Entry

Research Trends in Resilience and Vulnerability Studies

Christopher L. Atkinson [ORCID]

Public Administration Program, Department of Business Administration, University of West Florida, 11000 University Parkway, Pensacola, FL 32514, USA; catkinson1@uwf.edu

Definition: While the definition of resilience is disputed or even fuzzy, due in no small part to the diversity of its applications, the concept generally involves the ability to withstand and bounce back from shocks; vulnerability as a related concept involves the tendency to suffer from shocks, given existing characteristics that may prevent resilient responses. Vulnerabilities put individuals, groups, and societies at greater risk and disadvantage, suggesting a need not only for disaster response and recovery, but mitigation and preparedness. Resilience and vulnerability research has recently focused on the role of government, the COVID-19 pandemic, and flood hazards; topics of interest have also included resilience of rural and urban areas, development and sustainability, and displacement and migration.

Keywords: resilience; disaster management; vulnerability; climate change; rural areas; floods; literature reviews; sustainability

1. Introduction

Topics of disaster risk reduction and resilience have perhaps never been more in focus in popular understanding. This is likely due to the global effect of the Coronavirus disease 2019 (COVID-19) pandemic, but also because of the increasing impact upon human life of hazards, natural and technological, and the clear and present dangers posed by climate change. The Sendai Framework for Disaster Risk Reduction 2015–2030, related to other global accords on sustainability and climate change, plainly connects risk reduction and the building of resilience [1]. This framework ties the impacts of disaster to the need for resilience and poverty eradication, and includes educational, social, health, and economic resilience among the forms of resilience to be supported [1].

Definitions and applications of resilience abound. The diversity of definitions may be seen as either a strength or a weakness depending on one's perspective—in one sense the concept is a strong one because it could be applied in a variety of settings, but potentially weak because it seems to resist consistent definition across fields. Dovers called resilience ill-defined and noted its complexity in influential actors and variables [2]. Resilience can fail in implementation when it attempts to apply broad pronouncements or one-size-fits-all remedies when involvement of local knowledge, governance, and context is key [3].

Given the impact of the COVID-19 pandemic, discussions of societal vulnerability and resilience, ever timely, seem especially so now. Managing in the realm of crisis and emergency is a primary role of government [4]. The problem of addressing societal risks is especially salient; humankind's ability to respond proactively to threats is relevant beyond a single emergency. To this point, Melo and Oliveira Guimarães observed that "the construction of resilient societies, which includes everything from awareness of the environmental crisis to the reduction of social inequalities, is the one that emerges as a necessary learning process to make the future of humanity viable" [5].

This entry examines recent trends in resilience and vulnerability research, focusing on peer-reviewed journal articles mentioning resilience, vulnerability, disaster management, public policy, preparedness, and mitigation—all core principles associated with resilience and allowing an intensive approach to what is a rapidly expanding literature. The trends

are derived from a targeted review of literature, as described in Supplementary Materials (see link at the end of the entry for additional discussion). Resilience is considered in the literature from a variety of perspectives—societal, institutional, and personal—that interact with one another in complex ways. Societal crises tend to provide for focusing events that demand action from institutions, but also have significant impacts upon people; the problem of resilience is multifarious. This entry begins with a discussion of resilience and the role of government in emergencies. Sections on the impact of the COVID-19 pandemic and literature with emphasis on flood hazards follow. The entry continues with sections on rural areas, urban areas, development and sustainability, and displacement and migration, and how they relate to resilience. The entry concludes with a consideration of these contributions and opportunities for future research.

2. Resilience and Government Decisions in Emergencies

2.1. Definitions

Beyond the traditional view of resilience in materials science—a measure of resilience being "the amount of energy the material can absorb and still return to its original state" [6]—there are a variety of definitions of resilience from many disciplines. Holling wrote that "Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still exist" [7]. Engineering resilience is defined by a system's ability to return to stability following a shock, with a quicker return to steadiness being an indication of greater resilience [8]. In describing the organizational ability to adapt, Glor noted the importance of "variety, reactivity, and capacity for self-organized emergence" [9].

