sont des pentes, les pluies torrentielles et la déforestation. Même si dans le programme de Maroc vert ont décidé de remplacer la culture des céréales par les arbres pour lutter contre la déforestation, et ça c'est positive, mais avant les gens travaillent la terre selon les courbes de niveau, mais maintenant ils ramènent un tracteur et il griffe le sol perpendiculairement et cela aggrave l'érosion. Je me demande qu'est-ce que font les autorités ! Concernant le changement climatique, on peut distinguer les scolarisés qui sont informés parce que cela fait partie de programme d'éducation, et les paysans qui ont noté qu'il y a quelque chose que ne marche pas et qu'ils ont perdu les pédales. Nous avons observé qu'il a le changement de comportement des oiseaux, des nouveaux espèces, ou en retard. En plus, maintenant il y a que 2 saisons et avant il en était 4. L'administration n'a pas une bonne image chez la population et vice-versa. Et nous on est au milieu ! Les agents d'eau et de forêts sont très mal vus, ils interdisaient sans donner l'alternative et c'est difficile de les défendre. La même chose est pour les élus.

#### *21. Female Associate, 50, Tetouan*

J'ai toujours aimé vivre à Tétouan, de ma famille tétouanasse, j'ai que passé quelque temps à Rabat pour ma formation de comptabilité. Je donne des cours de darija pour les étrangers et des échecs dans l'association de centre-ville et je suis aussi la fondatrice de cette association, de centre de jour pour les enfants et femmes en situation difficile. Ici je reçois les femmes, on ouvre un dossier, on l'écoute, et si elle a des enfants entre 0 et 6 ans (avant la scolarisation), les enfants restent ici toute la journée comme chez eux. Ici c'est gratuit et elle peut aller travailler et les enfants sont ici sécurisés. Et cela est la seule association de ce type à tout Maroc ! Il y a des crèches sociales, mais ici il n'y a pas des conditions, on s'occupe même de visites chez médecins. Je n'ai pas d'aide, je l'ai créé avec mes propres moyens. Il n'y a pas de soutien de part de la ville. L'immigration est visible et chez nous il y a même deux garçons de Cameroun. Avant on n'avait pas l'immigration extérieure, que les paysans vers la ville. Mais aujourd'hui c'est la catastrophe, tout le monde veut partir, les marocains aujourd'hui veulent émigrer. Je ne sais pas pourquoi ! Et il faut que l'Etat change cette mentalité. Ailleurs ils n'ont pas le Paradis, il faut travailler. Le risque ni catastrophe naturelle ici à Tétouan il n'y a pas. Il y a de pluie, vent, froid, mais rien de grave. C'est normal, même les inondations, ce n'est pas grave, ici il n'y a pas des gens qui meurent. Quand on compare avec les autres parties de monde en Amérique latine et en Chine, ici ce n'est pas grave. La ville n'organise pas les séances de sensibilisation, mais il y a des associations de la protection de la nature et elles organisent les séminaires. On apprend un peu à l'école au cours de géographie, au Japon les tremblements de terre, en Inde les vents de moussons. Et au Maroc ils n'ont pas trop de chaleur pour les incendies naturelles donc chez eux les incendies sont provoqué par l'erreur ou volonté humain. La seule chose que je demande est qu'ils gardent la nature, à Tétouan il n'y a pas des parcs ni coins verts, pour respirer et pour se connecter avec la nature, l'aménagement de côtes d'oued va être touristique avec les hôtels et restaurants, mais pas des parcs pour la population. Avant Tétouan était tellement mieux qu'aujourd'hui, la ville, les rues, le maintien des maisons, la

vie culturelle est le point fort. Par contre, le point faible est peu de travail pour la vie sociale, et manque de sécurité et la drogue partout, les contrebandiers sur la frontière avec l'Espagne. Il y a pas mal de points noirs. Tétouan n'a pas de problème de changement climatique parce que Tétouan n'est pas une ville industrielle, notre ciel et soleil sont très clairs. Ici on avait toujours froid et le vent, c'est le même climat comme quand j'étais enfant. Les grands-mères disent qu'avant il avait plus de la pluie, beaucoup plus que maintenant, mais dès que je sais c'est le même climat que j'ai vécu depuis mon enfance.

