~~The importance of raising risk awareness: l~~Lessons learned about the importance of raising risk awareness ~~sessions from~~in the Mediterranean region (North Morocco and West Sardinia, Italy)

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Abstract. In order to mitigate the potentially dramatic effects of natural hazards, risk management measures are critical. Local authorities and managers use different indicators, usually modelled using statistical data such as % of vulnerable groups, minorities, per capita income, to quantify rescue and urbanism plans. However, existing risk indicators are often unidimensional and have certain limitations. The lack of interdisciplinary indicators and adaptable governance frameworks highlight society's vulnerability in the particular context of global environmental and climate change. This interdisciplinary research aimed at identifying reliable risk indicators and societal responses regarding natural hazards and climate change impacts, to provide a governance framework for disaster risk reduction. Different societies face diverse risks and do not necessarily have the same level of local awareness confronting them. To explore the diversity of risks, two sites were thus 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 for future financial protection allowed discussing the importance of risk awareness sessions as an indicator of risk management. The significance of risk awareness sessions is shown in a quantitative part of the study, and its importance is also discussed with local stakeholders in North Morocco in a qualitative part of the study. It is shown that, although risk awareness sessions are recognized as important in risk management, they are not necessarily implemented. Based on these findings, further ideas on a new series of less descriptive, more dynamic, and more user-friendly indicators are suggested. How can risk sessions be a dynamic indicator of a resilient society? The obtained results could serve in future governance frameworks for the mitigation of natural hazards in the Mediterranean region and wider. Finally, the urgent need for continuous work to overcome the communication gap between the scientific community, risk administrators, civil society and the general population is encouraged.

1 Introduction

Different societies living in one area sometimes face the same natural hazards, but do not necessarily have the same level of local risk awareness based on a knowledge uptake. They do not share a common conceptual understanding of that risk, which is reflected by risk perception (Slovic et al., 1976). Actually, vulnerability of societies is a dynamic process, always relative to a certain situation and depends on local knowledge, practices, and cultural specificities. The importance of local knowledge for sustainable disaster risk reduction and management is largely recognised by international policy, such as the Sendai Framework for Disaster Risk Reduction (UN, 2015) and other international policies dealing with climate adaptation (Sakic-Trogrlic et al., 2021). The question of values (Zinn, 2009) and cultural and socio-economic background (Joffe, 1999; Joffe et al., 2013) are key societal problems when dealing with risks. Risk awareness and perception result in with a certain precautionary behaviour which shows their relevance for risk management. However, the extent to which the is local knowledge is translated into concrete, effective and practical measures is still open to debate.

More than 500 million people are estimated to live currently in the countries bordering the Mediterranean Sea (Karadirek et al., 2019), with around 150 million people living along the Mediterranean coasts (Cramer et al., 2018). The Mediterranean basin is one of the cradles of civilisation and has always been an attractive migration hub, nowadays also the most visited tourist destination in the world. This region is prone to many natural hazards (Satta et al., 2016), and due to a very dense population, a vulnerability hotspot. It is one of the regions most vulnerable to global warming, with a forecasted temperature rise of 2-3°C by 2050 (Plan Bleu, 2019). The region is projected to experience the highest increase in the frequency of occurrence of extreme weather events due to climate and environmental change (Vousdoukas et al., 2017), and the open question is whether the population is aware of those imminent risks.

In this paper, North Morocco and West Sardinia, two case studies from the Mediterranean basin, are compared, in order to explore what could contribute to increased risk awareness and precautionary behaviour of the local, general population. These two studies provide the opportunity to compare how participating in risk awareness sessions is translated into practice. A face-to-face questionnaire-based survey of the general population is followed by interviews with the administrators, scientists and associations and the policy literature consultation, to confirm or reject the importance of risk awareness sessions in the actual risk management in the regions. This is important to predict the advantages and flaws of the present risk policy and to overcome a possible risk management gap. Analysing what these two different field studies have to teach us about the wider and more multicultural Mediterranean region would sustain a deeper reflection about how these common risks could contribute to risk management strategy in other interregional locations. The feasible policy advice related to multi-risks and risks related to climate change will be offered, which could contribute to disaster risk reduction in light of the UN Sendai's recommendation, preventing future human and financial loss.

1.1 Risk awareness

A leading role in efficient risk management is played by risk perception, a concept that~~which~~ is already widely recognized in risk literature, but still with some actual open questions. 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) suggested 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 a 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.~~ Rohrmann (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 to identify 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.

A~~Furthermore, a~~nother discipline that has a say in risk perception is applied social psychology. Moreover, as argued in the paper by ~~I.~~ Langford (2002), social and cultural settings need to be studied to determine 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 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.

However, w~~W~~hen determining 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 (AlQahtany and Abubakar, 2020), with awareness at times~~sometimes~~ considered to be just one of the components to measure risk perception (Khan et al., 2020)~~or even considered as synonyms~~, ~~here~~ the concepts in this paper draw from the distinction made by Papagiannaki et al. (2019a, 2019b). Risk awareness is, therefore, reflected 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. Papagiannaki thus considers that risk awareness is a less technical concept than risk perception. A recent study on hydrogeological risk awareness and preparedness in Italy (Mondino et al., 2020) concluded that lack of big

events and poor risk communication strategies can cause risk awareness to decrease. This shows that risk awareness is essential for adequate risk management policies and needs to be further explored. Moreover, since risk questions are always societal problems and relate to values (Zinn, 2009), tThe cultural context needs to~~will~~ be tested.

105 Inspired by a cultural approach that considers risk as a social and cultural construct (Bertoldo, 2021), this study will~~hile~~ compar~~ing~~e two different societies, with~~from~~ different socio-economic contexts. ~~, inspired by a cultural approach that considers risk as a social and cultural construct (Bertoldo, 2021).~~ T~~Cross-cultural differences between North Morocco and Sardinia will be detected, and the actual risk behaviour of North Moroccans and Sardinians will be described, in line with Rohrmann (1998). so t~~The focus ~~here~~ will be ~~more~~ on the indicator of risk awareness and its impact on precautionary behaviour, in order to 110 understand the practical drives for~~considering the cultural context for~~ measure-taking. ~~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 (Bertoldo, 2021). Cross-cultural differences between North Morocco and Sardinia will be detected, and the actual risk behaviour of North Moroccans and Sardinians will be described, in line with Rohrmann (1998). Sin addition, since it was shown long ago that the communication and the transfer of information contribute to different risk~~ 115 ~~perceptions between the experts and non-experts (Slovic et al.,1976, Covello, 1983, Renn, 1998), the efficiency of risk communication between the general population, scientists and managers will also be examined.~~

~~1.2 The study sites~~

~~The chosen fieldwork of this study are North Morocco and Sardinia in the Mediterranean basin (Fig. 1). The Mediterranean basin is densely populated region and also the most visited region in the world, with more than 330 million visitors in 2016~~ 120 ~~(Tovar-Sánchez et al., 2019). This region is prone to many natural hazards. The International Panel on Climate Change (IPCC) identified the region as one of the most vulnerable regions to global warming, forecasting a temperature rise of 2-3°C by 2050, which makes it a climate change 'hotspot' (Plan Bleu, 2019). With the rise in frequency of occurrence of extreme events, the concern grows with the increase of population in the region.~~

