



THE CUBAN SYSTEM OF DISASTER RISK REDUCTION AND ITS APPLICABILITY TO SEISMIC HAZARDS

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Abstract

Earthquakes and other natural hazards pose a worldwide threat and their effects are particularly devastating in poor countries. Finding solutions to cope with this threat is a matter of concern to countries in general, and particularly important to countries that show the worst results in these aspects. In contrast, Cuba's success in disaster risk reduction (DRR) has been globally recognised. However, this success cannot be explained by the mere application of some successful policies — as some analysts tend to do. Such views correspond to reductionist analyses that isolate phenomena and disregard their context, thus failing to consider processes of interdependence of multiple phenomena and the evolution of these processes. In the best case, reductionist analyses may acknowledge that successful policies are a result of experience and long-term improvement. However, incorporating the time factor only contributes to creating larger reductionist perspectives. Considering dialectical processes of interaction and co-evolution provides new insights to understand models and realities, such as the Cuban approach to natural hazards and DRR. This approach is noteworthy not only for providing solutions that can be globally applied. Cuba's example demonstrates that successful approaches to natural hazards are not necessarily based on the income level of countries or on the degree of investment in disaster risk management. Moreover, Cuba's remarkable results in DRR cannot be isolated from the socio-political context in which its DRR strategy is immersed. Cuba's strategy is part of a development model embedded in a socialist project. Taking into account the different nature of seismic hazards compared to those on which Cuba has vast experience, such as hurricanes, this article intends to explain and highlight aspects of Cuba's DRR approach that can be globally applied, whatever hazard being considered. Cuba's DRR strategy is analysed with a focus on principles, policies, practices and methodologies followed by its National Civil Defence system (NCD) in which the Cuban National Seismological Research Centre (CENAI); the Cuban National Seismological Service (SSN); the Cuban National Housing Institute (INV); the Institute of Physical Planning (IPF) and other institutions and mass organisations play a fundamental role. Cuba's NCD system reflects features of a socio-political model that encourages social engagement and promotes of human values in Cuban society, thus enabling democratic processes of popular participation to solve society's problems and particularly avoid disasters.

Keywords: dialectical processes; participation; risk; seismic hazard; vulnerability.



1. Introduction

Natural hazards pose a worldwide threat and their effects are particularly devastating in poor countries [1] [2]. In contrast, Cuba's success in disaster risk reduction (henceforth, DRR) has been globally recognised [3]. Cuba is exposed to several kinds of hazards, including natural, technological, and sanitary hazards. In the case of natural hazards in Cuba, these encompass hurricanes, tropical storms, tropical depressions, intense rainfall, floods, storm surges, wildfires, intense droughts, landslides, and earthquakes [4]. Among the above mentioned, hurricanes represent the highest threat to Cuba, in terms of frequency and intensity. Several authors provide comparative evidence of Cuba's remarkable performance in facing these phenomena. Between 1996 and 2002, only 16 fatalities occurred in Cuba due to hurricanes. In contrast, fatalities in other countries in the Atlantic affected by the same hurricanes amounted to 649 [5]. Hurricane George, for example, claimed only six lives in Cuba and more than 600 in the rest of the Caribbean, while maintaining similar categories in the Saffir-Simpson¹ hurricane-wind scale [7]. Furthermore, in 2004 hurricane Ivan claimed 25 lives in the U.S. and none in Cuba [8]. On the other hand, Cuba's DRR approach has not been as frequently tested with seismic hazards as it has been with hurricanes. The last disastrous aftermath of an earthquake occurred in 1932, almost thirty years before the triumph of the revolution of 1959, with an epicentre in the area of Santiago de Cuba. The earthquake, with a magnitude of 6.75 (Ms), affected 80 % of households of which 5 to 10 % resulted in total collapse [9]. Acknowledging the different nature of seismic hazards compared to those on which Cuba has vast experience, such as hurricanes, this article intends to explain and highlight aspects of Cuba's DRR approach that can generally be applied to help prevent disasters, no matter the kind of hazard being considered. Cuba has advantages over other countries especially in the early stages of DRR, which commonly encompass mitigation, prevention, preparedness, response, and recovery [5]. In this connection, a subtle difference of concepts should be noted. Avoidance of disasters during the occurrence of extreme phenomena can be a result of DRR strategies with emphasis on the first three of the five stages mentioned above, which are the main strength of Cuba's DRR strategy. On the other hand, response and recovery from a disaster situation can be understood as "disaster management." However, the literature often merges these concepts and thus "disaster management" is also used when referring to the early stages of DRR [5][9]. Bearing these concepts in mind, this article intends to contribute to the engineering and social sciences of disasters by providing a dialectical analysis² of the Cuban model of DRR and the multiple elements connected to it. Thereby this study builds on earlier contributions within the sphere of political ecology that reveal the misleading concept of "natural" disasters [12][13]. These contributions help to highlight that the natural aspect of this issue constitutes only the triggering element that transforms vulnerabilities into disasters. Particularly, the *Pressure and Release* (PAR) framework helps characterise the relationship between hazards, vulnerabilities, and disasters [13]. Authors applying this framework define the concept of progression of vulnerability, which explains vulnerability as a condition developed through different levels. These authors describe how *root causes* interact with *dynamic pressures* and *unsafe conditions* to increase vulnerability to disasters [13]. Root causes are elements that have settled in longer periods and cover greater spatial extensions compared to dynamic pressures and unsafe conditions [14]. Root causes include social and economic structures (such as maldistribution of power, wealth, and resources), ideologies, history, and culture. Dynamic pressures include societal deficiencies and macro-forces. Examples of the latter are pressures from multilateral financial agencies, poor governance, and corruption. Unsafe conditions include lack of physical, natural, human, social, economic, and political resources [15]. Although these aspects are directly or indirectly addressed throughout this article, the analysis of root causes and dynamic pressures that increase vulnerabilities to disasters is emphasised. In addition, authors reorganise these concepts and their interactions to define what they refer to as "the triangle of vulnerability." [15]. This triangle explains how root causes and dynamic pressures "marginalise" people by cutting their access to necessary resources for achieving sustainable livelihoods. These resources can be of all kinds, political, economic, social, human, physical, or natural [16]. Therefore, marginalisation can refer to one or many of these aspects. Additionally, marginalisation

