An institutional approach to vulnerability: evidence from natural hazard management in Europe

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Abstract

Institutional vulnerability to natural hazards has not been thoroughly investigated until now. Yet, institutional vulnerability is strongly connected to all other vulnerability dimensions, and specific socio-economic and physical indicators. Moreover, different types of crises such as economic, political or health crisis strongly affect the institutional capacity of communities to deal with the consequences of natural hazards. For this reason, a deep insight to the institutional dimension of vulnerability is needed in order to reduce disaster risk under the effects of climate but also socio-economic change. In the present paper, institutional vulnerability is defined and its main pillars and drivers are identified. A framework is presented showing the interactions between the drivers of institutional vulnerability and the indicators of other vulnerability dimensions (physical, social, economic, cultural and environmental). The interactions between institutional vulnerability and other vulnerability dimensions are highlighted through three European case studies: Greece, the United Kingdom and Austria. The case studies show how current issues such as the recent financial crisis and Brexit, may directly influence the drivers of institutional vulnerability and consequently all other vulnerability dimensions. The framework and the case studies clearly indicate that institutional vulnerability is an ‘umbrella’ dimension strongly related to all other dimensions and has to be approached as such in order to reduce vulnerability and, consequently, disaster risk.

1. Introduction

The importance of institutional vulnerability has been revealed through past events including Hurricane Katrina (2005), Nepal Earthquake (2015), and, more recently, Cyclone Idai (2019). The connection between institutional vulnerability and negative consequences of natural hazards was particularly evident in the wake of the Hurricane Katrina in 2005 that devastated New Orleans and other areas in Louisiana, USA. According to Baker and Relfgraad (2007), the negative consequences of the hurricane may be equally attributed to the severity of the event but also to the inadequate response, communication and coordination of the responsible organisations as well as underlying social problems. More recently, in 2019, Cyclone Idai that affected Zimbabwe killing 340 people, also revealed a number of institutional vulnerabilities related to policies, social protection systems, disaster risk management funding, implementation structures and settlement systems regulation (Chatiza 2019).

Also at the global scale, a study based on large scale natural hazards between 1984 and 2004 showed that loss caused by natural hazards globally is highly influenced by the quality, capacity and performance of institutions within a country (Raschky 2008). Past events reveal that countries with functional institutions experience usually less impacts from natural hazards, in terms of casualties, monetary damage and speed of recovery (Jongman et al 2015, Mechler and Bouwer 2015, Wu et al 2019). Governments with functional institutions have the capacity to invest in adaptation and mitigation strategies, react fast to crises or support private households during the recovery phase. It is, therefore, clear that institutional improvement may contribute to the reduction of negative effects from natural hazards (Kahn 2005).
Moreover, individual and community resilience can hardly be increased without addressing institutional issues since institutions play a key role to achieve resilient societies (Birkmann et al 2016, Thaler et al 2019). Moreover, the role of institutions is evident in all phases of the disaster circle including mitigation (land use planning regulations, risk transfer mechanisms), preparedness (accountability, public inclusion, early warning systems), response (accountability, priorities, treatment of vulnerable groups) and rehabilitation (resources and allocation, insurance, compensation) (Papathoma-Köhle and Thaler 2018). Nevertheless, institutional vulnerability is largely neglected within the current debate on vulnerability to natural hazards as most studies focus on physical and social vulnerability.

In the literature, studies on institutional vulnerability either they do not focus on natural hazards (e.g. the study of Park (2014) which investigates the institutional vulnerability related to blackouts caused by technical failures) or they investigate institutional topics related to natural hazards without explicitly define or analyse institutional vulnerability (e.g. the study of Ishtiaque et al (2019) which shows how institutions in different scales understand vulnerability). Often, institutional vulnerability is not clearly defined resulting in a one-sided or limited representation of the term. An example is the study of Lopez-Martinez et al (2017) that investigated the institutional vulnerability related to flood exposure in the Spanish coast. The study develops vulnerability indices that represent solely the urbanisation within the flood zone. Similarly, a more recent study by the same authors (Lopez-Martinez et al 2020) looks at the influence of socio-economic factors on local planning authorities and decisions related to exposure increase. A more integrated study is the one of Lebel et al (2011). The specific study focuses on formal and informal institutions related to flood management. Lebel et al (2011) recognise five institutional gaps (fragmentation, rigidity, scale, elite capture and crisis) and suggests ways to address them. Although the approach is tailor-made for Thailand it can be adapted and used in other places in the world. One of the few studies focusing on the assessment of institutional vulnerability is the one of Coutinho et al (2019). In this study, institutional vulnerability is considered as the aggregation of five indicators including planning and management instrument, management structure, taking preventive actions, multidisciplinary work and emergency funds. In other cases, institutional vulnerability is considered within a wider vulnerability assessment. Examples include the study of Rahman et al (2019) that assesses institutional vulnerability based on the presence of regional disaster management agencies and village disaster risk reduction forums in an area threatened from landslides in Indonesia as part of a wider vulnerability assessment. Another example is the study of Shah et al (2018) that includes an institutional component in a vulnerability index for floods in Pakistan. The institutional resilience component is based on indicators related to participation of the population in disaster risk reduction programs such as flood warning, zoning or building code standards, humanitarian assistance or access to funding, livelihood restoration, water sanitation and hygiene. Nevertheless, to date, none of these studies approached institutional vulnerability in a conceptual and holistic way.