#### *22. Male Associate, 55, Chefchaouen*

Notre association, basée à Chefchaouen et créée en 1996, travaille sur toute la région, sur 4 axes principales : environnement et l'éducation sur l'éducation (la ville est au cœur de la biosphère intercontinentale Espagne-Maroc avec 2 parcs qui ont le potentiel écologique énorme et comme la population habite dans les parcs il faut trouver un équilibre), l'autre axe est le tourisme durable, après aussi l'intégration de la femme dans la vie locale (formation, appui psychologique, juridique, éducation) et la valorisation des produits locaux. L'association a évolué avec le temps et aujourd'hui est sur +600 adhérents, ~50 conseil d'administration et 9 personnes dans le bureau exécutive, tous bénévoles, qui travaillent avec les salariés sur les différents projets et qui sont en ce moment 12. Les élections sont triennales. Nous travaillons administrativement avec les provinces, il faut les aviser, mais on travaille directement au niveau de la commune. Pour l'instant nous travaillons maintenant à Oued Laou sur la valorisation agricole des oignons. Au début la population n'était pas très favorable à nos activités qui étaient pour eux quelque chose de nouveau, par exemple l'organisation des gites touristiques, mais quand ils ont vu que ce développement est aussi pour leur bénéfice ils ont accepté et maintenant ils sont de plus en plus favorable à nos activités grâce à cette confiance que s'est créé. La population voit que le temps de projet est respecté et exécuté, et que le temps d'administration est totalement en décalage. Il y a beaucoup de glissement de terrain ici, il y a vers 8 ans un glissement vers Arshur, connu touristiquement en direction de parc, qui a détruit tout un village, aussi vers Al Hoceïma sur les routes de mer et de Rif, grâce à l'évolution géologique de Rif, grâce à la déforestation et récemment grâce au changement climatique de la pluie, pas dans le volume mais dans le temps (200 mm en 24 h ici à Chefchaouen). Et il y a aussi des incendies forestiers, le plus souvent sont les incendies provoqués. Je ne crois pas que les gens sont sensibilisés suffisamment par rapport aux risques naturels. Nous avons beaucoup travaillé dans la sensibilisation concernant les incendies forestiers, un peu aussi sur le glissement du terrain et le lien avec la déforestation, mais nous n'avons pas intervenu sur les autres risques. Même l'administration ne fait pas la sensibilisation, ils arrivent après l'événement pour le remédier, mais pas avant pour l'anticiper. Il faut que l'administration ait le plan d'action et d'urgence. L'Etat ne peut pas assurer les constructions donc les gens construisent eux même et d'autre côté l'autorité local ferme les yeux devant la construction et quand le quartier devient trop grand ça c'est après trop difficile d'arrêter la construction et l'agence d'urbanisme fournit l'infrastructure et les services de base et la population reste prier le Dieu que quelque grand événement ne se produit. Concernant le changement climatique, d'abord on ressent le décalage des saisons au niveau marocain et les précipitations ont commencé de tarder 1 mois de ce que je connaissais comme jeune. L'autre est l'intensité de pluviométrie, aussi ressenti par la population. Et même si on est dans une zone de pluie intense, il y a maintenant des zones qui manquent d'eau pendant été. Ce que la population ne ressent pas c'est la répartition des espèces et nous essayons d'expliquer ça, que certaines espèces vont être menacées dans leur distribution climatique. Le bien-être de vivre à Chefchaouen, c'est la ville écologique agréable à vivre, au milieu d'espace naturelle de valeur, on est ici comme dans un jardin à large échelle. L'accessibilité reste très faible, les routes manquent. Et maintenant nous avons très forte influence touristique et il faut la maîtriser pour que ça ne soit pas dévastatrice écologique. Il faut que les responsables commencent à penser à cet équilibre. Nous avons travaillé avec la commune sur la vision de la ville intermédiaire 2030 et il faut que la commune l'intègre dans tous les projets. Derrière tout notre travail il y a l'appui de la politique, c'est indispensable. Ex L'interdiction de cannabis est un choix politique, nous ne pouvons pas le combattre, nous pouvons que adhérer à une volonté politique.