¹ On the Saffir-Simpson scale, see [6].

² On dialectical analyses, see [11]



from resources does not only refer to actively obstructing people to gain access to resources. It also refers to the passive obstruction to resources or, in other words, not providing citizens with the tools to gain access to them.

A significant part of the literature has taken reductionist approaches to analyse Cuba, its socio-political system and economic development model, and the connected elements conforming it. These approaches focus on objective, tangible, or material aspects to explain Cuba's performance in reducing disasters, such as the country's legislation or monetary investment in disaster preparedness [17] [18]. Education, communication means, equality, and an efficient organisational structure following regulations are considered among objective aspects contributing to the Cuban strategy of DRR. Yet reductionist approaches neglect subjective elements when analysing the Cuban model and consequently its DRR strategy. Such views isolate phenomena and disregard their context, thus failing to consider processes of interdependence of multiple phenomena and the evolution of these processes. In the best case, reductionist analyses may acknowledge that successful policies are a result of experience and long-term improvement. However, incorporating the time factor only contributes to create larger reductionist perspectives. Considering dialectical processes of interaction and co-evolution provides new insights to understand models and realities, such as the Cuban approach to natural hazards and DRR. Therefore, this study seeks to understand the influence and relationship between subjective and objective elements and their evolving interaction, all which result in Cuba's DRR strategy. Ethical principles and social values such as solidarity, altruism, and brotherhood, together with culture and social relations that are inherent to the Cuban social model, can be considered subjective elements. Similar to these subjective aspects, is what some authors describe as "intangible qualities" contributing to Cuba's DRR approach [5]. An ideology and ethical principles followed by a society can be examples of intangible qualities contributing to reduce disasters. These two elements, rather than becoming evident only in extreme conditions might be reflected in the daily life of Cuban society. Whether descriptions of a strong presence of social values within Cuban culture are exaggerated or not is something that may depend on the political stance adopted. However, evidence of Cuba's value-based culture and solidarity can be found not only at a national but also at an international level—despite Cuba's economic difficulties. The Cuban relief brigades sent to several countries are indicative examples of Cuba's international solidarity [19][20]. Particularly remarkable has been Cuba's contribution to fight the Ebola outbreak in Africa in 2014, which included sending 165 Cuban doctors and health care specialists equivalent to the joint contribution of all other countries in the world [21][22]. Analysing Cuba's history and historical geopolitical context becomes essential to understand these and other features of Cuban society. The Cuban revolution is known for not having betrayed its commitment to social rights despite economic difficulties, which started in the early 1960s with the long-standing blockade imposed by the US. These difficulties worsened with the strengthening of the blockade in the early 1990s, coinciding with the fall of the Soviet bloc, which had been a fundamental support to the island. Cuba's system of social security including right to housing and free and universal access to continuing education and health-care are emblematic examples of its social commitment [23]. Furthermore, also indicative of the revolution's commitment to social rights is the protection of Cuban population in the face of hazards of all types to avoid disasters and loss of lives.