In absence of studies that define and analyse or assess institutional vulnerability to natural hazards, the aim of the present paper is to focus on institutional vulnerability related to the management of natural hazards and present a framework for its conceptualisation. The objective of the study is to identify and understand the main pillars of institutional vulnerability and to have a closer look at the drivers of every pillar that may result in a reduced or increased physical, social, economic, cultural or environmental vulnerability. This institutional vulnerability framework may act as a tool to guide institutional vulnerability assessment by providing a basis for the development of relevant indicators. The framework and the interaction of institutional vulnerability with the other vulnerability dimensions are highlighted through three European case studies (Greece, UK and Austria).

2. Institutions and institutional vulnerability

2.1. Institutions

Institutions play a significant role in the development of the society by controlling the social and economic behaviour of the people (Hodgson 1988, North 1990, Vatn 2009). In disaster risk management, this behaviour relates to choices concerning the protection from natural hazards. According to Frey (1990), institutions may belong to one of these categories:

- Formal rules: legal instruments, regulations, government guidance, policies and plans that are strongly related to disaster risk reduction activities (Tompsonks et al 2012).
- Informal institutions: rules such as customs, traditions and unwritten laws that determine human behaviour, actions and decisions and may be directly connected to the distribution of information, response to a hazardous event, community participation, risk perception, public awareness and accountability (Tompsonks et al 2012).
- Organisations: special institutions with clear boundaries and members (Hodgson 2007). They include public administration, and governmental organisations such as ministries as well as funding agencies and research institutes (Garschagen 2013) but also NGOs, political parties or volunteers.
and even groups such as families, clubs and clans (Fuchs 2009).

2.2. Framing institutional vulnerability

There is no universal concept of vulnerability and for this reason there is a wide range of definitions in the literature deriving from different scientific disciplines (climate change research, natural and social science, engineering, etc). In an effort to understand the concept of vulnerability numerous conceptual frameworks have been developed (e.g. BBC (Bogardi, Birkmann, Cardona)) conceptual framework, Bohle's conceptual framework, Pressure and Release model (PAR) etc, Birkmann (2006). The PAR model in particular is based on the assumption that risk is the result of the occurrence of a natural phenomenon in combination with unsafe conditions that are the result of a number of dynamic pressures that are initiated by root causes. According to Wisner et al (2004), root causes are general and widespread processes in the society or world economy that are temporarily and spatially distant to the event such as political and economic systems, access to power, structures and resources. Dynamic pressures, on the other hand, are more immediate processes and activities such as lack of local institutions, skills and training or rapid population change and deforestation. Finally, the unsafe conditions express vulnerability in conjunction with the hazard, e.g. unprotected buildings, dangerous locations, special groups at risk and lack of preparedness.

In the context of the present paper, the unsafe conditions of the PAR are directly related to indicators used to analyse most of the vulnerability dimensions (physical, social, economic, etc), whereas the root causes and dynamic pressures refer more to the institutional context of the society under investigation and relate to the drivers of institutional vulnerability.

According to Paul (2011), institutional vulnerability does not refer to the vulnerability of the institutions but to their role in causing societies to become more vulnerable to natural hazards. This shows clearly the interaction of institutional vulnerability to the other vulnerability dimensions. Hochrainer (2006, p 18) describes institutional vulnerability as 'the existence and robustness of institutions to deal with natural disasters'. On the other hand, Birkmann et al (2013, p 201) define vulnerability as 'the potential for damage to governance systems, organisational form and function as well as guiding formal/legal and informal/customary rules-any of which may be forced to change the following weaknesses exposed by disaster and response'. We define institutional vulnerability as 'the combination of the weaknesses embedded in institutions (purpose or non-purpose built for disaster management) that reduce the capacity to resist/withstand cope or recover from the impact of a hazardous event' (Papathoma-Köhle and Thaler 2018, p 107). According to Papathoma-Köhle and Thaler (2018), these weaknesses are directly rooted in the socio-political and legislative context (e.g. land use regulation) but also in the socio-cultural context (public participation, risk perception) as well as the financial context (e.g. risk transfer mechanisms).

Institutional vulnerability is not to be confused with risk governance although both terms are closely related. According to UNDP (2013), risk governance is the way in which different actors (including authorities, the public, etc) cooperate in order to manage and reduce disaster risk. This can be achieved (or not) given a strong institutional framework. Institutional vulnerability concerns the weaknesses of this background and it is not synonymous to risk governance.

At this point, it is important to emphasize that herein the focus is on the way institutions affect vulnerability to natural hazards and not the vulnerability of institutions. Moreover, we are limited to natural hazards meaning mainly geo- or hydrometeorological hazards and not technological or biohazards. As far as the scale is concerned, we consider institutions at the local, regional and national scale. Last but not least, the previous paragraph clearly shows also the limits of institutional vulnerability as far as other terms (e.g. risk governance) is concerned.

3. Pillars of institutional vulnerability

Institutional vulnerability is, therefore, an overarching attribute that reflects the degree to which institutions can reduce the capacity of a system to withstand, cope and recover from the impact of a natural hazardous process. Based on this definition and the types of institutions involved in the management of disaster risk, we consider that institutional vulnerability is based on the following pillars: the socio-cultural, the socio-political, the fiscal-economic and the legislative-regulatory pillar (figure 1).

Each one of the pillars is related to a number of drivers. The drivers are aspects directly connected to the pillars, and their quality, intensity and stability may influence directly or indirectly the indicators related to other vulnerability dimensions (physical, social, economic, cultural and environmental). In the following paragraphs the pillars and their drivers are described.