~~The region of North Morocco is a multi-risks zone, which is worth studying due to the increased complexity of social and~~ 125 ~~natural processes. The region is prone to natural hazards particularly due to the seismic activity in the Gibraltar/Alboran region, between the Nubian and Iberian plates, that hosted disastrous earthquakes like 1755 Lisbon and 2004 Al Hoceima events (Neres et al., 2016). In addition, due to natural predispositions (lithology and slopes) and land use of the Rif Mountains, as well as the location on the transition between different climate types, the area frequently suffers from landslides, erosion, droughts, floods and flash floods (Ivčević et al., 2020a). The region's coasts are also of decreased resilience to climate change~~ 130 ~~due to the heavy urbanisation of the coastlines (Snoussi et al., 2010), that are highly exposed to sea level rise (Satta et al., 2016) and possibly tsunamis (Benchekroun et al., 2015). During the last decades, the vulnerability of the region increased since the region became a big economic hub at the end of the 20th century, with a touristic infrastructure boom (Fig. 2) and the project of harbour Tanger-Med. Nevertheless, Morocco maintains, in its modernity, very strong traditional components, with the traditional forms of use of space (El Abdellaoui et al., 2008). The population lives of land, and the agricultural sector~~

135 ~~is the backbone of the regional economy (Salhi et al., 2020). Besides, Morocco is a Muslim society, with religion playing a significant influence on opinions and perceptions of risk, particularly seismic one (Paradise, 2008).~~

~~The coasts of West Sardinia are amongst one third of areas exposed to the highest level of hazard in the Mediterranean basin, mostly due to very high wave heights (Satta et al., 2017). The area of the Gulf of Oristano is frequently hit by extreme weather events, above all flash floods and coastal storms, predominantly during the cold season. Also, a maximum relative sea level~~

140 ~~for the Gulf of Oristano and the year 2100 is expected at about 949 mm above sea level based on the IPCC AR5 8.5 scenario, which could leave some parts of the gulf partially flooded (Antonioli et al., 2017). Regarding flooding, wetlands in this area (Fig. 3) play a vital role in disaster risk reduction, but they also create a conflict between urban, fishing and farming activities, with the famous fishing town of Cabras, and the fertile area of Arborea, home to an extensive agricultural production. In addition, Sardinians have a long tradition of autonomous governance and environmental awareness, which even included~~

145 ~~wildfire regulations in the 14th century (Ivčević et al., 2020b).~~

~~1.3 Summary and goals~~

~~Each territory is unique, and risks are socially constructed and locally managed. Local knowledge is recognised as valuable in the efficiency of disaster risk reduction of resilient societies. This is true at least theoretically, as promoted by the Sendai Framework for Disaster Risk Reduction (UN, 2015) and other international policies dealing with climate adaptation (Sakic~~

150 ~~Trogrlic et al., 2021). Accounting for local risk awareness contributes to tailoring risk management policies compatible with the core values of the communities at stake, hence facilitating the support of the local population.~~ The main questions we, therefore, ask in this paper are: Are locally organised sessions dedicated to increasing risk awareness a predictor of societal resilience facing risks? More precisely, are the participants in risk sessions associated with higher risk awareness and do they opt more for precautionary behaviour?

155 This comparative quantitative and qualitative study contributes to explaining risk preparedness by comparing the role of risk awareness sessions to all stakeholders included in risk management processes. It describes relations between risk awareness and precautionary behaviour in two areas chosen from the Mediterranean basin~~, North Morocco and West Sardinia~~. It also explores the role of risk awareness sessions in explaining ~~individual future~~ the precautionary behaviour of investing money to protect. Finally, it discusses the additional benefits ~~of~~that risk awareness sessions can have when constructing~~in the~~

160 ~~construction of~~ dynamic indicators of risk management.

2 Methodology

~~The study was imagined to choose two regions from the Mediterranean basin that face some of the natural hazards.~~ ~~The study was imagined to choose two regions from the Mediterranean basin that face some of the natural hazards.~~ ~~Then, the survey was organised with the general population using the set of the main topics, but adapting to the regions' particularities. In addition,~~

165 ~~the interview guide was elaborated, to hold a series of talks with the main stakeholders included in risk management, if deemed~~

relevant and if there is a lack of secondary literature on risk management in the region, to learn some lessons about the importance of raising risk awareness.

2.1 The study sites

More than 500 million people are estimated to live currently in the countries bordering the Mediterranean Sea (Karadirek et al., 2019), with around 150 million people living along the Mediterranean coasts (Cramer et al., 2018). The Mediterranean basin is one of the cradles of civilisation and has always been an attractive migration hub, nowadays also the most visited tourist destination in the world with more than 330 million visitors in 2016 (Tovar-Sánchez et al., 2019). This region is prone to many natural hazards (Satta et al., 2016), and due to a very dense population, a vulnerability hotspot. The International Panel on Climate Change (IPCC) identified the region as one of the most vulnerable regions to global warming, forecasting a temperature rise of 2-3°C by 2050, which makes it a climate change 'hotspot' (Plan Bleu, 2019). The region is projected to experience the highest increase in the frequency of occurrence of extreme weather events due to climate and environmental change (Vousdoukas et al., 2017), and the open question is whether the population is aware of those imminent risks. The chosen field cases~~work of~~ from the Mediterranean basin ~~for this study~~ are North Morocco and West Sardinia ~~in the Mediterranean basin~~ (Fig. 1~~1~~). ~~The Mediterranean basin is densely populated region and also the most visited region in the world, with more than 330 million visitors in 2016 (Tovar-Sánchez et al., 2019). This region is prone to many natural hazards. The International Panel on Climate Change (IPCC) identified the region as one of the most vulnerable regions to global warming, forecasting a temperature rise of 2-3°C by 2050, which makes it a climate change 'hotspot' (Plan Bleu, 2019). With the rise in frequency of occurrence of extreme events, the concern grows with the increase of population in the region.~~

The region of North Morocco is a multi-risks zone, which is worth studying due to the increased complexity of social and natural processes. The region is prone to natural hazards particularly due to the seismic activity in the Gibraltar/Alboran region, between the Nubian and Iberian plates, that hosted disastrous earthquakes like 1755 Lisbon and 2004 Al Hoceima events (Neres et al., 2016). In addition, due to natural predispositions (lithology and slopes) and land use of the Rif Mountains, as well as the location on the transition between different climate types, the area frequently suffers from landslides, erosion, droughts, floods and flash floods (Ivčević et al., 2020a). The region's coasts are also of decreased resilience to climate change due to the heavy urbanisation of the coastlines (Snoussi et al., 2010), that are highly exposed to sea-level rise (Satta et al., 2016) and possibly tsunamis (Benchekroun et al., 2015). During the last decades, the vulnerability of the region increased since the region became a big economic hub at the end of the 20th century, with a touristic infrastructure boom (Fig. 2~~2~~) and the project of harbour Tanger-Med. Nevertheless, Morocco maintains, in its modernity, very strong traditional components, with the traditional forms of use of space (El Abdellaoui et al., 2008). The population lives of land, and the agricultural sector is the backbone of the regional economy (Salhi et al., 2020). Besides, Morocco is a Muslim society, with religion playing a significant influence on opinions and perceptions of risk, particularly seismic one (Paradise, 2008).

The coasts of West Sardinia are amongst one-third of areas exposed to the highest level of hazard in the Mediterranean basin, mostly due to very high wave heights (Satta et al., 2017). The area of the Gulf of Oristano is frequently hit by extreme weather

events, above all flash floods and coastal storms, predominantly during the cold season. Also, a maximum relative sea level for the Gulf of Oristano and the year 2100 is expected at about 949 mm above sea level based on the IPCC AR5 8.5 scenario, which could leave some parts of the gulf partially flooded (Antonioli et al., 2017). Regarding flooding, wetlands in this area (Fig. 33) play a vital role in disaster risk reduction, but they also create a conflict between urban, fishing and farming activities, with the famous fishing town of Cabras, and the fertile area of Arborea, home to an extensive agricultural production. In addition, Sardinians have a long tradition of autonomous governance and environmental awareness, which even included wildfire regulations in the 14th century (Ivčević et al., 2020b).