#### *23. Male Associate, 50, Larache*

Pour moi, l'association, le travail associatif est celui qui donne sens à ma vie, en ce qui concerne les enfants et le bruit que tu entends, tout ça est pour eux, pour moi ces enfants ne sont pas seuls, ils ont des parents ou des tuteurs qui souffrent de difficultés et de conditions précaires dans leur vie. Nous dans cette association on accueille tous ces gens-là, et ceci remplit un grand vide dans ma vie. A titre personnelle, j'ai mon propre boulot mais j'ai bien trouvé refuge au sein de cette association, c'est ce que je peux dire à propos de l'association. En ce qui nous concerne (autant qu'association), la chose la plus importante est l'éducation, car si on a l'éducation on a tout, car on a des gens conscients, donc si ces enfants arrivent à bien s'instruire et devenir intellectuels, l'éducation c'est tout ce qu'il faut. Car dès que ces enfants aient une certaine éducation et qu'ils se confrontent avec la société, ils vont devenir des gens positifs. En ce qui me concerne comme riverain ayant grandi dans cette ville radieuse, une ville que j'aime beaucoup et

que je ne m'imaginerai jamais la quitter un jour, mon problème à moi, quand j'étais petit je sens par rapport à mon enfance un très grand changement. Ce qui a changé, et ce que je constate c'est le nombre d'habitants, dans la passé ils n'étaient pas nombreux, et tu les trouves chacun bien prendre soin de ces enfants et son foyer, les rues étaient bien propres, la présence d'une certaine entraide entre les habitants (en ce qui concerne la question de la propreté). Il y avait donc un certain travail associatif d'une manière spontanée, c'est-à-dire les gens étaient très solidaires entre eux, malheureusement, ces derniers temps j'ai pu constater que c'est devenu chacun pour soi. En ce qui concerne la propreté, les gens s'y prennent moins d'importance surtout à la question de la gestion de leurs ordures ménagères. Moi personnellement chaque matin, je balaye la cours et la rue devant ma maison il y a tant d'années et malheureusement, aucun de mes voisins n'est venu un jour pour me prêter main forte pendant qu'ils me voyaient faire ça tout seul (il a utilisé le mot « honte : que personne n'avait dit, la honte, on doit tous participer à ça ! »). Et ce comportement passif de mes voisins me fait de la peine, mais je garde toujours espoir qu'un jour ces gens-là vont s'en rendre compte et prennent eux aussi les choses en main pour participer à la préservation de l'environnement de vie. Personnellement, je ne comprends toujours pas cette passivité, est-ce que par manque de conscience ? Où c'est juste leur éducation qui est comme ça, moi je pense que c'est plutôt question d'éducation, car si une personne est sale à l'intérieur même de sa maison, comment veux-tu qu'il se soucie de l'extérieur (les rues, le quartier). Mais pour moi le changement que j'ai constaté entre mon enfance et maintenant à l'âge de 50 ans c'est la dégradation de l'opinion publique vis-à-vis des questions comme la propreté et le maintien des services et biens publics (propreté, sécurité, éclairage, etc.). Les changements d'un point de vue économique, parlons du tourisme par exemple, il y a eu une chute drastique, dans le passé, ce sont des espagnols qui vivaient chez nous, et tu te sens que ces étrangers ramènent leurs familles, amis et la ville était propre, et maintenant les repères de la ville ont changé, y avait des cinémas (cinéma España, une autre), c'était pour nous les habitants une sorte de fierté symbolique, même d'un point de vue architectural, malheureusement ces cinémas ont été démolis et on a construit à leur place des bâtiments (logements). Ce qu'on essaye maintenant c'est de faire des choses (activités !) en dehors de la ville, le jour où l'autoroute est passée par là, la ville a été marginalisée. Avant quand une personne voulait faire le trajet entre Rabat et Tétouan ou Tanger, il devait passer obligatoirement par notre ville, mais maintenant ce n'est plus le cas car il prend l'autoroute, du coup le centre-ville est « mort », tout fonctionne au ralenti, commerce, industrie, agriculture, pêche, tout, au point que si une personne entre dans notre ville, il la sent directement « froide », il se demande même où sont les habitants, où est-ce qu'ils dorment ? Mais avant ce constat il faut comprendre ce qu'a tué la ville, tant de choses, dont l'autoroute et la délinquance, des gens qui se baladent avec des sabres ! Imaginons un touriste qui vient et voit un délinquant comme ça ! Dans les plages pareil, il y a beaucoup de saletés, il faut la propreté, on essaye de travailler avec des associations qui activent dans le domaine de l'environnement, on s'associe tous et on consacre une journée spéciale pour la sensibilisation des gens et aussi pour une campagne de nettoyage, les autorités aussi devront nous aider à faire cela en déployant leurs moyens logistiques et main en main la ville sera plus propre et on aura plus que le « cordon bleu » (apparemment un label pour les ville propres et j'imagine aussi côtières à cause de la couleur bleue que porte le nom). Beaucoup d'usines ont fermé leurs portes. Nous avons des migrations internes, de la campagne à la ville, et les ruraux ne sont pas bien éduqués ! Ils s'en foutent de tout ! Pour l'immigration, il faut savoir que ces gens qui viennent s'installer ici ils construisent des bidon villes et font du commerce de légumes illégalement, après l'état leur cède 70 mètres carrés et ceci n'a aucun intérêt ou apport pour la ville. Ceci va davantage tuer la ville. Ces gens exercent n'importe quel type d'activité lucrative, le père vend les légumes, la mère travaille comme femme de ménage chez les particuliers en ville et l'enfant dès son très jeune âge est exploité pour rapporter de l'argent à travers de petits boulots loin de la surveillance des parents ce qui va l'amener plus tard à la délinquance, résultat des courses, la désintégration de la famille. Pour cela dans le centre-ville ou même dans la banlieue si tu te balades tu vas être choqué de ce que tu vois, même si l'Etat les a aidés pour se débarrasser des bidon villes au détriment d'un logement décent, la mentalité est restée la même. Les risques que nous avons tout le temps et constamment sont les inondations, tu sais quand la pluie tombe, surtout dans des régions comme (Djennane Baydawa) ici au centre-ville, des ruisseaux se forment à cause du problème d'assainissement (très mal fait), quand la pluie tombe, les gens quittent leur maisons car l'eau pénètre jusqu'à l'intérieur, mais ces gens-là se sont adaptés à ces situations et ils sont débrouillards, dès que le risque arrivent, ils quittent la maison car ils connaissent bien le danger de rester à l'intérieur. Ensuite, dès que c'est le beau temps, ils reviennent tranquillement à leurs maisons ! Donc ces gens-là, ne sont pas aussi embêtés que ça par les inondations ! Il y a aussi le problème des canicules pendant l'été, dans ces bidon villes, la température est intolérable à cause des matériaux de construction de ces bicoques, mais malgré ça, les résidents de ces quartiers finissent toujours par s'adapter avec la situation, nous avons un autre type de gens qui habitent à côté des cimetières (un exemple pour montrer à quel degré ces gens-là sont capables de s'adapter avec les situations difficiles). En ce qui concerne les feux de forêts, juste à côté de la plage, les gens ont assisté récemment à un feu de forêt mais sans rien faire pour sauver la végétation. Pour moi il faut interdire les barbecues dans la forêt car c'est très dangereux. Au sein de la forêt aussi il y a des traces de très grand incivisme (saleté, etc.). On n'a pas de séisme, pas de tremblement de terre. Pour les tempêtes aussi. Il y a la sécheresse bien sûr, pour les agriculteurs c'est très mauvais. C'est un enchaînement, selon moi, du