3.1. Socio-cultural pillar

This pillar is associated with informal institutions and focuses on the socio-cultural status of a community including the use of local knowledge and practices, the level of community participation, the risk perception and public awareness which is connected to socio-economic and cultural characteristics (religion, financial capacities, educational level, etc). It also relates to the informal rules including human behaviour, customs and traditions that together with past experiences and trust in local authorities and experts form the perception of risk (Wachinger et al 2013). Positive aspects of the socio-cultural status are often
associated with the so-called ‘indigenous’ or ‘traditional’ knowledge and coping mechanisms (Twigg 2015). Such an example is the island of Simeulue in Indonesia which suffered a disproportionately low number of deaths in comparison with neighbouring islands during the 2004 tsunami (Gaillard et al 2008). According to Gaillard (2008) the residents of Simeulue used local knowledge to respond to the 2004 tsunami that resulted in significantly low casualties. Local knowledge and practices, however, are relevant in all phases of the risk cycle. During the reconstruction phase, for example, the use of local knowledge and local practices may lead to the development and promotion of resilient buildings such as in the case of Manizales (Colombia) where earthquake resistant traditional buildings (bahareque) are promoted and maintained for this reason (Suarez 2011).

Participation, meaning the active involvement of people to decision making, plays also a central role in the way societies manage risks but it is often undermined by societal inequalities. According to Cohen and Werker (2008), the lower the social homogeneity in a country the higher the death toll from natural hazards is. Past events such as Katrina in 2005 have demonstrated that institutional policies create and maintain segregated societies. In more detail, in New Orleans, the fact that black people lived in high flood hazard areas was due to low income and employment which was related to racial disparities (Henkel et al 2006). Furthermore, during the response phase, most of the black population could not evacuate due to financial reasons. Finally, during reconstruction, the black population rehabilitated slowly in comparison with the white population due to mistrust and discrimination (Henkel et al 2006).

The connection between this pillar and the social dimension of vulnerability is evident since low risk perception, limited participation of the public and non-inclusion of local knowledge and practices in disaster management may directly influence the coping capacity of the population increasing the social and cultural vulnerability. Moreover, by ignoring local techniques in building practices the physical vulnerability of the built environment may increase.

3.2. Socio-political pillar

Preparedness, response and recovery following the occurrence of natural hazards are clearly political tasks (Albrecht 2017). Hence, the response to natural hazards is strongly related to the level of democracy and the political stability of the country. This was clearly supported by research showing that the vast majority of deaths due to natural hazards (more than 80%) between 1964 and 2004 were recorded in 15 countries. The majority of these countries (87%)
are also below the mean democracy index which represents the level of accountability, violence, regulatory quality, rule of law, government effectiveness and control of corruption (van der Vink 2007). Moreover, according to the World Bank & United Nations (2010) less democratic countries suffer more deaths from natural or man-made hazards, however, the number of deaths is also related not only to public awareness but also to the credibility of politicians to commit to the citizens.

Furthermore, the effectiveness of the government plays a significant role in the capacity of dealing with natural hazards. Government effectiveness may include the quality of public and civil services and their dependence from political pressures, the quality of policy formulation and implementation and the credibility of the commitment to such policies (Kaufmann et al 2010). Moreover, political stability also guarantees a proper functioning of institutions in natural hazard emergencies. The responsibility of the different actors before, during and after a hazard event — often described as accountability — also controls the institutional capacity of a society (Saechao 2007). Twigg et al (2001) consider accountability a synonym of sharing risks and responsibilities among actors, stakeholders and citizens. According to Amaratunga et al (2016), the lack of accountability of governments, public authorities, officials and institutions and other stakeholders may lead to increased material costs and casualties. It is clear that accountability issues are relevant in all the phases or the risk cycle. As far as the responsibility to prevent is concerned, vivid example is the one of Chernobyl in 1986 when the former Soviet Union failed to notify neighbouring affected countries (Saechao 2007). Regarding responsibility to react, Hurricane Katrina exposed the deficits of the response mechanism of the United States and the accountabilities of officials. During the reconstruction phase, experiences following earthquakes, show that deficits in accountability of officials may be associated with financial constraints (Saechao 2007).

Finally, lack of transparency and corruption are important aspects related to the institutional vulnerability. Corruption is ‘the abuse of entrusted power for private gain’ (Transparency International 2010) contributing to social and ecological imbalance and the vulnerability of industry, commerce, construction, health and agriculture (Lewis 2011). As far as natural hazards are concern, research suggests that there is connection between corruption, underdevelopment and disasters (Lewis 2011). Corruption is directly connected with insufficient rule of law, lack of implementation of land use and building regulation, and consequently buildings of bad quality that may lead to more disaster related deaths. More precisely, data from 344 earthquake events in 42 countries for the period 1975–2003 demonstrated a positive correlation between the level of public sector corruption and the number of deaths (Escaleras et al 2006). Corruption in the construction industry is often the reason for disaster related victims, but also corruption in other sectors may have similar results. For example, the consequences of the floods in Pakistan in 2010 may be also connected to illegal deforestation as a result of corruption (Lewis 2011). Similar examples from Bangladesh are provided by Rahman (2018) who suggests that corruption reduces the capacities of the society to respond to climatic stressors such as sea level change, biodiversity degradation, saltwater intrusion and desertification. Furthermore, Mahmud and Prowse (2012) investigate how corruption in Bangladesh may influence pre- or post-disaster interventions in different groups of the society.

3.3. Legislative and regulatory pillar

In the national scale, apart from legislation concerning the civil protection mechanism (CPM) and the financing of disaster risk reduction strategies, legal frameworks and policy strategies can contribute significantly to disaster risk reduction. However, they may also trigger a number of conflicts between authorities and the public or local businesses.