The definition for resilience proposed by the United Nations, which incorporates a variety of perspectives on the topic, is "The ability of a system, a community or society exposed to hazards to resist, absorb, accommodate to, and recover from the effect of a hazard in a timely and efficient manner including through the preservation and restoration of its essential basic structures and functions" [10].

Social vulnerability is a related concept to resilience because it affects the ability of individuals to absorb and withstand shocks, and speaks to resilience's absence [11]. Essential to understanding resilience, risk has been defined as the combination of vulnerability and disaster frequency and scale, which in turn informs adaptive capacity and coping approaches in communities [12]. Risk shifts depending on timing, vulnerability within a system, and a commencing event [13].

Recovery offers an opportunity to take stock of where communities have fallen short in addressing vulnerability and may yield a foundation for more resilient redevelopment [14]. Pal and colleagues [15] recommended improvements in infrastructure in the instance of schools, but also professional development for staff, to better situate officials to respond effectively to disasters.

2.2. Public Roles and Concepts in Resilience

Lara and colleagues wrote that "building resilience refers to a transitional, ongoing process with learning potential, instead of an initiative that just takes place once" [16]; through governance, communities may play an important role in building resilience because there is the potential for positive transformation in the system. Echoing the essential role of governance, Terblanche, de Sousa, and Niekerk emphasized, in their review of application of risk reduction measures for cities, the importance of governance, obligations to stakeholders, educative capacity, and effectiveness in risk management to identify vulnerabilities in both service provision and specific locations where focus is needed based on social exposures [17].

A major problem though is that the most vulnerable citizens may play little role in prevention and disaster mitigation choices; the building of collaboration and trust is essential in such efforts [16]. Spirkova, Mura, and Stehlikova placed resilience as a process included within disaster risk reduction, involving "knowledge, innovation, and

education" [18]; this treatment is situated within a larger discussion of vulnerable groups, various forms of hazard because of climate change, and coping capacity. While some governments may have significant climate change policies, the vulnerable populations most affected by climate change may have little understanding of the policies, as they were not involved in their creation and are largely not aware of them [19].

Efforts are being made to allow for participation in disaster risk mitigation. Much is made about the importance of public participation for due reason—community participation in disaster mitigation efforts demonstrably leads to adoption of disaster mitigation recommendations by individuals and households [20]. In an Indonesian example, participation was quite low. The study authors attributed this to weaknesses in training and social capital issues as well as past involvements with disasters; the issues involving indigenous knowledge were also seen as important [21].

Social capital is generally considered to be positive in reducing vulnerability and increasing resilience, primarily when relationships exist before hazard events occur [22]. As an example, there is evidence that social capital can be a factor in encouraging populations to heed warnings and evacuate in the event of a hurricane threat [23]. There is the potential that social capital may be negative and increase vulnerability, as in a terrorist attack when a terrorist may pose as a police officer or rely on cellphone use to detect potential victims [22].

It is important to understand why efforts to reduce vulnerability do not work in certain contexts; when best practices are not easily transplanted, this should not come as a surprise, because attempting to implement a solution, without all the supporting aspects and individual/institutional learning that made the solution work in the original instance, is perhaps doomed to failure. If people have not had drills for a hazard event, it is then no wonder that they do not acclimate themselves well or quickly to the institution of hazard drills [21]. This makes the ideal of public outreach, involvement, and inclusive public spaces doubly difficult in addressing vulnerability—the people who are most vulnerable might be the hardest to reach, and address in a way that is meaningful to them, and useful and positive to all concerned. It is nevertheless worthwhile to engage in the effort, and expend the resources to reduce the vulnerabilities seen individually and on a larger scale.