moment que la population augmente, le chômage augmente aussi, et avec lui la délinquance, les stupéfiants, problèmes économiques et sociaux, par la suite le problème des catastrophes naturelles prend de l'ampleur ! L'exploitation des forêts, auparavant y avait pas ça, y avait une exploitation durable, maintenant on coupe les arbres n'importe comment, on rase tout, pourquoi, parce que il y a une course vers l'exploitation des ressources naturelles due à une forte demande du bois, et aussi par besoin de terrains constructibles, à l'époque y avait plein de fermes d'orangers, on était un grand exportateur d'oranges, il y avait même beaucoup d'usines (des unités de transformation en boîtes de conserve des différents fruits et légumes). Des unités industrielles espagnoles. La mentalité des gens ! Pour moi ce n'est pas facile, c'est une question de volonté, si on veut on peut. Comme montrer le bon exemple, si tu vois quelqu'un faire une bonne action tous les jours (nettoyage des ordures dans les lieux publics ou à côté de la maison), si on fait ça continuellement, les gens vont se remettre en question, car la personne est en train de faire de bonnes actions (entretien et plantation d'arbres, décoration, etc.). J'ai pour vous un message, nous on se doit d'être propres, et pour moi je n'arrive pas à voir en cela un problème (le fait d'être propre et vouloir un environnement propre), donc pour moi le seul problème c'est bel et bien la mentalité. Y avait une école de langues (anglais) et y avait une personne anglaise très âgée (apparemment le professeur), qui était de passage au moment où une personne faisait du nettoyage dans la rue, alors cet anglais lui a prêté main forte, et ensuite il a même donné un cadeau à cette personne bienfaitrice (le marocain) et lui a félicité pour son acte de civisme, alors qu'à la base cet homme (l'anglais) n'a aucune relation avec nous dans notre ville, lui il est anglais et ça lui a plu au point de venir aider à ça tous les jours ! C'est facile pour moi de changer les mentalités, car quand on dit à une personne « adulte » ne mange pas le poison et mange le pain, alors il suit notre conseil, et automatiquement si tu lui dis mange le poisson, il ne le fait pas car il est conscient du danger, à l'encontre, pour un enfant, si on lui dit mange le poisson il le fera car il n'est pas conscient, donc le problème pour moi réside dans nos mentalités, elle manque de beaucoup de choses et nécessite beaucoup d'améliorations et je pense qu'on est en train de gaspiller beaucoup de notre temps. Il est toujours possible de se rattraper dans un si peu de temps si on le veut, pas besoin de beaucoup de temps. Dans les campagnes de nettoyages qu'on fait, les seules personnes qui participent et qui s'impliquent sont seulement nos enfants, on constate un refus et un mépris du reste de la société (ils parle des adultes), un autre exemple pour montrer la faible implication de la population dans le travail associatif, si par exemple une personne a un talent dans le dessin et que tu lui demandes d'adhérer une association pour développer son talent et participer dans les différentes activités avec les différentes catégories de la société durant les week-ends par exemple, il refusera et te dira qu'il n'a pas le temps pour ça, qu'il ne veut pas être exploité par d'autres ou juste que ce n'est pas lucratif pour lui, alors que quand il s'agit de flâner ou juste passer du temps dans les cafés, il peut y rester du matin au soir sans souci de perte de temps !