Regarding land use planning, the implementation of exclusively structural measures in the past encouraged development within the ‘protected’ areas increasing the vulnerability of parts of the community and leading to the so-called ‘levee effect’. This term was first used by Burton and Kates (1964) referring to the extensive use of the land between the levee and the river by farmers in the USA in the 1960s. Nowadays, however, non-structural risk management solutions, such as land use planning regulations, are generally favoured and are used in combination with structural measures. Nevertheless, the ‘levee effect’ can be still observed in many places in Europe, such as the European Alps (Fuchs et al 2017), the Netherlands and Italy, as well as the USA (Di Baldassarre et al 2015). Land use planning may contribute significantly to disaster risk reduction, however, it may also trigger a number of conflicts between authorities and the public or local businesses. For this reason, land use planning instruments such as hazard zones have to be communicated to the public in the right way ideally based on public participation. Conflicts are often related to building restrictions within the hazard zones or relocation requirements of existing buildings.

Legislation does not only determine where we build but also how (Holub et al 2012, Attems et al 2019). Building regulations are essential, especially in the reconstruction phase, in order to ensure that the buildings will be built in such a way to withstand future natural hazards. The building codes are a very strong tool for disaster risk reduction, however, there are two drawbacks associated with them. The first one is their implementation. The availability of
building codes does not guarantee their implementation. There are plenty of examples worldwide (e.g. in Turkey, Taiwan, El Salvador, India, Italy and Japan) showing that despite the availability of building codes, due to corruption, indifference and lack of adequate personnel, the codes were not implemented (Wisner et al 2004). The second drawback is the fact that buildings built before the implementation of the newest building codes are often the majority and they are still in use. For example, in Greece, 65% of the reinforced concrete building stock was built before 1985. Nevertheless, since 1985 the seismic building codes have been reviewed and updated twice (Pomonis et al 2014).

Finally, environmental legislation (e.g. legislation related to deforestation, air pollution, land degradation, etc) also influences the exposure and vulnerability of communities and natural resources. The lack of this type of legislative framework, its quality and implementation may influence the institutional vulnerability to natural hazards significantly. Additionally, conflicting policies reflecting conflicting national priorities may also lead to inability of legislation to protect the environment and consequently people and the built environment from natural hazards. An example that highlights this conflict is the inability of the government in Bangladesh to protect mangroves from commercial shrimp farming (Ishtiaque and Chhetri 2016).

This pillar of institutional vulnerability may directly influence the physical, economic, social and environmental vulnerability since it relates to characteristics of the society that may influence the capacity of the build environment and the society to withstand the impact of a hazardous process. Indirectly, legislation influences also the risk transfer and CPMs that are based on specific legislative frameworks.

3.4. Fiscal economic pillar
This pillar is related not only to the household budget of individuals but also to the national budget and the financing of organisations and agencies that are essential to the management of natural hazards, as well as to the financing of relief and reconstruction. The latter is strongly related to available public and private risk transfer mechanisms.

As most of the organisations involved in the management of natural hazards are public, this pillar reflects eventually the financial status of the country or region. However, the financing of organisations and works is not only based on available funds but also on decisions that reflect the priorities of governments.

Lack of national budget and support often decreases protection by communities. In particular, the recent financial and economic crises and fiscal squeeze reduced community resilience (Thaler and Priest 2014). Besides, the capacity to bounce back better is related to the available risk transfer mechanisms. Reconstruction costs following disastrous events often exceed the capacities of the affected population and, therefore, costs are transferred, shared or spread among several entities such as international aid organisations, the public sector and the insurance industry. A good share of the costs between these sectors can enable a promising and effective resilient reconstruction. However, events with extensive media coverage attract enormous amounts of international aid that often is not used adequately to ensure a sustainable ‘build back better’. A good example is the case of the 2004 Indian ocean tsunami. Although a record donation of nearly US$13.5 was collected (Smith 2013), it was not used efficiently for the reduction of existing vulnerabilities that could reduce the risk to future tsunamis (Khasalamwa 2009).

As far as developed countries are concerned, the state or private insurance companies bear the majority of the reconstruction costs. Worldwide, private insurance penetration varies significantly. Indicatively, the global distribution of premiums per capita for non-life insurance shows that in the US the insurance premium per year for the average citizen is as high as US$500 whereas in Africa or parts of Asia is less than US$5. Communities and authorities have to face in this case the so-called ‘natural disaster syndrome’ which is the combination of ex ante low investment in preparedness and ex post high costs of reconstruction (Kunreuther 1996). It is in fact remarkable that in many African countries there is no insurance coverage whatsoever (Linnerooth-Bayer et al 2011). In this part of the world, insurance coverage is often the privilege of some wealthy households or industrial and commercial assets that can afford it (Arnold 2008). On the other hand, in some parts of Europe (e.g. Germany and Romania), low income households have a priority with regard to potential financial assistance from the state (Priest 2014). Nevertheless, in the European Union, the market penetration rate of disaster insurance is generally low but varies according to the hazard type. In detail, penetration rates for insurance for storms is higher than that for earthquakes or floods (European Commission 2013).

Phenomena such as adverse selection, and moral and charity hazard influence negatively the market of private insurance (Browne and Hoyt 2000, European Commission 2013, Raschky et al 2013). In more detail, charity hazard is the phenomenon of some households that are deliberately not private insured because they rely on ‘charity’, meaning public insurance or aid from their social network or international organisations (Browne and Hoyt 2000). On the contrary, households that have bought insurance, underinvest on preparedness measures because they rely on knowing that they will be compensated after an event. This phenomenon is called ‘moral hazard’ (Raschky et al 2013). Finally, ‘adverse selection’ is the
tendency of some households to buy private insurance only when they perceive a risk as particularly high (European Commission 2013). All these phenomena can be reduced by the development of successful public private partnerships that can promote local adaptation measures for lower insurance premiums (Kleindorfer and Kunreuther 1999).