This article is based on extensive qualitative and quantitative research performed in Cuba between November 2013 and March 2014, which can be found in its extended version in [24].

2. The Cuban system of disaster risk reduction

The institution holding the highest responsibility to protect the Cuban population and its economy is the *Cuban National Civil Defence* (henceforth, NCD). Its headquarters are located in the city of Havana. The origin of the NCD can be traced back to July 31, 1962, when the *Cuban Popular Defence* was created. Later, in 1966 this institution evolves to what is nowadays the NCD system [25]. The NCD system is defined in the Cuban *Law No.75* enacted on December 21, 1994:

The civil defence is a system of defensive measures of state character, undertaken in peacetime and during exceptional situations, for the purpose of protecting the population and the national economy against the means of destruction of the enemy and in cases of natural disasters or other catastrophes, as well as the consequences of environmental degradation. It also includes carrying out of rescue works and urgent repair of breakdowns in foci of destruction or pollution [26].



The Cuban NCD System encompasses the Cuban President, Ministries, economic entities, national and local-government institutions and Cuba's society in general. The national and local-government institutions in Cuba are known respectively as the *Superior Organs of Popular Power* (*Órganos del Poder Popular*, OPP) and the *Local Organs of Popular Power* (*Órganos Locales del Poder Popular*, OLPP). Within the OPP the *National Assembly of Popular Power* (ANPP, for its Spanish acronym) represents the Cuban parliament, and currently accounts for 612 deputies elected every five years [27]. The NCD system encompasses also the *Risk Reduction Management Centres* (CGRRs, for their Spanish acronym). These centres exist at both the provincial and municipal level and work within their respective local government levels. *Popular Councils*, which are the lowest political structure at the circumscription level, are transformed in *Defence Councils* during extreme situations, thus having more power to make decisions. Also important within the NCD system are the *Early Warning Points*, or EWPs (PATs, for their Spanish acronym). These are strategic observation-points located in vulnerable areas, such as river basins or landslide-risk areas. These points are provided with tools to observe or measure environmental conditions and keep the CGRR informed of possible anomalies. Additionally, the NCD system has been reinforced with the yearly celebration of the *International Day for Disaster Reduction* and the performance of the *Popular Exercise of the Actions in Case of Disasters*³, also known as “*Meteoro*” (*meteor*) mock drill. During this exercise, authorities get prepared to face hazards and plans for DRR are disseminated and put into practice in schools, workplaces, communities, and neighbourhoods [28]. These practices indicate Cuba's understanding of the concept of risk as a result of the interaction between hazards and vulnerabilities as shown in Eq. (1), which is also known as the pseudo-equation⁴ of disaster risk [13]:

$$\text{Risk} = \text{Hazard} \times \text{Vulnerability} \quad (1)$$

Multiple variations of this pseudo-equation exist in the literature [29]. However, these variations share the three main concepts of risk, hazard and vulnerability. The approach Cuba has adopted to address these issues results from the interdependency and mutual-interaction of parts and wholes, as discussed in the following sections.

3. Interdependency of parts and wholes in the Cuban model

The conceptual map below (see Fig. 1) interconnects elements grouped in three levels. These interconnections indicate the mutually dependent relationship between subjective and objective elements that evolve and interact in dialectical processes to constitute Cuba's DRR strategy. These elements are at the same time influenced by the whole they constitute, namely Cuba's DRR strategy, which is likewise part of a larger whole represented by Cuba's socialist project. This socialist project reflects an absence of *root causes* and *dynamic pressures* causing vulnerabilities and disasters in other countries [15]. At the *first* or *outermost level*, the conceptual map illustrates the three main actors of the system, who overlap with each other in different degrees and aspects: The government or the state, the institutions and NGOs, and the Cuban population. The *second level* presents intangible and subjective aspects influencing Cuba's DRR strategy, namely: Ideology and the socio-political model as basis of a political will to reduce disasters; the degree of participation in development processes and decision-making instances; Cuban's culture, tradition, and idiosyncrasy; Formal/non-formal education based on values such as solidarity; and the Cuban civil defence functioning as an intertwined system rather than just an institution. At the *third* or *innermost level*, more objective or tangible elements appear, namely: The experience built on the historical occurrence of hazards; a stringent environmental legislation on each phase of DRR; the high level of formal education of the Cuban population; the high social equity and equality still present in Cuba; and the high and active socio-political organisational level. These tangible elements are those frequently considered in the literature on natural hazards and DRR.