The literature on resilience has a recurring theme of vulnerabilities that exist pre-event becoming points of difficulty or even serving as a breaking point during a disaster response. Reinhardt and Lutmar [24] raised the challenge of resilience in areas where conflict already exists; coupling a conflict, rebel groups against a government for example, with a pandemic scenario, can present even greater conflict or provide an opportunity for cooperation to serve both communities amid the difficulties being experienced by all.

Even when governments are willing to engage in conversations about disasters, there is still a tendency to want to focus on disaster responses, rather than resilience and prevention, regardless of the benefits of doing so [25]. Decisions may be political in nature and confusion may exist as to what constitutes an acceptable risk in disaster planning, recalling Waugh [4]. Decision-makers may be path-dependent in desiring certain solution sets for resilience, limiting discussion [26]. This is becoming an even bigger problem with the rise of so-called "unprecedented events" [27] that overwhelm existing systems, which were planned for times long since past, when extreme weather and climate change were not as much of a consideration. Governments have less right to a response-only pattern when experience suggests extreme events and a need to plan for what might happen, not what has happened in the past. Threats are not actually exogenous in the first place; "hazards and vulnerabilities [are] endogenous to state sovereignty" [28]. Overconfidence and handling a hazard event poorly can contribute to disaster [28].

Babulal [29] also connects the problem of climate change with the need for approaches to resilience in organizations and to allow for continuity in critical infrastructure; within disasters are the seeds of potential improvement and the possibility to "build back better", and to move beyond coping or planning for a response to events like what has already been experienced. Problems facing such efforts are information sharing, as well as a lack of information, especially in developing countries, and not approaching preparation for

resilience as a "system of systems"—necessitating shared responsibility and collaboration between government, industry, communities, and individuals [29]. Implicit in a "system of systems" is that each actor group must work toward some semblance of resilience on their own, autonomously, so that they may in turn accord some strength to the network of the whole. This may involve a level of decentralization or optimized sharing of information, as in Society 5.0 [30]. Information should be accurate and shared from a source that is trusted by the intended populations [31]; this seems simple but can be tricky in application.

Comfort and Wang [32] raise several examples of failures in responding to hazard events, exposing significant vulnerabilities in systems, and showing the importance of resilient infrastructures. In a Taiwanese case, the need for learning was coupled with a necessity to "recalibrate" and adjust to shifting contexts associated with the differences in future events [32]

Information sharing about disasters is essential for learning to occur. It has been reasoned that, with the growing consequence to situational mindfulness of geospatial data sources, the sharing of this information in effective, efficient ways is a primary goal for disaster risk reduction [33]. Technology, Geographic Information System (GIS) modeling for local-scale hazard inference, and big data analysis can be aids in understanding threats, and sharing information about them can support resilience and sustainability [34,35]. Beyond sharing information, reducing the gap between risk information and individual perception of risk has been a goal, as evidenced in the study by Fischer and colleagues [36] linking seismic vulnerability and stakeholder discussions about real versus perceived risk in a densely populated district in Italy.

While government in China is typically thought to be centralized, Goyal [37] made the case that even with centralization, there is considerable variation in local government experience and experimentation; when shocks and crises occurred, central government favored allowing some latitude to local governments to address crises, showing a certain resilience in adaptability amid the fragmentation.

The relationship of public roles with resilience was a major theme of the papers included in the sample. The interaction of public systems and processes with evolving technologies, understanding and individual responses poses difficult problems, solutions to which may be supported by new research in this area, as evidenced by the papers discussed above.

3. The Impact of the COVID-19 Pandemic

It presents little surprise that some works reference the COVID-19 pandemic in relation to the term resilience. The co-incidence of COVID-19 with other vulnerabilities, the role of adaptive capacity, impacts on business, and planning for future threats, were major areas of overlap in the sampled literature. COVID-19 forced individuals and communities to make difficult choices, often cutting people off from each other [11]; in many cases, this was devastating to community bonds, and weakened human relationships and the ability of people to work together to solve problems. A literature review on COVID-19 in disaster/crisis literature suggested that resilience studies "discuss the necessity of developing dynamic capabilities in logistics and production capacity, recalibrating and reconfiguring operations, as well as the importance of emotions as an intrinsic element of resilience during pandemic governance" [38]. Vasilescu, Apostu, Militaru, and Hysa [39] noted that the COVID-19 response in certain respects showed low resilience, with opportunities available to improve responses for future events. Mental health, clarity of communication, and social responsibility are subtopics associated with community resilience [38].