Risk transfer needs a strong institutional environment in order to function. In many developing countries, poor management practices in the public sector, inadequate risk statistics, insufficient systems for loss valuation and claim settlements cannot support an insurance system even if the latter is available (Petersen et al 2005, Cavallo and Noy 2009).

This pillar shares many characteristics with the social and economic dimension of vulnerability. Lack of accountability may lead to reduced coping and administrative capacity. Political instability may lead to weakening of the economy and eventually the financing of institutions and mitigation measures that will affect the physical and economic vulnerability. Moreover, lack of democracy has a direct impact on the legislation quality and implementation. Transparency, on the other hand, is directly associated with corruption which also weakens law implementation and leads directly to increased exposure and physical vulnerability.

3.5. The institutional vulnerability framework

In order to understand the structure of institutional vulnerability (pillars) and its interaction to other vulnerability dimensions, an institutional vulnerability framework was developed (figure 1). The framework shows the main pillars of institutional vulnerability, the interaction among them and the drivers attached to each one of them. Additionally, the relationship between the drivers of each pillar and vulnerability indicators for different dimensions is also demonstrated.

One of the challenges in understanding and analysing institutional vulnerability is related to the interaction among the four pillars. It is clear that differences in the socio-political context will affect decisions related to the national budget, affecting the fiscal-economic pillar directly. Moreover, legislation related to risk transfer mechanisms (e.g. mandatory private insurance) will have an impact on the fiscal-economic pillar which is directly related to the financing of the recovery following natural hazards. The socio-cultural pillar is closely connected to the socio-political one since the nature and quality of the political system often reflects the requirements and expectations of the lay people which are based on their culture and experiences. Moreover, a society with a weak democratic base is not expected to allow its citizens to take initiatives and participate in decisions that are related to disaster management. In undemocratic-totalitarian regimes the government may tend to take decisions for the citizens using a top down approach.

The connections between drivers and indicators of other vulnerability dimensions are shown in the framework but are not exhaustive. Most of the connections shown in figure 1 are the most direct and straightforward connections anticipated. For example, it is expected that changes in building codes will directly influence the physical vulnerability of buildings. The presence of hazard zone planning is expected to improve land use planning and reduce the exposure of buildings. However, there are also indirect connections. For example, the presence of risk transfer mechanisms (private or public insurance, reinsurance etc) will directly support the recovery and rehabilitation phase but, it can also indirectly contribute to the decrease of physical vulnerability by motivating homeowners to adapt their buildings. Furthermore, lack of transparency may influence the enforcement of building codes reducing in this way the physical vulnerability of buildings. Single drivers may influence more than one indicator and the adjacent vulnerability dimension. For example, environmental legislation may influence environmental vulnerability (e.g. air quality, sensitive habitats, water reserves) but also economic vulnerability (forest productive areas, agricultural areas). The vulnerability indicators may vary according to the country, environmental context (mountain, coastal, urban etc) and the scale (global, national, regional, local/community) and, therefore, the list of indicators cannot be considered exhaustive. Nevertheless, the framework gives an overview of the overarching aspect of institutional vulnerability and its interaction with other vulnerability dimensions.

4. Case studies

In order to understand the pillars and the way the different drivers affect the indicators of other vulnerability dimensions, we take a closer look at case studies in three European countries. Two of them have experienced a shock or significant institutional changes in the near past (Greece) or are about to experience institutional changes in the near future (UK). The third one, Austria, has been chosen due to its relative stability and robustness of its economy and institutions. Nevertheless, also Austria can demonstrate institutional vulnerabilities. The institutional context and vulnerabilities are described in the following chapters and the possible impacts on the other vulnerability dimensions are visualised and highlighted through the institutional vulnerability framework.

4.1. Institutional vulnerability of Greece: the financial crisis

4.1.1. The institutional background of Greece

Greece suffers often from a wide range of natural hazards. Apart from being the most seismically active...
country in Europe (Burton et al 2004), the country experiences on an annual basis wildfires, flash floods, storms and heatwaves.

In Greece, there are two levels of government: the state and the local self-government and the number of municipalities has been reduced from 1034 in 2009 to 325 in 2020 (OECD 2009). As stated in the new Law for Civil protection (Law 3013/2003), prevention plans and programs for natural and technological risks are the responsibility of the General Secretariat for Civil Protection which works under the Ministry of Interior. These plans are developed in close collaboration with the authorities in national, regional and local level respectively (Alexandris 2005). As far as preparedness and response are concerned, the general plan for civil protection is the ‘Xenokratias’ plan which includes regularly updated annexes for different hazard types (Alexandris 2005). Regarding compensation in the aftermath of a catastrophic event, Greece dedicates part of its annual budget to finance response and mitigation following the occurrence of natural or technological hazards. As far as earthquakes are concerned, the earthquake-stricken restoration service is the responsible instrument for the restoration of buildings and infrastructure as well as the sheltering of homeless population. As far as companies are concerned, the Hellenic organization of Small and Medium Sized Enterprises and Handicraft S.A. (EOMEX S.A.) is responsible for restoration and rehabilitation (Alexandris 2005).

4.1.2. The institutional vulnerabilities of Greece
In Greece, institutional vulnerabilities may be related to many different aspects including the government system, insufficient funding, shifted responsibilities, problems of fit and interplay among services and officials, inadequate land use practices (e.g. lack of completed cadastral survey), shortage of resources, enforcement of rules and access and use of scientific and local knowledge (Morehouse et al 2011).