³ Ejercicio Popular de las Acciones en Caso de Desastres.

⁴ It must not be understood as a mathematical equation, but as a representation of the factors involved and how they interact.

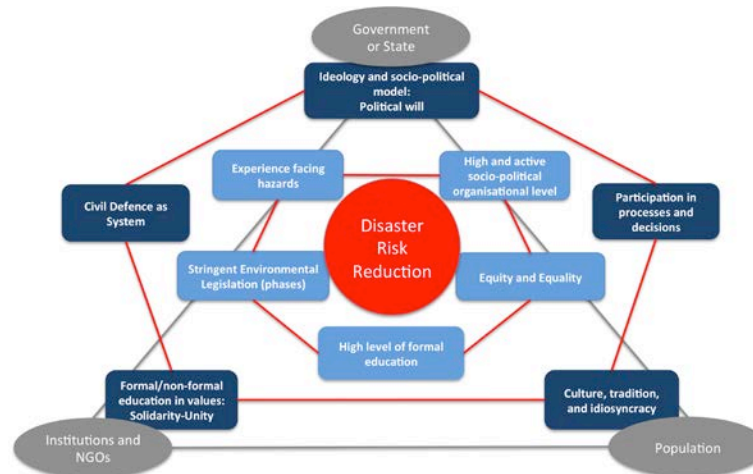


Fig. 1 – Conceptual map of elements and relationships within the Cuban strategy of disaster risk reduction [24].

The following sections delve into the dialectical interaction and interconnectedness between Cuba's DRR strategy and subjective and objective elements constituting it.

4. The first level of interaction: The main actors

The Cuban government, institutions, and civil society tend to blend and become intertwined to a degree that might not be seen in any other country in the world. This feature enables a natural process of mutual learning of society's needs and commitment to common goals. The blending of these three actors may result from deliberate and less deliberate processes. In the former case, the influence of socialist principles motivates a conscious goal of continuously merging the state, institutions and civil society with each other [30]. On the other hand, a less deliberate blending process may be influenced by Cuban society's degree of equity and equality (illustrated on the third or innermost level of Fig. 1). Evidence of deliberate processes to merge the government with the population can be found through an analysis of representativeness and electoral mechanisms in Cuba. The Cuban electoral model is based uniquely on social merits of candidates and prohibits competition through campaigns based on money expenditure [31]. Furthermore, neither elected delegates of the local government nor national deputies in Cuba receive salaries for their duties. Deputies in Cuba continue performing their regular occupation (i.e. as students, workers, athletes, etc.) and do not jump to a status of a *political class* separated from civil society [31]. Consequently, these aspects of the Cuban model denote the inexistence of economic barriers to people's participation in decision-making. Similarly, the Cuban Electoral Law (Law No. 72) also forestalls political barriers. Herein, ordinary Cuban citizens are given the right to nominate candidates for municipal assemblies. In the case of provincial governments and the national parliament (ANPP), commissions integrated only by mass organisations can nominate candidates to these political institutions. The main organisations in these electoral commissions are the *Cuban Workers Federation* (henceforth, CTC), the *Committees for the Defence of the Revolution* (henceforth, CDRs), and the *Federation of Cuban Women* (henceforth, FMC). Additionally, the Law No. 72 excludes the Cuban Communist Party (henceforth, PCC) from nominating candidates and candidates are not required to be members of the party to be elected [32].

Moreover, the blending of institutions and NGOs with the ordinary population is favoured by the absence of special benefits or higher salaries for their members in the same way it favours the relationship between the government and the population. This aspect has reached a point that Cuban society and its leaders have criticised for being an excess of *economic egalitarianism* [33]. Economic egalitarianism detoured from the aim of social justice and equality of rights and opportunities advocated by socialism. As a result, salaries of doctors or other specialists have been similar to those of people performing non-specialised activities. However, these and other unpopular trends are currently addressed by recent changes introduced in the Cuban model, which resulted from a process of national debates and consequent social consensus [34][35]. These changes are detailed in the



document called *Guidelines For The Economic and Social Policy of the Party and the Revolution* [36]. Similarly, the merging of institutions and ordinary citizens is also evident in the interaction of specialists of the Cuban NCD, the CGRRs and private households. In the province of Holguín, for example, 26 private households located in the most vulnerable areas run *early warning points* (PATs). These PATs provide essential information that is used by CDRs to organise evacuation measures with the guidance of CGRRs [37].