In this study, North Morocco and West Sardinia are compared, in order to explore what could contribute to increased risk awareness and precautionary behaviour of the local, general population. These two studies provide the opportunity to compare how participating in risk awareness sessions is translated into practice. A face-to-face questionnaire-based survey was organised with the general population using the set of the main topics, but adapting to the regions' particularities. In addition, the interview guide was elaborated, and interviews held with the main stakeholders in North Morocco, as well as policy literature from Sardinia consulted, to confirm or reject the importance of risk awareness sessions in the actual risk management in the regions. In the quantitative part of the study, the used regression model was binary logistic which allows dividing variables into more blocks, tracking the model's progress, with the dependent variable of investing money. Second, qualitative part of the study, represented an additional source of information to be crossed with the responses from the questionnaires. This is important to predict the advantages and flaws of the present risk policy and to overcome a possible risk management gap. Analysing what these two different field studies have to teach us about the wider and more multicultural Mediterranean region would sustain a deeper reflection about how these common risks could contribute to risk management strategy in other interregional locations. The feasible policy advice related to multi-risks and risks related to climate change will be offered, which could contribute to disaster risk reduction in light of the UN Sendai's recommendation, preventing future human and financial loss. A flowchart explaining the steps of the methodology adopted is presented in Fig. 4.

2.21 Participants and fieldwork procedure

The fieldwork procedure was both quantitative and qualitative, organized around questionnaires and interviews. Firstly, to gain the answer on the usefulness of risk awareness sessions, the questionnaires and interviews were used for the Moroccan case study. The questionnaire for the general public resulted in responses of 391 inhabitants of the region North Morocco from eight different communes, responded in a public setting during November 2018. The chosen municipalities belong to areas with a different historical hazardsdifferent historical hazards record and different geographical characteristics and are divided into three areas for the purpose of this study: Atlantic coast (Tangier, Larache), valley of river Martil (Tetouan, Martil, M'Diq) and Rif Mountain zones (Al Hoceima, Chefchaouen, Oued Laou) (Fig. 11). The obtained sample is composed of 44.2% female respondents and thus underestimates the female population (which is represented on the regional level with 49.27%, census

2014). The respondents are on average between 36 and 41 years old (which overestimates the fact that Morocco is a young nation with a median age of 29.5 years, census 2014).

In the Sardinian 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. Hundred and seventy-six inhabitants of the area of
235 West Sardinia from three different municipalities, urban Oristano and rural Cabras and Arborea, responded to our questionnaire in a public setting. This questionnaire-based survey was conducted during May and June 2019. Data were collected face-to-face, by targeting the general population, and about 20 min were needed to complete each survey. The Sardinian sample is composed of 45% of male respondents (figures in the population are 49% from the 2011 census, so our sample underestimates the male population). The average participant is 46.4 years old (44 is the average age in population, census 2011).
240 Secondly, the use of interviews in the North Moroccan study was two-fold. They served to introduce the problem of risk management in the region and to construct the questionnaire. ~~Besides, they are an additional source of information to be crossed with the responses from the questionnaires.~~ Regarding the Sardinian case study, the secondary literature on risk management at the regional and national level was analysed.

~~There were twenty-five interviews conducted, and the interviewees were grouped into three: a) the elected or appointed~~
245 ~~administrators (eight), b) the scientists and technicians that work in the risk research or management (eight), and c) the members of civil society, i.e. associations (nine). During the interviews, the indicators, risk management policy and personal memory of risks in the region of the study were discussed. As far as the Sardinian case study is concerned, 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~~
250 ~~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, conversely to the Moroccan case study.~~

2.~~3~~2 Quantitative part of the study: Survey content, ~~and~~ variables and analysis

The Moroccan and Sardinian questionnaires consisted of 39 and 30 questions, respectively, and were divided into five sections. Not all questions from the questionnaires were used in this analysis. The common part of the questionnaire were the sections
255 that dealt with risk awareness, personal experience, formal and informal education on risks; in addition to questions regarding institutional trust, environmental identity and place attachment; and finally questions about the belief in climate change, adopting precautionary measures and investing money. It is to note that no risk awareness sessions were organised in the local community, only the previous experience of respondents regarding risk sessions was registered. Those questions were close-ended (dichotomous and Likert rating scale). The full questionnaires (in French and Italian) are available ~~as~~in supplementary
260 material~~are available upon request~~. The data were described in Excel and SPSS, the latter used for ~~correlations~~factor analysis and regression model. ~~Since the data do not follow a normal distribution, correlations were verified using Spearman's test.~~ The

used regression model was binary logistic which allows dividing variables into more blocks, tracking the model's progress. All the variables were nominal (Table 1).

The first set of variables used in the regression model consists of demographic ones: gender (value 1 for women), age (value 1 for those respondents older than the mean age of 36 years old), education (value 1 for those with bachelor's degree or higher), and zone of living (Morocco: Atlantic, Martil, Rif, Sardinia: urban and rural, five dummies for five zones). The second block includes variables related to risk awareness that are considered to describe better future ~~readi~~willingness to invest money, as an indicator of precautionary behaviour. Risk awareness was described using questions related to the level of information about natural hazards, i.e. how much the respondents considered themselves informed about natural hazards in their region (each hazard listed and evaluated on the Likert 1-5 scale), rating their level of information about natural hazards (drought, flood, landslide, coastal storm, sea-level rise, heatwave, earthquake, coastal erosion and wildfire), and about climate change, and whether they participated or not in the awareness sessions or environmental education campaigns organized by the municipalities or associations), (e.g., Domingues et al., 2018; Ivčević et al., 2020a). ~~The respondents rated their level of information about natural hazards (drought, flood, landslide, coastal storm, sea-level rise, heatwave, earthquake, coastal erosion and wildfire), and about climate change.~~ The first study was the North Moroccan when the variables were explored and constructed, and the reliability was tested. Items were submitted to a factor analysis (Kaiser-Meyer-Olkin Measure of Sampling Adequacy = .897; Bartlett's test of sphericity: $\chi^2 = 1679$, df = 55, p < .001). One factor retained was 'risk informed' ($\alpha = .890$), and the other 'risk sessions' ($\alpha = .381$), used in the following analysis. ~~Risk awareness was described with two indicators: one related to the level of information about natural hazards (each hazard listed and evaluated on the Likert 1-5 scale), other related to risk sessions (whether the respondents participated or not in the awareness sessions or environmental education campaigns organized by the municipalities or associations), (e.g., Domingues et al., 2018; Ivčević et al., 2020a).~~ Besides, the variable of personal experience of a natural hazard (yes/no) was added, whose importance in risk perception was showed in similar studies (e.g., Papagiannaki et al., 2019b). Next~~Moreover~~, respondent's belief in the existence of climate change was asked (yes/no). Moreover~~Furthermore~~, the respondents were asked if they have previously taken any precautionary measures (yes/no). The final block of variables, related to trust, environmental identity and place attachment, was to test the supplementary variables about the impact on future precautionary behaviour. The place attachment was measured using items such as 'I think this municipality offers a good living environment' and represents a relationship of the resident with her municipality (Bonaiuto et al., 2016). These items were averaged to a single variable with a satisfactory consistency ($\alpha = .827$). The environmental identity was measured using items such as 'I think of myself as someone engaged in environmental issues' and represents environmental concerns of residents (Bertoldo and Castro, 2016), averaged into a single variable with a good consistency ($\alpha = .846$). The social trust, regarding science and institutions involved in risk management, is of importance especially when respondents cannot manage risks on their own (Achterberg et al., 2017). The items were submitted to a factor analysis (Kaiser-Meyer-Olkin Measure of Sampling Adequacy = .768; Bartlett's test of sphericity: $\chi^2 = 1230$, df = 21, p < .001) which split them in two dimensions: trust in science ($\alpha = .887$) and trust in state ($\alpha = .804$). The variables were constructed

295 based on the Moroccan case study, and were implemented in a similar way for the collection of the Sardinian dataset. ~~When the variables were constructed, the Sardinian data was added later when it was collected.~~ Later, ~~A~~all those items were measured using a 5-point Likert scale, and then dichotomized: participants with responses above mean were considered to have a high value, those under mean to have low value, and are as such used in a binary logistic model, schematically presented ~~o~~in Fig. 5. For more details on variables chosen refer to publications by Ivčević et al. (2020a, 2020b).