Additionally, Greece has been subjected to significant socio-economic changes due to the financial crisis and the austerity measures that have been recently forced in the country (Mavridis 2018). Reforms enforced to Greece by its creditors demolished economy, increased unemployment, poverty and social exclusion as well as tax evasion and corruption (Mavridis 2018). Governments performed significant cuts in public expenditures including the way authorities and individuals manage natural hazards (Kassaras and Sotirhos 2015, Mavridis 2018).

Kassaras and Sotirhos (2015) suggest that the physical vulnerability of buildings has been increased since between 2010 and 2015 because the construction industry has been reduced by approximately 70% resulting in a large amount of people residing in older buildings. In parallel, seismic training of the population suffered also from reduced funds and is considered as inadequate. Moreover, despite the scientific potential and modern observational infrastructure, cuts in funding and personnel have reduced the performance of the institutes involved in earthquake monitoring. Additionally, a potential earthquake will challenge the first aid agencies as well as the response mechanism that are weakened due to limited funds. Kassaras and Sotirhos (2015) also argue that the financial crisis has increased social (unemployment, social exclusion, etc) and physical (degrading building quality, safety of public facilities, schools, etc) vulnerability. Sapountzaki and Chalkias (2014) claim that reforms due to the financial crisis include personnel, financial support, technical means and skills loss of organisations and agencies for civil protection. Budget cuts have also led to closure and merging of organisations, changes in forest policy and wildfire protection leading to reduced funds for seasonal personnel, clearance of forest fuels, opening of forest road network and maintenance of equipment. For example, the annual budget for fire services was reduced by one fourth in 2019 (Boitard 2018). These budget cuts have led to the obsolescence of at least 30% of the fires engines due to lack of maintenance (Smith 2018). An expression of this vulnerability was unfortunately reflected on the consequences of the forest fires near Athens in the summer of 2018 that claimed 102 lives and destroyed more than 1500 buildings (Goldammer et al 2019). Furthermore, a significant decrease of the household income and increase in poverty, social exclusion, unemployment, and psychological illnesses have been recorded and have a direct impact on the social vulnerability to natural hazards (Sapountzaki and Chalkias 2014, Kassaras and Sotirhos 2015). Finally, changes in the public administration (e.g. merging of municipalities) have negative consequences on the way natural hazards are managed (Ladi 2014).

The institutional vulnerabilities of Greece can be shown in the framework of figure 2. From the figure it is clear that the financial crisis has mainly affected the socio-political and the fiscal economic status. For example, changes in the accountability will eventually affect the administrative capacity of areas affected from natural hazards having a direct impact on the many vulnerability dimensions including the social and physical dimension. Moreover, changes in the national budget (mainly cuts) may directly affect the financing of institutions and mitigation measures as well as local adaptation measures that will have a direct effect on the physical vulnerability of buildings and infrastructure. Moreover, national budget cuts will increase unemployment for some sectors affecting in such a way not only social but also economic vulnerability. It is clear that the financial crisis has multiple impacts on the society and that the other pillars have been or will be directly or indirectly affected, therefore, further research is required.
4.2. Institutional vulnerability of the UK: Brexit

4.2.1. The institutional background of the UK

The United Kingdom has been often affected by natural hazards, however, the range of hazard types is not as wide as in other countries. The EM database reports that in the UK the last 50 years the main cause of death due to natural hazards has been heatwaves (2003 and 2013) and storms. In terms of material losses, the costliest natural hazards have been floods and storms.

The framework for civil protection is delivered by a single act, the Civil Contingencies Act. The Act provides the UK government with the necessary information in order to plan for emergencies and ensure civil protection. Risk assessment and mapping for five years ahead as well as resilience advice and guidance can be found in the National Risk Register. Last but not least, the Emergency Planning College offers consultancy and training in resilience, public safety and crisis management for individuals, groups or businesses (ECHO 2019).

The referendum of 2016 resulted in Britain leaving the European Union. Following the referendum, unstable short-living governments and the uncertainty of Britain’s future as well as the impact of Brexit on the economy and other sectors brought Britain in a period of uncertainty and instability. In the following chapter, the impact of Brexit on institutional vulnerability of the country is investigated.

4.2.2. The institutional vulnerabilities of the UK

On 31 January 2020 the UK officially left the European Union. Following the referendum in 2016 and until January 2020, continuous negotiations together with numerous unsuccessful attempts to convince the parliament to accept a Brexit deal created high uncertainty which was reflected on many sectors, including employment and inflation rate (Inman 2019). As far as the future is concerned, it is expected that Brexit may lead to changes in environmental legislation in terms of implementation of the European Water Framework or the European Floods Directive (Burns and Carter 2018, Fraser et al 2020). That could lead to an increase of environmental and physical vulnerability. Moreover, it is anticipated that Brexit will have a negative effect on poverty and unemployment, increasing in this way the social vulnerability of people to natural hazards but also the physical vulnerability since homeowners will not be able to invest in maintaining their buildings.

Furthermore, government spending on disaster risk management activities and related works may be also reduced. Regarding flood protection, there are concerns that, since flood defence works are often funded by EU regional development plans, there will be shortages in this respect (Black et al 2017) increasing exposure and physical vulnerability. Moreover, having left the European Union, Britain will not be
able anymore to get assistance from the EU Solidarity Fund which provides financial assistance to EU countries following the occurrence of natural hazards. Additionally, a large number of multi-lateral and bilateral agreements and treaties will not be valid anymore and will have to be renegotiated. In fact, at least 759 treaties that are essential for the function of the country will have to be renegotiated (McClean 2017). It is still unclear how the UK will address the fact that they will not participate in EU initiatives that relate to environmental security, and community and infrastructure resilience in the post-Brexit era. These initiatives include the European Programme for Critical Infrastructure Protection, the Directorate-General for European Civil Protection and Humanitarian Aid Operations, the CPM and the associated Emergency Response Coordination Centre, as well as the EU Energy Security Strategy (Black et al 2017). Moreover, research on natural hazards will also suffer since the UK will not have access to EU research funds (MacKenzie 2016). Additionally, a point of concern is the transboundary flood risk management system between Northern Ireland and Republic of Ireland as both countries have no international treaty about water management as well as multiple transboundary catchments (Fraser et al 2020). The consequences of Brexit for flood risk management might be uncertainty regarding the legislative framework in Northern Ireland as well as poor collaboration between both countries in flood risk management including emergency management, common protection strategies, etc.