The remaining locus of interaction is that created between NGOs and public institutions on the one side, and the state and the government on the other. Institutions and NGOs operating in Cuba, despite their autonomy, reflect to a greater or lesser extent the state interest by implementing public policies. Therefore, yet separated, NGOs and institutions blend with the Cuban state by following political priorities of the revolution. On the other hand, NGOs and autonomous institutions play a key role in providing alternative perspectives and methodologies to correct failures, confront problems, or improve strategies. A remarkable contribution of NGOs and specialists is to have incorporated multidisciplinary approaches to confront different problems of Cuban society. Studies on natural hazards performed by Cuban institutions include the participation of professionals from engineering and social sciences and their results are utilised to update practices such as the *Meteoro mock drill* performed throughout the country [37].

The perceived proximity of the state, institutions, and civil society in Cuba may favour relations based on trust at different levels. A statistical analysis performed among Cubans above 15 from different areas of the country, shows that 90 % of them ($n = 87$) considerably trust in the government and public institutions⁵ [24]. Processes generating proximity and trust include the necessary adaptation of these actors to evolving local and global contexts, resulting in a positive co-evolution toward aspects such as Cuba's DRR strategy. Furthermore, Cuba's socio-political model encompasses subjective aspects that favour the interaction and integration of the different actors of Cuban society, as discussed below.

5. The second level of interaction: The subjective elements

At the second level of Fig. 1 the interaction of subjective elements is presented. These include ideological principles and social values reflected in processes of participation, contents of education, culture, and the concept of civil defence. These elements are supported by the actors at the first level and maintain dialectical relationships between each other. The promotion of ethical principles and social values among these actors is an essential aspect of socialist ideology guiding the Cuban model. In this connection, citizens interviewed claim that the entities that ought to and indeed transmit these values in Cuba⁶ are society in general (31 %), the family (24 %), school or formal education (22 %), and the state or the government (18 %) [24]. These perceptions help understanding how social values are transmitted and reinforced in Cuba. Besides, these results may give an idea of how feasible is to build processes that develop these values in other contexts—or how difficult it would be in societies where a lack of essential social values is evident. On the other hand, many agree that solidarity and other social values are features found in Cubans and their *idiosyncrasy* or the so-called *cubanía*, which is in turn influenced by Cuba's colonial history [38]. Additionally, the revolution has also reinforced social values through mass organisations such as the CDRs, CTC, and FMC [39]. Furthermore, socialist ethical-principles may also have inspired Cubans' altruism to cooperate in hypothetical or experienced extreme situations. Most interviewees (69 % of the sample) claim to be capable of risking their lives to save the lives of others—if necessary. Moreover, since 89 % of respondents claim to have experienced extreme phenomena at least once in their lives, their experience in this matter is palpable. Surveyed citizens explain Cubans' cooperation in extreme situations as a result of solidarity (33 %), humanism or brotherhood (24 %), unity (18 %), awareness of possible damages of a disaster (8 %), culture (7 %), revolution teachings (6 %), and others (4 %) [24]. The above results delve into understanding the *psychology of cooperation*⁷ or *mutual help* among Cuban citizens. Nevertheless, according to many specialists interviewed, values such as solidarity motivating cooperation are essential but not decisive. An example of the latter can be found in how evacuation measures function in Cuba. People evacuated

⁵ 9 % of the sample is uncertain and 1 % has little trust.

⁶ The remaining 5 % includes entities mentioned with less frequency.

⁷ On *psychology of cooperation*, see [40].



from vulnerable homes prefer to find shelter at a neighbour's safer home, due to proximity to their own homes. Nevertheless, if neighbours would not agree in receiving the vulnerable ones in their homes (because of lack of solidarity or any other reason), the government still ensures the alternative of receiving people in full-equipped *albergues* (shelters). Therefore, if people lacked solidarity, this would indeed affect the system, but not up to a level that the system cannot work any longer. This situation also applies during the recovery phase, where people's cooperation is still essential. In this phase people normally help, for example, in collecting debris, and in clearing the streets [37]. On the other hand, solidarity and the values and beliefs motivating cooperation can be indicative of the existence of an ideology in its broadest sense. The influence of an ideology can also be examined through people's concepts, views, and ways of conceiving reality. An example is given by the concept of democracy described by the citizens interviewed. Most of the essential requisites for a democracy they pointed out differ substantially from those prioritised by liberal or electoral democracies. Cuban interviewees consider equity and equality, peace, social rights, and freedom of speech the most important conditions. These views may be favoured in a society like Cuba, with a system of values that encourage and prioritise social success rather than individual competitive economic-success. Prioritising social success results in a political will to avoid disasters and preserve human lives. This is evident in, for example, the legislation (see the third level of Fig. 1), which ensures that every necessary resource in the country be available to save lives. In this connection, the *Cuban Law of the National Defence* articulates:

All the resources and activities of the country, regardless of their nature, can be seized by the Government of the Republic in order to satisfy the needs of the national defence during exceptional situations [26].

These social priorities, which seem unquestionable according to Cuba's socialist principles, are difficult to conceive in societies whose evolution is guided by for-profit goals. In these societies, private interests may hinder the necessary availability of resources in extreme situations [41]. In contrast, the principles guiding the Cuban model can motivate a more sustainable use of natural resources, physical planning, and implementation of construction codes. The *National Housing Institute* (INV, for its Spanish acronym) and the *Institute of Physical Planning* (IPF, for its Spanish acronym) regulate the quality of constructions and their geographical location in non-vulnerable areas [42][43]. In Cuba, these issues, whilst not being subject to pressures of market forces, are more easily guided to meet social needs and reduce vulnerabilities [5]. On the other hand, the perception of a political will to prevent disasters together with public transparency can reinforce Cuban's trust in public institutions. This process can, in turn, be a source of *social consensus*, *unity*, *social cohesiveness*, and *legitimacy*. Respondents' trust in institutions is significantly correlated with their perception of transparency of the government and institutions ($p < 0.001$; $\alpha = 0.05$)⁸. Most interviewed authorities and ordinary citizens perceive a considerable degree of public transparency, although 17 % claim that more transparency is necessary. In contrast, a more significant degree of social consensus is evident in, for example, respondents' positive perception (88 % of the sample) of the NCD system and Cuba's environmental governance [24]. People's trust in public institutions may also be developed as a result of Cuba's participatory implementation of policies. Public institutions have intended to reduce vulnerabilities with no regard to the socio-economic status of citizens but emphasising their participation. Acknowledging lack of means, Cuban authorities promoted strategies such as the *construction microbrigades* and the *self-help construction method* (*método de construcción por esfuerzo propio*). These methods encourage people's participation in the planning, construction, reconstruction, or modification of households in compliance with construction and seismic codes and the physical planning of the country. In such methodologies, people's participation in detecting and solving vulnerabilities has been essential. Hitherto, these initiatives have had great impact and considerably increased people's initiative to modify their homes⁹. To enable compliance with technical requirements and train the microbrigades, authorities launched the programme of the *architect of the community*, which had been developed in Cuba in the 1990s by the Argentinean architect Rodolfo Livingston. The method provides technical assistance to the population, while making them participate actively in the whole process of planning and constructing their homes [43][44]. Moreover, as part of the Cuban Ministry of Science, Technology, and Environment (CITMA), the *Cuban National Seismological Research Centre* (CENAIIS) was created to address seismic risks in Cuba. CENAIIS is

⁸ For additional statistical analyses see [24].

⁹ In 2014, self-help construction accounted for 50.7 % of finished homes in Cuba [45].