300 **2.~~4~~3 Qualitative part of the study: Interviews and secondary literature**

In North Morocco, the interviews were based on an interview guide, which consisted of five main parts. The general topic was ~~focused on~~ the influence of the representation that associates, administrators and scientists have on the relationship between citizens and risk; and on the influence of memory and the territorial context in the development of management tools, particularly preventive communication. Firstly, the life in the region and the relationship and attachment the respondent has
305 with the place of living was discussed. Then, the knowledge and history on risk phenomenon in the region were questioned, followed by the personal experience and risk memory. There the interlocutors were asked about the different types of knowledge (scientific and vernacular) that the institutional practices base their risk awareness activities on when talking about risks to the general population. Thirdly, the information, prevention and risk management in the region, as well as the importance of risk awareness sessions in risk management strategies were debated, followed by the consideration of the region
310 within the context of national and international risk policies. Finally, the meaning and use of indicators in risk management were argued. ~~The administrators were also asked about the indicators used in risk management. Besides the topic of risk experience and risk memory, the interlocutors were asked about the different types of knowledge (scientific and vernacular) that the institutional practices base their risk awareness activities when talking about risks to the general population and about the importance of risk awareness sessions in risk management strategies. The administrators were also asked about the~~
315 ~~indicators used in risk management.~~There were twenty-five interviews conducted, and the interviewees were grouped into three: a) the elected or appointed administrators (eight), b) the scientists and technicians that work in the risk research or management (eight), and c) the members of civil society, i.e. associations (nine). All twenty-five narratives were recorded and transcribed and basic discourse analysis was carried out using the software Iramuteq (Ivčević ~~et al.~~, 2020c). The main parts of the interview guide and the groups interviewed are presented in Table 2. As far as the Sardinian case study is concerned, the
320 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, conversely to the Moroccan case study.

3 Results

3.1 Quantitative: Explaining future willingness to invest money based on actual risk awareness

Table 21 presents the correlations of five different areas (binary variable for each area) of the study with main indicators. The zones Martil and the Rif are positively correlated with 'personal experience', unlike Sardinian areas that are negatively correlated with the same variable. Sardinian areas are also negatively correlated, and the Rif positively correlated with 'risk sessions'. Martil area is positively, and urban Sardinia negatively correlated with the variable 'trust science'. All three Moroccan zones are negatively correlated with the variable 'trust state', conversely to Sardinian zones that are positively correlated with the same variable. Rural Sardinia is positively correlated with both 'place attachment' and 'environmental identity', whereas the Rif is negatively correlated with the former and Martil with the latter variable. Martil area is also negatively correlated with variable 'invest money', similarly to the Atlantic area with the variable of 'precautions taken' (Table 21).

WillingnessReadiness to invest money in order to protect from future natural hazards was examined through a binary logistic model. ReadiWillingness was regressed on three blocks of variables. The first block included demographic variables of gender, age, education and zone of study. The second block included risk awareness variables that were considered to contribute more to explaining future willingness to invest: personal experience, precautions taken, risk informed and risk sessions. The last block included additional variables that hopefully could help clarify which profiles are up to risk investing: trust in science and state, environmental identity, place attachment, and belief in climate change. Presented in Table 32, results show that demographic variables that significantly predict future readiwillingness to invest money in protection are the age of the sample over 36 years old $(-.433, p < .05)$, and the education level of any university degree $(.459, p < .05)$. This result suggests that being under 36 years old and having a university education is positively associated with monetary investments for natural risk protection. The only additional indicator that predicts future willingness to invest is the awareness indicator of following risk sessions $(.539, p < .05)$. Personal experience is a marginally significant positive predictor $(.396, p < .1)$, as well as the fact of living in West Sardinia – in both urban $(.780, p < .1)$ or rural areas $(.743, p < .1)$. None of the indicators introduced in the third block did significantly contribute to future willingness to invest money. The model overall describes over 11% of the social variability of the sampled population (Nagelkerke $R^2 = .115$).

3.2 Qualitative: The importance of the risk awareness sessions according to the stakeholders

The interviews served not only to learn about the region and to build bridges with local contacts in the region of North Morocco, but also to contrast the general population's responses with the official directions in managing natural risks. The

interviewees~~locutors~~ have been asked about natural hazards, their memory of catastrophic events and the risk management policy in the region. Among the useful information given, some particular answers need to be discussed. During these interviews, among the main topics debated, risk awareness sessions ~~elaborated~~ were the hot subject argued~~indicators of risk management, both with the scientists and with the administrators~~. The verbatim extracts with these results are presented in Table 4.

As far as risk awareness and risk sessions are concerned, the administration in some cities (Male, 45, Rabat; Male, 40, Martil) claims that the sessions are present and organised and that the population is risk aware. However, those from smaller municipalities do agree that the population is somewhat aware of risks, but they do not agree that there are risk awareness sessions (Male, 55, Oued Laou; Female, 60, Al Hoceima). The administration even admits that sometimes talking about risks is omitted on purpose (Male, 45, Rabat; Female, 60, Al Hoceima), but also thinks that the associations know better than themselves how to raise awareness (Male, 55, Tetouan).

The scientists are more critical. They agree that discourse on risks can be intentionally left aside (Female, 50, Tangier) and they can agree that the population is aware of their local risks, but is more money-driven and decides economically (Male, 65, Tetouan; Male, 30, Al Hoceima; Male, 50, Tetouan). The scientists agree that more risk awareness is needed, but that the outreach campaigns need to be regulated (Male, 30, Tetouan). The scientist also admitted that, when undertaking risk awareness sessions in schools, they lack the expertise or means of what to do later with that data (Male, 50, Tetouan).

However, regarding risk awareness, the civil society expects more from the administration. Whether there is some awareness at schools (Female, 30, Tangier) or not (Female, 35, Tetouan), more awareness and prevention are expected from the municipalities (Male, 55, Chefchaouen; Female, 30, Tangier). If the municipality does not raise the awareness, there are luckily some associations that fill in that gap (Female, 50, Tetouan), but the question posed is how does the awareness translate into a behaviour and is the awareness sufficient to change attitudes regarding natural hazards (Male, 50, Al Hoceima)?

As far as the Sardinian case study is concerned, risk awareness sessions among the local society experiencing and managing risks seem to be taken into consideration in the official documents, but in a form of a theoretical wish list. In 'Elements for National Strategy of Adaptation to Climate Change' (Castellari et al., 2014), the authors recognised the importance of risk perception: "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 in 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 towards the development of bottom-up planning 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, among them the farmers' perception of the threats related to climate change is elaborated. In addition, a 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 and states that "[a] deeper understanding of how a sector / system / territory behaves with respect to climate changes contributes, in fact, to establishing adaptation objectives and targets, to providing the necessary elements for planning adaptation measures, to raising community awareness and to monitoring and evaluating adaptation policies" (p. 31).

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. Male Administrator (55 y.o. from Oued Laou) confirmed: *"Wilaya produces the ORSEC and therefore I have no idea about the indicators."* ORSEC[1] is an emergency response in case of disasters, here related to floods. Besides, the concentration of power is demonstrated in the term 'wilaya' which is an administrative unit, headed by a wali, appointed by the king. In short, the higher entity 'wilaya' is in charge of risk management, and the small municipality is not informed about it. A 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 y.o.).