#### *24. Female Associates, 30, Tangier*

Je suis tangéroise de naissance, je suis né ici à Tanger, mais je ne me souviens pas d'une catastrophe naturelle ici à Tanger. Par la suite je peux dire qu'on avait un problème d'inondation ici, il a beaucoup pleut et comme la structure de sol n'est pas bonne ils avaient des problèmes. Ils pouvaient vraiment même ne pas sortir de chez soi dans quelques quartiers. Ici le développement est très léger et très, très lent. On espère de vivre une ville plus simple. Quand même je ne m'imagine pas de me déménager. Franchement je pense que les anciens bâtiments sont plus durs que les nouveaux, et s'il y a un bâtiment qui s'est écroulé ce n'est pas d'une raison naturelle mais c'est plutôt de triche de construction. Je parle de petites maisons, qqn qui triche, et on avait des cas où ils n'ont pas mis de bon fer ou bon ciment, je ne sais pas. Concernant les immigrants je crois que leur but est juste de passer vers l'Europe, mais ici ils arrivent de s'intégrer, je pense qu'ils sont bien accueilli par les marocains. Je les vois travailler dans le souk, dans les rues, mais ils ne travaillent pas dans les bonnes conditions, sans domicile, sans abri, mais on est quand même une société qui est bien touché par le besoin d'autre. Ce n'est pas un vrai travail qu'ils ont, mais ça leur permet de se débrouiller, de continuer. Je ne pense pas que la vie à Tanger est une vie en rose, bien au contraire, il y a de crime, peut-être ils regrettent d'avoir décidé de passer par ici. Je pense qu'il y a des associations qui sensibilisent les gens sur les immigrants, mais je doute qu'il y en a pour les risques naturels. Je suis informé sur les inondations parce que on les avait ici, pas très grand, mais quand on ne pouvait pas sortir de chez nous. Ici nous n'avons pas beaucoup d'espaces verts, que la construction des grands immeubles partout et n'importe où. La sensibilisation passe que par les écoles, jamais la municipalité. Points faibles de la ville sont la pollution, beaucoup de voitures, peu d'espaces verts et aucune sensibilisation. Autre : Je suis tangéroise de naissance. Points forts de vivre ici sont le climat et les gens, je suis attaché à vivre ici, mais bien sûr il y a des problèmes de vivre ici, comme partout. Ici il n'y a pas beaucoup d'espaces verts, trop d'immeubles. Le développement touristique est assez récent, le port de plaisance date de cette année, 2018, les hôtels sont aussi assez récents. Cela porte un peu du tourisme, mais nous avons beaucoup d'industrie aussi, les usines de voitures, de Renault. Malgré tout ça il y a pas mal de chômage, les gens viennent de travailler ici de partout. L'immigration intense est ici ça fait vingtaine des années. A la base ils essayent de traverser vers l'Europe, mais comme ils ne réussissent pas, ils s'installent ici. C'est difficile de les intégrer, je ne sais pas s'ils ont des diplômes, tu les vois plutôt mendier ou voler. Je garde dans ma mémoire une inondation, il y a 4-5 ans. Les gens sont restés coincés chez eux ou dans leurs bureaux.