involved in projects such as the seismological survey of households of the old historical-area of the city of Santiago de Cuba, with a focus on the most deteriorated homes [46]. In this and other cities in the eastern part of Cuba, education on environmental hazards has been focused on preparing the response to seismic events. Information on these issues is disseminated in the media or through didactic material distributed to authorities and the population in general [47]. Additionally, CENAIIS and other institutions and NGOs such as CARE have performed multiple workshops with the community. Priority is given to employing the existing socio-political organisation to develop and deepen the mutual transfer of knowledge [48]. In these events, specialists give talks and interview citizens and local leaders to identify key problems of the community [49]. These events also give local knowledge a prominent role in reducing vulnerabilities and risks. Strategies such as the *family emergency plans* are eloquent examples of the role played by citizens. Herein, families adopt responsibility for carrying out their own analyses at their households and neighbourhoods to assess risks [47]. Thereby, they become more conscious of the risks and of what needs to be done to reduce them. Family emergency plans are revised and complemented by CENAIIS [46]. It is claimed, however, that considerable lack of seismological knowledge in the population and insufficient contribution from actors such as public media are still evident [50]. Efforts to address a lack of knowledge are therefore maintained. In 2014 for example, CENAIIS launched the *popular self-construction manuals*. These manuals translate the seismic code to an easily understandable language, thus making sure that everybody comprehends the requirements to be fulfilled [46]. In this connection, the institution responsible for revising and updating the Cuban seismic code is the *State Committee for Standardisation*. Updates contemplate refining the seismic mapping and the seismic micro-zoning of the country [51][52]. Currently, a new modification of the seismic code is about to be approved. For the assessment of seismic hazards and vulnerable areas, the *Cuban National Seismological Service* operates seismological stations, which have been modernised through collaboration with China [51]. Moreover, reducing physical vulnerability to disasters involves relocating and resettling people in non-vulnerable areas, rather than just evacuating them [53]. These actions together with reconstructing and repairing homes imply high costs, but the economic situation of the country hinders their proper fulfilment. In the aftermath of extreme phenomena, the annual budget of each municipality can be destined to short-term reconstruction. Middle and long-term reconstruction require a research and assessment process in which many actors take part, from the bottom to the top administrative level. Thereby it is evaluated if households are able to cope with the expenses or if they need bank loans, bonuses, subsidies, or if the state must fund and perform the complete reconstruction of homes. Additionally, the state, by means of international cooperation, has fostered local production of construction materials, prioritising the use of local resources and renewal energy to enhance sustainable construction-processes [9][43]. In terms of reconstruction, it is acknowledged that a considerable part of low-quality infrastructure was inherited from the colonial and republican periods before 1959. During the colonial period, constructions had a better seismic performance than the so-called “eclectic constructions” of the republican period. Moreover, after the 1932 earthquake, reconstruction processes did not focus on eliminating vulnerabilities and favoured those with economic capabilities [9]. Conversely, since 1959 onwards, the 20th-century European mass social housing influenced construction processes in Cuba. These processes aimed at providing rapid housing to the most vulnerable population, while considering feasible solutions according to the difficult economic situation of the country. However, mass construction processes implied a secondary effect of destroying the aesthetics and the local identity of traditional areas. Acknowledging this secondary effect, urban rehabilitation of historical areas was prioritised from the 1980s onwards [54]. Nowadays total-collapsed structures, such as those destroyed by hurricane Sandy in 2012, are reconstructed by using different systems. For single-family homes, the *rigid core system* (núcleo rígido) and the *progressive housing* are utilised as methods to provide rapid and safe solutions. For larger buildings, the systems FORSA and VHICOA are utilised. The former consists of monolithic armed-concrete structures and the latter is based on braced steel-frames. These systems provide safer structures against the impact of extreme events and they also incorporate seismic design [46]. However, the VHICOA system may still have vulnerabilities to wind action because of using lightweight close-off panels [43].

Efforts made by CENAIIS and multiple other Cuban institutions are reflected in the views of the citizens interviewed. They point out the degree of information held by Cuban society, and the preparedness of leaders and institutions as some of the elements that have allowed Cuba to build a successful DRR strategy. Additionally, citizens recognise the organisational level of Cubans and the above-mentioned political will of the government as other key elements [24]. The high organisational level of Cuban society has favoured people's



contribution in detecting and solving vulnerabilities (see the third level in Fig. 1). This can be exemplified in the labour performed by CDRs to provide information to the CGRRs and the NCD. Cuban mass-organisations are omnipresent and have similar structures to that of the OPP and the PCC, namely from zone committees, to municipal, provincial, and national level. These structures prevent *political isolation* or *political marginalisation* of Cuban citizens. These features have reinforced the development of the NCD as a system—in which everyone is considered an essential part that shares responsibilities—rather than an institution separated from civil society. Hence the system has generated social disposition of being protected and social discipline to avoid disasters [24].

Participatory processes within Cuba's DRR strategy, although only partially covering a broader concept of participation, contribute to legitimise the Cuban model. In the same way, its legitimisation is favoured by the existence of practices or rights that Cubans identify as fundamental in a democracy. A democratic development-process of the Cuban model since 1959 onwards is evident in subsequent changes to the constitution, the labour code, and the electoral law among others, which have embodied popular demands [31]. In this connection, 81 % of the surveyed people recognise control mechanisms or accountability exercised by citizens over leaders and institutions. In contrast, these rights seem absent in liberal democracies [55][56]. Some interviewees claim, though, that the right to recall leaders and other features of a *direct democracy* are still not sufficiently exercised in Cuba. However, their political recognition in the Cuban constitution provides the foundation to improve their application [57]. The latter requires enforcing existing laws and abolishing practices that obstruct them. In this connection, examples of the effects of non-compliance with regulations and laws, together with lack of comprehensive application of technical knowledge are found in the assessment of geotechnical risks in Cuba [58]. Laws, regulations, knowledge and other more objective elements within Cuba's DRR strategy are analysed in the following section.