During interviews, scientists, however, called for more investment and more studies, but also underlined what they do not have: *"[...] 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 y.o., Tetouan). The same scientist continued on awareness: *"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."* His colleague confirmed that people are aware, but they choose hazardous behaviour: *"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."* He continued about the awareness campaigns: *"Unregulated awareness-raising among the population (schools, associations) is useless, it should be in the law. To do an intervention you need authorisation and ABHL[2] was already refused to avoid controversy. In 2016, we participated with the*

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[1] Organisation de la Réponse de SEcurité Civile = Organisation of the Civil Security Response
[2] Agence du Bassin Hydraulique du Loukkos = Loukkos River Basin Agency

wilaya on awareness-raising but it was mediocre. Officially in education, there is no notion of risks, only a few individual initiatives done voluntarily." (Male Scientist, 30, Tetouan).

420 In the region, the 2004 Al Hoceima earthquake is still fresh in the memory of the population: *"After the 2004 disaster, half of the population sought help from a psychologist. I myself stayed with my family for 1 month in a tent."* (Female Administrator, 60 y.o., Al Hoceima). The administration is aware of the need for raising risk awareness: *"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 y.o., Martil).

425 This leaves some hope, but there is a need to raise awareness in small municipalities and outside of big urban centres as well, because the awareness campaigns, if they exist, evidently do not arrive in all parts of the region: *"At school, there is no awareness. Even at the mosque, which is a showcase, in the speech of Friday, never a speech on the risks was mentioned. So there's nothing, total absence."* (Male Administrator, 55 y.o., Oued Laou)

However, regarding risk awareness, the civil society expects more from the administration: *"The city does not organise the*

430 *awareness-raising sessions, but there are nature protection associations and they organise the seminars."* (Female Associate, 50 y.o., Tetouan); *"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 y.o., Chefchaouen).

4 Discussion

4.1 Correlations point at regional variability

435 The correlations between the five different areas of this study and the main chosen indicators capture the signal of regional differences between two case studies within the Mediterranean basin. This regional variability indicates a different level of risk awareness between the two case studies, which are with either stronger risk memory than other areas, or more informed and educated about risk. Both urban *(-.087, p < .05)* and rural *(-.146, p < .01)* Sardinian areas are negatively correlated with 'risk sessions', whereas Moroccan Rif area is positively correlated with 'risk sessions' *(.220, p < .01)*, a result that demonstrates

440 a similar dynamics as 'personal experience'. This contrast could be explained by the difference in hazard history that those areas experienced. Inhabitants of the Rif have in memory a recent series of earthquakes, with a notorious and deadly event in 2004. Conversely, Sardinians seem to be less impacted by what they experienced and learned about regarding their territory. These differences of risk experience may lead to differences of main hazards perceived between two studied regions (Fig. 4).

4.21 All stakeholders underline the importance of risk awareness sessions, but do theyes it remain only a wishful

445 **thinking?**

The results from quantitative case studies in North Morocco and Sardinia, targeting the general population, indicate that participation in risk sessions seems to have an impact on precautionary behaviour, related to future readiwillingness to

investing money in order to protect (~~.539, p < .05,~~ Table 3~~2~~). The importance of risk awareness sessions is also confirmed by interviews in the qualitative study in North Morocco. Although both scientists and members of associations call for more
450 awareness campaigns, the majority of administrators defend, however, the position that the population is already aware of risks and that the institutions are well-involved. Still, an administrator from a smaller municipality admitted the absence of sessions and learning processes on risk. The risk awareness sessions in risk management are 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, showing the local differences within the region. ~~, where the~~
455 ~~latter stated "[...]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 talked about partial awareness, where one of them from Al Hoceima underlined that "awareness exists, but there is still a high illiteracy rate so we are making a great effort to explain it to everyone."~~

460 On the national level, the Moroccan state is well-included in risk management and international policies, as confirmed by an administrator from Rabat~~.: "Morocco has positioned itself as the hard-working student for the fight against climate change and the protection of the environment within the COP21. The State is well involved, the blue flags, the institutions, ... with specific awareness training, 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."~~
465 Besides, the Moroccan 'Référentiel de l'Urbanisme Durable'[3] (2017) elaborated the detailed commitment for which Morocco engaged by adopting the new urban agenda 'Quito Habitat III' from October 2016. The fifth issue, dedicated to 'Health and Citizens' Security', includes a special theme on 'Management of Natural and Technological Risks', with natural hazards like avalanches, wildfires, floods, landslides, cyclones, storms, earthquakes and volcanic eruptions. The listed objectives of prevention are: to suppress the extent of the hazard, to control its effects and to reduce the exposure of people and goods. The
470 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.
However, there is some void that is argued by the interlocutors, starting from the lack of legal respect, to lack of awareness
475 and trust. 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 financial matters, which creates distrust~~, as elaborated by the scientist from Tetouan~~

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[3] Sustainable Urbanism Reference System

480 ("The land was expropriated for non-construction, but now according to the development plan it is no longer. The state still decided to build 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."). Is the local population aware of risks or just decides based on an economic opportunity? Based on another scientist from Tetouan, iIt could be considered that awareness and
485 financial means are actually intertwined. : "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 more space possible." The financial resources are also likely to influence the risk management that is deficient at the municipal level. TheAs stated by smaller municipalities of Oued Laou and M'Diq,
490 they do not use indicators of risk management therefore they do not manage risks on their own. In addition, the lack of resources, financial but also human, is underlined by the administrator from Oued Laou: "We are 4 civil servants for 9665 inhabitants (2014) and during summer [this number] is tripled."

Secondly, a remarkable obstacle in advanced risk awareness campaigns is the reciprocal dmistrust between administrators and scientists. Previously mentioned dDistrust regardingtowards awareness and prevention sessions of local leaders towards
495 scientists from Tetouan's ABHL who was already refused authorisation to intervene to avoid controversy is confirmed by the researcher working in the national research institute CNRST[4] in Rabat. While conducting her research on tsunami hazard in Tangier she was refused to do the evacuation exercise on tsunamis and to place tsunami signs in the city. "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
500 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 bother with the tsunami?" The distrust between the administration and the broad population is mutual, as well. As aA female member of the associatione from Tetouan judged the administrative, repetitive discourse of taking commitment before each election, but not fulfilling any
505 later on, and a female administrator admitted not even communicating the risk to the inhabitants of the cliff in Al Hoceima. stated: "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". A female administrator from Al Hoceima confirmed: "We work secretly because the population is not interested in public work related to risk, it is the task of the
510 municipality. We did not even communicate the risks to the inhabitants of the cliff."

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[4] Centre National pour la Recherche Scientifique et Technique = National Centre for Scientific and Technical Research

To sum up, a point stated by an associate from Al Hoceima can be used to depict the situation in the region: *"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?"*

515 As far as the Sardinian case study is concerned, there is a lack of explicit evidence for the rupture of information regarding risk awareness sessions among the local society experiencing and managing risks. Actually, 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 authors recognised the importance of risk perception: "investments in innovative monitoring technologies, investments to improve communication and to raise awareness of perception and risk management by citizens

520 (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 in 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

525 associated with expected climate pressures and to stimulate responses also oriented towards the development of bottom-up planning 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),

530 where indicators useful for knowledge of the state of the environment in Sardinia are listed, among them the farmers' perception of the threats related to climate change is elaborated. In addition, a 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

535 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 and states that "[a] deeper understanding of how a sector / system / territory behaves with respect to climate changes contributes, in fact, to establishing adaptation objectives and targets, to providing the necessary elements for planning adaptation measures, to raising community awareness and to monitoring and evaluating adaptation policies" (p. 31).