In figure 3, the institutional vulnerabilities of Great Britain that are related to Brexit are depicted. In more detail, changes in environmental and land use planning legislation will have a direct impact on exposure and environmental quality which will directly affect physical and environmental vulnerability. Political instability has a direct effect on the way national budget is managed directly affecting the financing of relevant institutions and mitigation measures. This will directly affect the physical vulnerability of buildings and infrastructure. Indirect effects of Brexit could be also depicted on this framework after some further research.

4.3. Institutional vulnerability of Austria: risk transfer

4.3.1. The institutional background of Austria

Mountain hazards including torrent processes, snow avalanches and landslides are the main concern of authorities, decision makers and scientists in Austria. Apart from mountain hazards, river floods as well as earthquakes constitute also a significant hazard in the country (Embleton-Hamann 2007).

The legislative framework that concerns the management of natural hazards includes the Austrian Forests Act (Republik Österreich 1975), the Water
Figure 4. The institutional framework highlighting the institutional vulnerabilities of Austria related to the existing risk transfer mechanisms.

Act (Republik Österreich 2014) or the Disaster Fund Act (Republik Österreich 1996). At national level, however, there is a national disaster management coordination and communication and coordination mechanism called SKKM (Staatliches Krisen- und Katastrophenmanagement) which is responsible for the management of crises and catastrophes (IFRC 2012). Due to the federal character of the country, federal governments and local authorities play the most important role in natural hazard management implementing a number of own policies and laws. Every federal state has its own disaster management laws and building codes (‘Bauordnungen’) (IFRC 2012). As far as the buildings are concerned, each federal state has regulations regarding the building process, however, regulations concerning measures for existing buildings are scarce (Rauter et al 2019).

The Austrian Service for Torrent and Avalanche Control (WLV) is responsible for the development of hazard zones that indicate the catchment areas of rivers and torrents as well as the areas that are susceptible to related hazards (mainly torrents, avalanches and erosion). Development plans are based on the hazards zones although these are not legally binding, unless they are referred to by the individual federal spatial planning law (Holub and Fuchs 2009).

As far as the compensation of the damages is concerned, in absence of private compulsory insurance, the main instrument for the compensation of damages due to natural hazards is the Austrian Catastrophe Fund.

4.3.2. The institutional vulnerabilities of Austria

In Austria, the market penetration of private property insurance is exceptionally low (Thaler and Fuchs 2020). The main reason is the option of being compensated through the Austrian Catastrophe Fund (Republik Österreich 1966, 1996), even if claimants only receive a compensation between 20% and 50% of documented loss (Thaler and Fuchs 2020). Although the financing of the Fund is centrally organised and derives from surcharges on taxes, the federal states decide how the fund will be distributed to the homeowners in need (Holub and Fuchs 2009). Nevertheless, federal states that are often impacted by floods pay the same premium (as percentage of their share from income taxes) as federal states with lower exposure to floods (Holub and Fuchs 2009). Furthermore, the Catastrophe Fund but also private compensation schemes do not include strategies for the reduction of physical vulnerability or the promotion of sustainable housing. In fact, these administrative practices are unlikely to change without legislative rules and political guidance (Thaler and Fuchs 2020). Finally, when the budget reaches the amount of 29 million euros it is used for other expenses and it...
may not be available when needed (Holub and Fuchs 2009).

Austria’s weaknesses of the existing risk transfer mechanisms are expected to influence the existence of local adaptation measures and, eventually, the robustness of the built environment as well as the coping capacity of the homeowners following a catastrophic event, leading to an increase in physical vulnerability (figure 4).

5. Discussion

The framework of figure 1 shows the relationships and interactions between institutional vulnerability and other vulnerability dimensions that were also evident in the three European case studies. In Greece, the financial crisis and the austerity measures altered the national budget leading to cuts in the financing of institutions and mitigations measures. Cuts in the national budget led to administrative changes that reduced the organisational capacity of the state and the local authorities to manage a natural hazard event. It is clear that the financial crisis in Greece, led to an increase of the institutional vulnerability of the country which affected the physical but also the social vulnerability to natural hazards. In the UK, the prospect of Brexit reduced the political stability of the country and influenced its economy. Brexit itself, however, is expected to affect not only the economy but also the legislative framework of the country in such a way that the institutional vulnerability will increase, increasing at the same time its social, physical and environmental counterparts. The institutional vulnerabilities of Austria, on the other hand, are mainly related to the risk transfer mechanisms which affect the reconstruction phase and the copying capacity.