Je suppose que les égouts sont en mauvais état. Comme nous sommes ici à côté de la mer et avec le niveau de mer qui augmente, il y a toujours de risque. On a eu un grand incendie vers l'océan au sud l'année dernière, ce n'était pas naturel. Les incendies arrivent des fois, mais ce fois ci était très près d'habitants. Je pense que ce sont que 20% les incendies naturels et 80% l'humain. Concernant les inondations, il y en a partout, pas que au Maroc, mais on se dit qu'on peut toujours faire mieux. Point faible est qu'il y a de moins en moins des espaces verts et les routes ne sont pas très bien faits pour cette quantité de trafic. Il y a un peu d'associations qui plantent les arbres et ramassent les déchets.

*25. Male Associate, 55, Tetouan*

Malheureusement comme ça sans rendez-vous je n'ai pas pu inviter les spécialistes. De point de vue religieux, il y a deux parties : on sait que les facteurs naturels géologiques qui influencent, et d'autre côté religieux car on est croyant. Mais d'abord, on doit déterminer la définition des risques naturels. Si on parle de tous les risques on croit donc qu'il y a une force extraordinaire qui gère ces phénomènes, qui contrôle tout l'univers, la volonté du Dieu. Il n'y a pas de différence de ce que nous croyons et ce que vous croyez, sauf que nous croyons que ces risques sont contrôlés par une force de Dieu qui est plus forte. Par exemple, effectivement, ici au Maroc, si la précipitation est moins intense, s'il y a la sécheresse, on invite des gens à prier ensemble la prière d' Istiskae en demandant Dieu de nous aider à avoir de la pluie. Le sujet de risque, les séismes, est plus abordé par la Faculté de sciences, mais ici aussi on parle un peu de ça, mais ce n'est pas un sujet principal. Et pour les victimes, on prie pour eux, on demande au Dieu de les ouvrir la porte de paradis. Même les incendies et les inondations sont décrits dans le Coran, il y a des flashes, c'est tout dans le Coran. L'imam a une action forte. Il parle toujours à la population sur les risques en vue islamique, il essaie d'expliquer à population. L'islam n'a été jamais contre le savoir, contre la science, l'islam est complémentaire à science, comme selon les premières phrases transmises de Dieu au prophète, le premier surah est lis, éduque toi, lis au nom de ton Dieu, de ton Dieu qui t'a créé. Les imams enseignent les croyants de se protéger, dans les communes ils jouent un rôle très important, et ça reste toujours au niveau de l'islam, mais les autres [institutions] ne font pas leur devoir. Ici au Maroc, on n'est pas au Japon, ici on n'a pas une prévention, on ne prévoit pas les incendies, l'inondation. C'est un inconvénient. La nature est intégrée dans l'homme. S'il y a une inondation, on baisse les mains et on dit : C'est le Dieu qui veut ça, c'est son décision et on ne peut pas être contre. L'islam s'intéresse beaucoup à l'environnement, les forêts, la mer. Mais dans leur Faculté les questions prioritaires de recherche sont la croyance et la pensée islamique et le sufisme. L'imam agit, mais que avec des paroles, en se basant dans la première catégorie sur les paroles de Coran et deuxièmement sur les paroles du prophète, car un imam n'a pas le pouvoir ni les moyens d'agir, de construire, donc il parle aux gens, que des paroles.