540 To state again, all the documents look professional and well-elaborated, nevertheless without concrete measures of a broad assessment of risk awareness. As far as the Sardinian case study is concerned, all official documents look professional and well-elaborated, nevertheless without concrete measures of a broad assessment of risk awareness. Based on the results from the quantitative case study, the indicator of risk awareness sessions seems to be significant in deciding whether or not the local population invests in future protection. Besides, the lack of risk awareness sessions was often brought out by the respondents

545 on the margins of the quantitative study. However, actual actions might in fact exist. The impression is that these strategic documents do recognise the need for awareness and education sessions, yet without specific training activities.These documents do recognize the need for awareness and education sessions, but there seems to be an 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. This calls for the administration to promote more risk awareness sessions among the general population. As argued,

550 among other criteria that contribute to taking precautionary behaviour is the economic criteria. However, risk awareness sessions will certainly contribute to some future risk decisions the inhabitants make. To sum up this discussion, a point stated by an male member of the associatione from Al Hoceima can be used to depict the awareness situation in the region: *"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?"*

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4.23 Future perspectives of the results as an input for risk policy: the importance of dynamic indicators

Another risk management recommendation of this study regards dynamic indicators in risk management, where risk awareness sessions particularly contribute. Although the content of the past risk awareness sessions was not analysed within this study, risk awareness sessions seem to be considered useful in preparedness and risk management strategy by the participants of these

560 research activities. As such, they could be imagined as an effective risk management tool and their true utility should be tested to confirm the effectiveness of risk awareness sessions in adopting precautionary behaviour. In efficient risk management, indicators should be used to collect information on every phase of the disaster management cycle, building a less vulnerable society. For example, in economics, cost-benefit analysis of the actual and new risk policy, before and after the investment, could be coupled. Also in education, for instance, the number of middle- or high-school pupils educated on risk and climate

565 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. Raising awareness in schools was already testedone in Tetouan, as brought out by our interlocutor, but so far without the success rate estimate. (Male Scientist, 50 y.o., Tetouan)

The information on hazard history, recurrence time of earthquakes or return interval of floods can be used as input data for

570 risk awareness sessions, that would boost both awareness and perception, and provoke changes in attitudes towards precautionary behaviour, as was shown in North Morocco. Risk awareness sessions could be followed up on a time scale, and that can further contribute to the interdisciplinarity of risk science with policy, psychology, and economics.

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

575 an outcome of an ethical maxim of adopting precautionary behaviour to save human lives. Moreover, the participatory approach is always important for a successful information flux between all stakeholders included in risk management

processes. It can also be assessed dynamically, by initially identifying the individual positions of the risk management stakeholders, and consequently reaching consensual priorities of all stakeholders after participatory focus groups.

This way of approaching indicators is a suitable consideration forto different hazard types. If we consider flood hazard, and
580 the number of people living in the area exposed to flood, that would be an example of a 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 notify about the success of the flood awareness campaign, but also about the local readiness to cope with
585 the ongoing change. Last but not least, 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 are divulged to the 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. There again risk awareness sessions have an important
590 position in the learning process. A similar idea can be used for the example from geomorphology. These ideas are presented in Table 543 and are some of the possible changes that dynamic indicators could bring to the community. Finally, organizing a series of risk awareness sessions in the local community, opened and destined to all stakeholders, would certainly represent an instructive research activity that would contribute to clarifying the existing learning processes between the local stakeholders and improving risk management.

595 **4.34 Limits of this study**

The contribution of two Mediterranean case studies analysed 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. Likewise, undertaking risk perception case studies in the lower-income countries could help us to get out from the mindset of the higher-income country, when financial obstacle can play a role in different forms of
600 precautionary behaviour. The variety of case studies should increase the efficiency of risk management strategies. Still, comparing two areas of study is not always a simple task: risks are complex phenomena and those acceptable in one cultural context are not necessarily acceptable in another (Dauphiné, 2003). In this case, the first to keep in mind while trying to compare these two Mediterranean territories was their size proportion. North Morocco is a region of more than 17,000 km² and with more than 3,5 million inhabitants. The Sardinian surface is a bit over 24,000 km² with 1,6 million inhabitants.
605 However, the Gulf of Oristano municipalities included in our Sardinian case study are of surface that is seventeen times smaller than those of the Moroccan case study, and with forty times fewer dwellers (1000 km², 85,000 people). This is, therefore, the biggest limit of this comparative study. Another important remark regards the difference in hazard history that those areas experienced. Inhabitants of the Rif have in memory a recent series of earthquakes, with a notorious and deadly event in 2004. Conversely, Sardinians seem to be less impacted by what they experienced and learned regarding their territory. These

610 differences in risk experience may lead to differences in main hazards perceived between the two studied regions (Fig. 6). To continue, additional comparative studies from the Mediterranean basin should be organised, from both North and South coasts. Those 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 local dwellers, that are, although diverse, not so different in the end.

615 **4.~~5~~ Conclusions**

Hazards occur regardless of the situation, whereas vulnerability is a dynamic process, always relative to a certain situation. Local knowledge, practices and cultural particularities between countries 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, keeping it from oblivion. The results from two Mediterranean case studies, North Morocco and West Sardinia,

620 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 the importance of risk awareness sessions in financial precautionary behaviour. The general population seems to reveal that 'risk awareness sessions' are an adequate indicator of local resilience. This information should be useful for policymakers at regional and national levels. Unfortunately, the policy literature and

625 interviews held with the administrators and scientists indicate that although recognised, the importance of risk awareness sessions is not necessarily put into practice. As a consequence, this could lead to a failure of risk management policy. 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 suitable for different groups of society included in risk management. To overcome

630 this gap, more dialogue between different stakeholders included in the risk management process is needed. The dire need for continuous transdisciplinary work to overcome the communication gap between the scientific community, risk administrators, and the general population is encouraged. 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. Last but not least, risk awareness sessions have a crucial position in learning processes and in the usage of dynamic indicators. They can be

635 followed on a time scale, and that can further accompany the transdisciplinarity of risk management.

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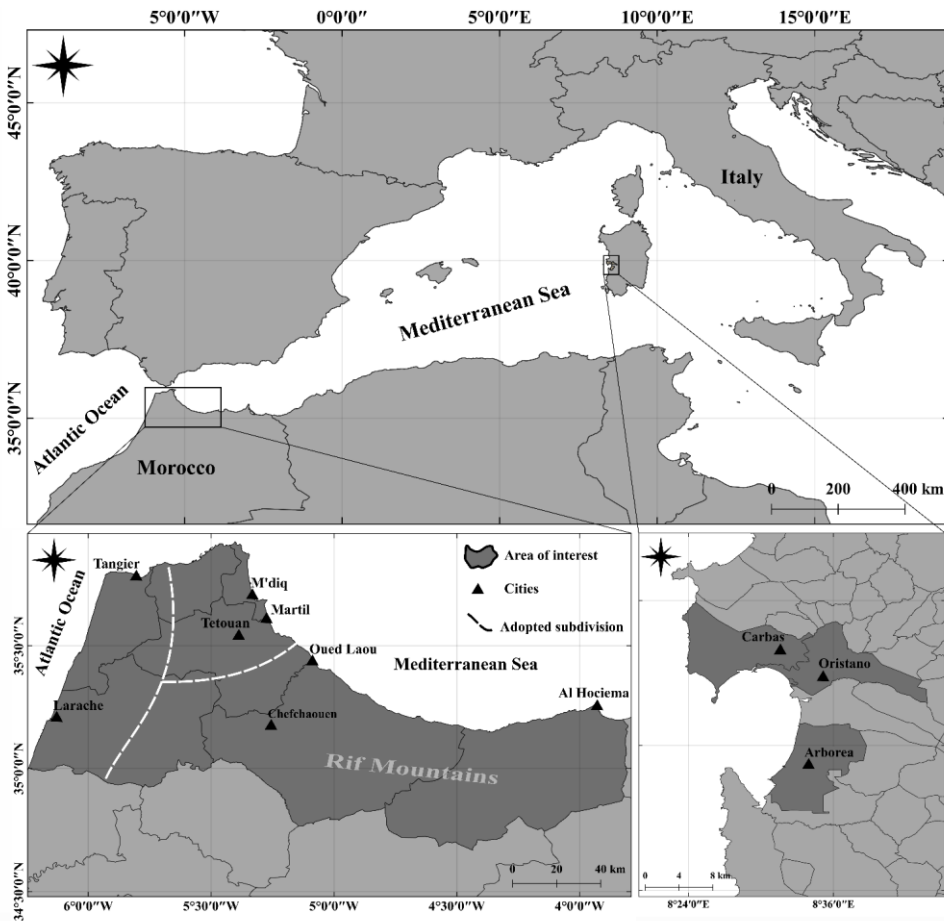
Figure 11: Study sites: North Morocco and West Sardinia, Italy.