Looking at all three case studies, it is clear that institutional vulnerabilities related to the way we deal with natural hazards exist in all countries no matter the degree of political or economic stability, the wealth or legislative framework. The case studies have shown that external shocks (e.g. Brexit, financial crisis) or internal organisational weaknesses (risk transfer mechanisms) may affect the drivers of institutional vulnerability, affecting directly or indirectly all other vulnerability dimensions. For this reason, we consider institutional vulnerability an overarching concept, in other words, an ‘umbrella dimension’, that holds the key to the reduction of the other dimensions of vulnerability. In more detail, changes in the building codes or legislation are the key to reduce the physical vulnerability of the buildings. Improvements in accountability and participation reduce social vulnerability of communities by improving their coping capacity. It is, therefore, important to comprehend the concept of institutional vulnerability and then find the right indicators to analyse and quantify it. However, it is clear that the choice of indicators, their metric and the source of the information required depends on the scale of research. Assessing the institutional vulnerability at national scale has the advantage that some indicators (e.g. corruption perception index) are already available by international organisations (OECD, Transparency International, World Bank, etc) but others may be challenging to capture. On the other hand, at the local scale, information regarding some indicators (e.g. risk perception, participation rates, incorporation of local practices in risk reduction activities) may be collected through interviews and questionnaires.

The closer look at the three European case studies may lead to a number of recommendations regarding the way institutional vulnerability has to be handled. These include:

(a) The connections and interactions demonstrated in figure 1 are only some of the obvious and direct relationships that could be shown at this stage. As it has been mentioned earlier in this paper, there are additional indirect connections as well as interactions among the drivers, and the indicators that are not shown herein. It is, therefore, important to carry out more research in this direction.

(b) It is important to recognise that institutional vulnerabilities may be present in different levels (e.g. society, authorities) and sectors (financial, legislative, political etc) and should be investigated in this way.

(c) Disaster managers, decision makers and stakeholders should not handle different vulnerability dimensions in isolation. The connections of vulnerabilities to natural hazards to the institutional context have to be considered.

(d) Strategies for the reduction of vulnerability and consequently disaster risk reduction should include institutional changes where possible.

(e) Equally, institutional changes should also consider the domino effects that can be seen in the framework of figure 1 and the impact that may have in the way a society deals with natural hazards and eventually on their consequences.

(f) Institutional vulnerabilities may be present in all countries regardless their financial, political and even institutional status.

(g) There is a need for methods, approaches and indicators to assess institutional vulnerability in a systematic way and at different scales. In table 1 recommended indicators connected to each of the pillars presented in figure 1 are shown. The indicator list is only preliminary and indicative. More indicators may be recommended that suit the particular context of the area under study. Further research is required for the weighting of the indicators, the aggregation method and
Table 1. Recommended indicators for the assessment of institutional vulnerability.

| Pillars               | Drivers        | (Indicative) indicators                                                                 |
|----------------------|----------------|----------------------------------------------------------------------------------------|
| Socio-cultural       | Participation  | • Percentage of people involved in disaster risk management planning                    |
|                      |                | • Type of engagement (non-participation, tokenism, or citizen power)                    |
|                      |                | • Who is engaged in disaster risk management planning (socio-economic background)      |
|                      |                | • Number of official meetings between public administration and citizens               |
|                      |                | • Inclusion of local and indigenous knowledge and practices in the disaster risk planning |
|                      |                | • Number of voluntary groups for Disaster Risk Reduction (DRR)                         |
|                      |                | • Number of platforms                                                                  |
|                      | Local knowledge and practices | • Number of local knowledge and practices used in the management of natural hazards |
|                      | Risk awareness and perception         | • Percentage of people being aware of the probability of occurrence of specific natural hazards of a certain magnitude and within a specific time frame |
|                      |                | • Number of households who implemented property-level flood risk adaptation (PLFRA) measures |
|                      |                | • Coping and adaptive capacity of individuals                                          |
| Socio-political       | Accountability | • Number of strategies for DRR                                                          |
|                      |                | • Clear definition of who is responsible for each strategy for DRR                     |
|                      | Political stability | • Frequency of violent demonstrations                                                  |
|                      |                | • Frequency and intensity of social unrest                                              |
|                      | Democracy      | • Free and fair elections                                                               |
|                      |                | • Equality before the law                                                              |
|                      |                | • Equal rights to participate                                                          |
| Fiscal-economic       | Transparency   | • Corruption perception index                                                          |
|                      | Risk transfer mechanisms       | • % of private insurance penetration                                                   |
|                      | National budget | • Level of compensation                                                                |
| Legislative and regulatory | Land-use planning | • % of cuts in specific sectors                                                        |
|                      | Building codes | • Existence of hazard zones                                                             |
|                      | Environmental legislation | • Numbers of exposed buildings                                                          |
|                      |                | • Existence of building codes                                                          |
|                      |                | • Legislation related to conservation                                                  |
|                      |                | • Legislation related to pollution                                                     |
|                      |                | • Legislation related to land cover (vegetation, deforestation etc)                   |
|                      |                | • Legislation related to water management                                              |

the classification of institutional vulnerability classes.

(h) Last but not least, institutional vulnerability should be investigated for all the phases of disaster cycle (prevention, mitigation, response and reconstruction).

6. Conclusion

The present study provides an overview on the complex but essential concept of institutional vulnerability. Institutional vulnerability was defined, analysed through its four pillars and demonstrated through three different European examples. It has become clear that institutional vulnerability has very strong interactions with all other vulnerability dimensions. Focusing on the reduction of institutional vulnerability, namely, by improving legal frameworks and regulations, encouraging participation, improving public awareness, enhancing the accountability of important actors, tackling the shortcomings of our risk transfer mechanisms and designing our national budgets to ensure the financing of disaster risk reduction measures, we can reduce all other vulnerability dimensions as well as the negative consequences of natural hazards in the future. Future research, however, is necessary, in order to see how relatively recent changes and shocks—such as austerity measures and Brexit—have influenced in the long term the way countries manage natural hazards.

Data availability statement

No new data were created or analysed in this study.
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