## Abstract

Risk management indicators are used to mitigate the potentially dramatic effects of natural hazards. Local authorities and managers use them in elaborating rescue and urbanism plans, which do not always work, highlighting society's vulnerability in the particular context of global environmental and climate changes. Within this context, the United Nations (Sendai, 2015) advised constructing a series of indicators to better cope with human losses and economic disasters. In fact, the question is whether or not such indicators do constitute successful decision-making tools. This interdisciplinary PhD thesis aims at identifying reliable risk indicators and societal responses related to multiple risks (natural risks and climate change impacts) to provide a governance framework for disaster risk reduction. The recent literature was critically reviewed to assess how indicators are currently being constructed in risk management. Since different societies face diverse risks and do not necessarily have the same level of local perception confronting them, two sites were selected from the Mediterranean basin, one chosen from the South coast (North Morocco), other from the North coast (the Italian island of Sardinia). North Morocco, the region of multi-risks, is characterized by high demographic and economic pressures; West Sardinia counts for remarkable biodiversity of wetlands and is characterized by high environmental and agricultural pressures, which in both cases intensify the vulnerability of the coastal areas. Testing for the local population's preparedness to change allowed discussing the spatial and temporal scale at which indicators of risk management can be applied. Based on these findings, further ideas on a new series of less descriptive, more dynamic, and more user-friendly indicators are suggested. The obtained results could serve in future governance frameworks for the mitigation of natural hazards in the Mediterranean region and wider. Finally, the dire need for continuous work to overcome the communication gap between the scientific community, risk administrators, and the general population is encouraged.

*Keywords:* indicators, vulnerability, risk, hazard, management, climate change

## Résumé

Les indicateurs de gestion des risques sont utilisés pour atténuer les effets potentiellement dramatiques des aléas naturels. Les autorités locales et les gestionnaires les utilisent pour élaborer des plans de sauvetage et d'urbanisme, qui ne fonctionnent pas toujours, mettant en évidence la vulnérabilité de la société dans le contexte particulier des changements environnementaux et climatiques mondiaux. Dans ce contexte, les Nations Unies (Sendai, 2015) ont conseillé de construire une série d'indicateurs pour mieux faire face aux pertes humaines et aux catastrophes économiques. En fait, la question est de savoir si ces indicateurs constituent ou non des outils décisionnels efficaces. Ce doctorat interdisciplinaire vise à identifier des indicateurs de risque fiables et des réponses sociétales liées aux risques multiples (risques naturels et impacts du changement climatique) afin de fournir un cadre de gouvernance pour la réduction des risques de catastrophe. La littérature récente a fait l'objet d'un examen critique pour évaluer la manière dont les indicateurs sont actuellement construits dans la gestion des risques. Étant donné que différentes sociétés sont confrontées à des risques divers et n'ont pas nécessairement le même niveau de perception locale, deux sites ont été sélectionnés dans le bassin méditerranéen, l'un choisi sur la côte sud (le nord du Maroc), l'autre sur la côte nord (l'île italienne de Sardaigne). Le nord du Maroc, région à risques multiples, se caractérise par de fortes pressions démographiques et économiques; la Sardaigne occidentale compte une biodiversité remarquable des zones humides et se caractérise par de fortes pressions environnementales et agricoles, qui intensifient la vulnérabilité des zones côtières. Tester la préparation de la population locale au changement a permis de discuter de l'échelle spatiale et temporelle à laquelle les indicateurs de gestion des risques peuvent être appliqués. Sur la base de ces résultats, d'autres idées sur une nouvelle série d'indicateurs moins descriptifs, plus dynamiques et plus conviviaux sont suggérées. Les résultats obtenus pourraient servir dans les futurs cadres de gouvernance pour l'atténuation des risques naturels dans la région méditerranéenne et au-delà. Enfin, le besoin urgent d'un travail continu pour combler le fossé de communication entre la communauté scientifique, les administrateurs des risques et la population générale est encouragé.

*Mots clés :* indicateurs, vulnérabilité, risque, aléa, gestion, changement climatique