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Figure 22: The region of North Morocco has a high increase of touristic infrastructure.

Figure 33: Wetlands of West Sardinia are famous for its fishing activities.

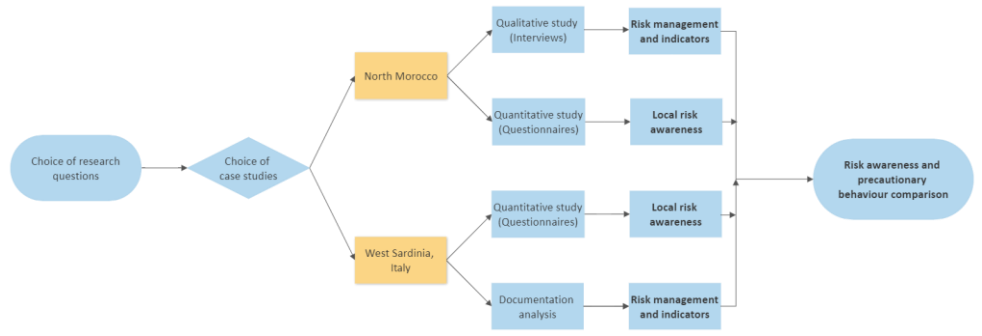



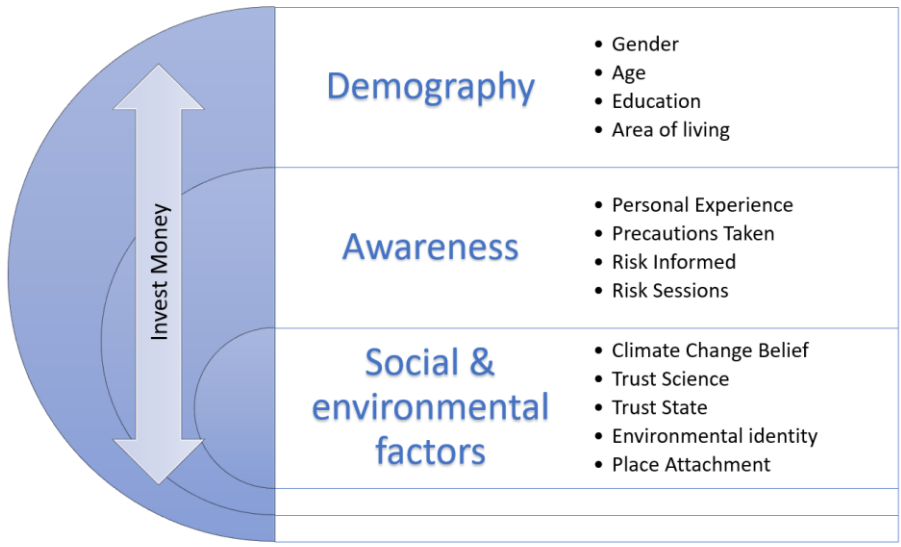
Figure 4: Flowchart (by SmartDraw) explaining the steps of methodology adopted.

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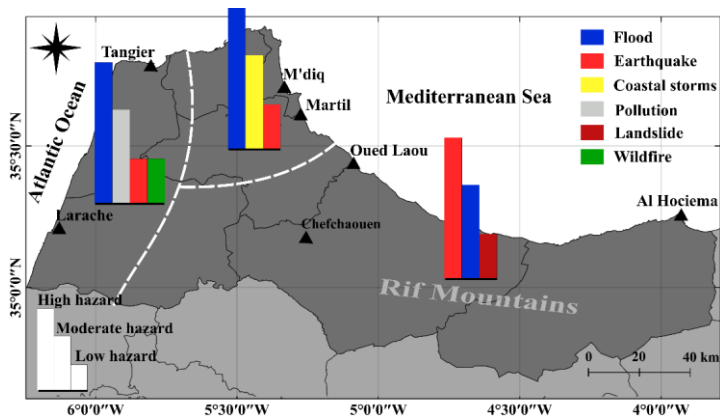
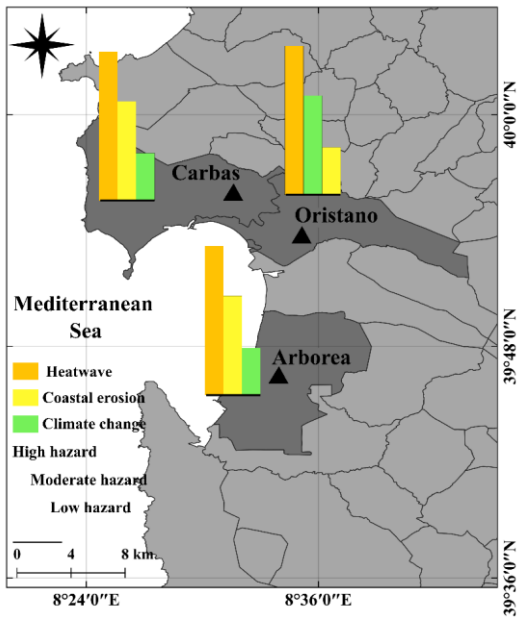
Figure 5: Schematical presentation of binary logistic model describing willingness to invest money in disaster risk reduction, with dependent variable of investing money.

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Figure 64: Differences of main hazards perceived in North Morocco and West Sardinia by the general population

Table 1: Variables used in regression model

Variable	Description	Questions	N obs.	Mean	St. Dev.	Min	Max
Gender (female = 1)	Demographic	Gender	567	.4762	.49987	0	1
Age > 36	Demographic	Age	565	.5894	.49238	0	1
Education	Demographic	What educational qualification do you have?/ number of years at school	539	.3581	.47988	0	1
Zone Rif	Demographic	Municipality of residence	567	.2328	.42299	0	1
Zone Atlantic	Demographic	Municipality of residence	567	.1464	.3538	0	1
Zone Med Martil	Demographic	Municipality of residence	567	.3104	.46307	0	1
Urban Sardinia	Demographic	Municipality of residence	567	.1411	.34843	0	1
Rural Sardinia	Demographic	Municipality of residence	567	.1693	.37536	0	1
Personal Experience	Constructed	Have you ever personally experienced a natural disaster in your life?	566	.5442	.49849	0	1
Precautions Taken	Constructed	Have you ever taken any precautions to avoid a potential natural disaster?	558	.1828	.38685	0	1

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Climate Change Belief	Constructed	Do you believe that 'climate change' exists?	562	.9146	.27974	0	1
Risk Informed	Constructed	How well do you feel you are informed about each of the following natural phenomena?	508	.4606	.49894	0	1
Risk Sessions	Constructed	Have you ever participated in information and awareness-raising sessions on natural phenomena? (If yes, who organised the activity?)	516	.4438	.49731	0	1
Trust Science	Constructed	Regarding natural hazards, how much trust do you place in science/ scientists/ research institutions?	555	.5802	.49397	0	1
Trust State	Constructed	Regarding natural hazards, how much trust do you place in regional and national government/ media/ risk management institutes?	555	.227	.41929	0	1
Environmental Identity	Constructed	Concerning your municipality, would you say that you have ecological concerns/ that you are involved in environmental issues?	559	.4758	.49986	0	1
Place Attachment	Constructed	Concerning your municipality, would you say you are proud to live in it/ that it is a good place for living/ you identify with other inhabitants/ you would regret if you had to move out?	556	.4029	.49092	0	1
Invest Money	Dependent	Do you intend to protect yourself financially against natural risks in the future? How much are you ready to invest per year to insure yourself against potential natural risks?	556	.5827	.49355	0	1