6. The third level of interaction: The objective elements

Objective elements are reflected in Cuba's exposure to different hazards, its stringent environmental legislation, the acknowledged high educational level of Cuban population and their involvement in mass organisations. Evidence shows how these elements are interconnected with the previous two levels. The long experience of facing natural hazards—and particularly hurricanes—has developed what is referred to as Cuba's "culture of hurricanes," which makes people inevitably aware of the threat posed by hurricanes [59][60]. This awareness is favoured by people's level of education. The high-standard universal education in Cuba not only includes concrete contents of DRR strategies, but also provides general knowledge that allows an active and influential participation in socio-political processes. Furthermore, a stringent environmental legislation takes advantage of the human capital provided by formal and non-formal education. In addition, the NCD system and the legislation underpinning it benefit from the social capital provided by the high and active involvement in socio-political organisations. Approximately 97 % of the surveyed individuals claim to be involved or participate in mass organisations, and 91 % participate specifically in their CDRs [24]. The high organisational level makes possible not only mobilising the population toward common goals, but also knowing and understanding the specific social, economic, or biological needs of each member of every Cuban household. Moreover, the positive effect of equality in Cuba is maintained by unyielding socialist principles such as free and universal access to health-care and continuing education. Ensuring social rights, despite long-lasting economic difficulties, has contributed to maintain consensus and the legitimacy of the Cuban model. Furthermore, respect for social rights is essential in the process of building *sustainable development*, which in its broadest concept includes sustainable livelihoods. These achievements have given Cuba the recognition of the only country in the world satisfying the requirements for sustainable development in its broadest sense [61].

7. Conclusions

This article presents evidence of the complex interaction of objective and subjective elements, their co-evolution, and the evolving contexts in which these interactions take place to constitute Cuba's DRR strategy. The dialectical processes of interaction and co-evolution of these elements have contributed to reduce *dynamic*



pressures and address *root causes* of the progression of vulnerability described by Wisner et al. (2004). Cuba's model has reinforced social values whose influence has been essential to the success of Cuba's DRR strategy. As a constitutive part of the Cuban development model, its DRR strategy reflects fundamental principles of a larger whole represented by Cuba's socialist project. In the same way, the Cuban model cannot be assessed correctly without considering the historical geopolitical context and its dialectical influence toward Cuba's revolution. Conversely, reductionist approaches focus on objective or material aspects that are withdrawn from their context, thus neglecting their interaction with multiple subjective elements in different spatial and temporal levels. Aspects such as stringent laws, and a high educational and organisational level are not independent from Cuba's socio-political and ideological model. This model prioritises social values and common goals rather than individual material-success. Isolating elements from the whole with which they interact obstructs an understanding of the structural change that other societies may require to reduce vulnerabilities. Therefore, reductionist approaches create an impression that poor countries have no hope of improving their performance in DRR. On the contrary, the findings of this study suggest that dialectical analyses provide better expectations for the improving capacity countries have. These solutions are feasible to different economic-realities of countries, as long as their societies set common goals to address *root causes* and reduce *dynamic pressures* of their systems. Cuba has advantages over other countries especially in the early stages of DRR. At these stages, the influence of subjective elements is intensified, in contrast to stages of recovery or reconstruction, which can be more dependable on economic expenditure. Consequently, it remains a challenge to replicate successful pathways connected to DRR in all aspects of the Cuban development model. Indicative examples are the participatory non-hierarchical mechanisms of mutual learning, incorporated as a systematic practice in the dissemination of knowledge to reduce vulnerabilities. These mechanisms have generated confidence, commitment, and responsibility in social actors. However, expanding channels of participation to the daily agency of all socio-political mass organisations and public institutions, according to socialist standards and the high intellectual level of the country, becomes a major challenge and a necessity.

Although Cuba opted long ago for the path of self-improvement in aspects such as its DRR model, maintaining these and other multiple elements of a sustainable development remains a challenge in an adverse geopolitical context. This adverse context, which continuously threatens Cuba's national sovereignty and right to self-determination, becomes an additional challenge and an imposed-risk of disaster to a society that, on the contrary, has taught and helped the world to avoid disasters.

8. References

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