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Table 2: The main parts of the interview guide and the individual interviews with stakeholders representing different groups of actors in North Morocco

	Topic	Administration	Scientists	Associations
1	Life in the region and place attachment	Male, 55, Oued Laou	Male, 50, Martil	Male, 60, Tangier
2	Knowledge and history on risk, personal experience and risk memory	Male, 40, Martil Male, 60, M'Diq	Male, 50, Tetouan Male, 30, Tetouan	Male, 25, Tetouan Female, 35, Tetouan
3	Information, prevention, awareness sessions and risk management	Female, 60, Al Hoceima	Female, 50, Tangier Male, 35, Tangier	Male, 50, Al Hoceima Female, 50, Tetouan
4	Region within the national and international risk policies	Male, 45, Rabat Male, 55, Tetouan	Male, 30, Al Hoceima Male, 45, Tetouan	Male, 55, Chefchaouen
5	Meaning and use of indicators in risk management	Female, 35, Al Hoceima Female, 40, Rabat	Male, 65, Tetouan	Male, 50, Larache Female, 30, Tangier Male, 55, Tetouan

Table 21: Correlations between five different zones of the study and constructed indicators.

Zone	Clim.ch. belief	Personal experience	Risk informed	Risk sessions	Trust science	Trust state	Place attachment	Environm. identity	Precautions taken	Invest money
Atlantic	.000	-.067	.055	-.022	-.002	-.107*	.000	-.042	-.090*	-.024
Martil	-.056	.209**	-.064	.009	.145**	-.199**	-.048	-.176**	-.018	-.097*
Rif	.048	.127**	-.051	.220**	.022	-.149**	-.128**	.073	.031	.054
Urb. Sard.	.069	-.168**	.072	-.087*	-.208**	.365**	.038	.014	.045	.037
Rur. Sard.	-.049	-.182**	.017	-.146**	-.014	.186**	.172**	.160**	.030	.047

** significance < 0.01   * significance < 0.05

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Table 32: Binary Logistic model of future financial precautionary behaviour ('Invest Money' N = 447)

Block	Predictor	-2 Log-likelihood	Nagelkerke R²	χ²	Df	Sig	B	SE	Exp(B)	95% C.I. for Exp(B) Lower	Upper
1		581.371	.058	19.647	7	.006					
	Gender (female = 1)						.050	.202	1.052	.708	1.562
	Age						-.506*	.210	.603	.399	.910
	Education						.652**	.212	1.920	1.266	2.910
	Zone Rif						.245	.338	1.277	.659	2.478
	Zone Med Martil						.146	.317	1.157	.622	2.153
	Urban Sardinia						.486	.387	1.626	.762	3.471
	Rural Sardinia						.640	.367	1.897	.923	3.896
2		566.297	.101	34.720	11	.000					
	Gender						.122	.207	1.130	.752	1.696
	Age						-.447*	.215	.640	.420	.974
	Education						.528*	.219	1.696	1.104	2.605
	Zone Rif						.082	.349	1.085	.547	2.151
	Zone Med Martil						-.006	.329	.994	.521	1.895
	Urban Sardinia						.521	.394	1.683	.777	3.646
	Rural Sardinia						.705	.374	2.024	.972	4.215
	Personal Experience						.397	.219	1.487	.969	2.284
	Precautions Taken						.351	.272	1.420	.834	2.419
	Risk Informed						.170	.207	1.185	.790	1.777
	Risk Sessions						.555**	.212	1.743	1.150	2.642
3		561.319	.115	39.699	16	.001					
	Gender						.130	.210	1.139	.754	1.720
	Age						-.433*	.219	.649	.422	.997
	Education						.459*	.226	1.583	1.016	2.465

Zone Rif	.068	.351	1.070	.538	2.130
Zone Med Martil	.008	.333	1.008	.525	1.935
Urban Sardinia	.780	.429	2.181	.940	5.058
Rural Sardinia	.743	.390	2.102	.980	4.512
Personal Experience	.396	.220	1.486	.965	2.290
Precautions Taken	.374	.275	1.454	.848	2.494
Risk Informed	.118	.212	1.125	.743	1.704
Risk Sessions	.539*	.217	1.714	1.121	2.621
Clim. Change Belief	.181	.496	1.199	.454	3.168
Trust Science	.147	.222	1.159	.750	1.789
Trust State	-.410	.270	.664	.391	1.127
Environm. Identity	.347	.219	1.415	.921	2.173
Place Attachment	.017	.223	1.017	.657	1.576

** significance < 0.01   * significance < 0.05

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Table 4: Verbatim of stakeholders interviewed regarding risk awareness sessions

Administration	Scientists	Associations
"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, 40, Martil)	"The population is aware of the seismic risk when building, but in the poor area they think economically. Many times there are differences between the built construction and the authorized plan. There is a lack of control, workmanship and quality of the materials used. Everything works economically. [...] Awareness is there, but the illiteracy rate is still high, so we make a great effort to explain to everyone. [...] On the scientific side scientific side we did a lot, but on the outreach side nothing." (Male, 30, Al Hoceima)	"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, 55, Chefchaouen)
"This question of risk is not a regulatory, institutional or scientific problem, it's a problem of raising people's awareness. The population is not susceptible, it wants to build. Town planners have no experience in raising awareness. Neighbourhood associations have much more experience, and support at neighbourhood level would be more effective. And the fundamental issue is education in schools, it's a pedagogical problem. There is no awareness, so the population does not understand the need to relocate." (Male, 55, Tetouan)	"Unregulated awareness-raising among the population (schools, associations) is useless, it should be in the law. […] 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, 30, Tetouan)	"The city does not organise the awareness-raising sessions, but there are nature protection associations and they organise the seminars." (Female, 50, Tetouan)

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"The State is well involved, the blue flags, the institutions, ... with specific awareness training, workshops organized, […] 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. So the awareness is there and it should not be overlooked, in addition with the installation of the Fund to fight against natural risks." (Male, 45, Rabat)	"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 more space possible." (Male, 65, Tetouan)	"I had no notion of prevention in school. No education, no awareness campaign, nothing, it's useful for people to have this notion that there are risks, it must be in the national education curriculum. 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" (Female, 35, Tetouan)
"After the 2004 disaster, half of the population sought help from a psychologist. I myself stayed with my family for 1 month in a tent. […] 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, 60, Al Hoceima)	"I retained by working with the managers in Tangier on the tsunami simulation is that initially […] 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. […] 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 bother with the tsunami?" (Female, 50, Tangier)	"I think there are associations that raise awareness about immigrants, but I doubt there are any for natural hazards. I am informed about floods because we had them here, not very big, but when we couldn't get out of our house. Here we don't have a lot of green spaces, only the construction of big buildings everywhere. Awareness is only raised in schools, never by the municipality. The weak points of the city are pollution, a lot of cars, few green spaces and no risk awareness." (Female, 30, Tangier)
"At school, there is no awareness. Even at the mosque, which is a showcase, in the speech of Friday, never a speech on the risks was mentioned. So there's nothing, total absence." (Male, 55, Oued Laou)	"The problem is that people forget, we need more awareness, we need to train people at the institutional level. Everything that worked in theory during the disaster on the spot falls. So the risk culture must be developed. […] 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, 50, Tetouan)	"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?" (Male, 50, Al Hoceima)

Table 54: Some examples and ideas of constructing dynamic indicators (adapted from Ivčević, 2020c)

Discipline	Hazard Indicators	Vulnerability (pre-disaster)	Impact (response, during disaster)	Resilience (recovery, post-disaster)

Climatology	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
Climate change	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
Geomorphology	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 restauration
Psychology-Sociology	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
Religion	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
Economics-Policy	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
Rupture of information	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
Management	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

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