Co-incidence of COVID-19 with other hazards, such as a dam failure, exposed existing vulnerabilities, as disasters could be seen as processes resulting from "economic, political, and social constructions" [5]. A scoping review also identified the co-incidence of physical hazards with the occurrence of COVID-19, with negative impacts on resilience and lifestyle, but noting the key roles of women in responding to disaster [40]. This speaks to the continuing importance of work on resilience that seeks to quantify benefit of proactively

addressing risks, to reduce the consequences of failure and improve times to recovery [41]. COVID-19 was especially difficult on people who were already in vulnerable positions, such as the homeless, who experienced greater exposure to COVID-19 itself as well as the "spillover" effects of unemployment: being forced out of housing; the incidence of COVID along with other predicaments invariably worsened the situations of the people affected. Still, Pixley, Henry, DeYoung, and Settembrino cautioned against underestimating resilience of homeless populations or romanticizing it, given that homelessness presents unique needs and challenges in the face of a pandemic for the client population and caregivers alike [42].

Krasnikov, Shultz, and Rebiazina noted variations in response outcomes during the COVID-19 pandemic. Community resilience is based in adaptive capacity, which helps determine the speed and effectiveness of responses, services to communities, and attention to quality of life [43]. They found that community resilience was supported by a threefold model of economic development, information communication (including deployment and reliability), and transformative potential, which would include measures of trust, involvement, and accountability (2022). This is echoed by Kunguma [44], who in pointing out the importance of technology in the sharing of information, and the cost-effectiveness of doing so, also raised the essential nature of stakeholder involvement in such an effort from the perspective of increasing resilience. Community development and security are also supported by the development of collective identity [13].

Businesses were dramatically affected by COVID-19, and because individuals rely on business for livelihood, keeping businesses going is essential to societal resilience. An Australian study found that while businesses anticipated remaining in operation, they required technology and online assistance, and experienced challenges with risks in meeting demand and supply challenges, along with financial shortfalls; problems with border issues, staffing, extreme weather, and customer connections heightened the challenges of COVID-19 [45].

A recurrent theme in COVID-19-related papers is how society might plan for future pandemics. A resilient response might include "strong linkages between strategic partners, alternative resource mapping strategies, a robust institutional and legal framework, and promoting health equity across economies", as suggested by Panneer and colleagues [46]. This noted, suggestions for "practical, evidence-based public policy measures" [46] must be weighed against the tendency in some quarters to use a pandemic for political gain, or to engage in magical thinking in hopes a threat will simply dissipate on its own [47]. It is not clear that the lessons of the pandemic have turned the public sphere toward a preference toward rational, evidence-based thinking in all cases.

4. Floods: Comfort with Calamity?

The literature continues to expand with interesting case studies that show practical applications of resilience to addressing real-world considerations of vulnerability and risk. Floods have been a topic of some interest within the period covered in this review; this is consistent with floods being common and costly events [4]. It could be that there is some growing consensus that floods, being events experienced widely and on a fairly regular basis, offer the potential to better understand resilience given a constant threat and set of circumstances, that may be applied across a variety of contexts. Floods are considered in the sampled literature along with notions of responsibility, risk and planning, adaptation to avoid disruption, far-reaching impacts of floods, and the need for strong government roles in response to these events, to increase resilience from societal and personal perspectives.

Snel and colleagues focused in their article on four different notions of risk responsibility in floods—"legal responsibility, accountability, perceived responsibility, and moral responsibility" [48]—and wisely noted that there is some gap between what individuals perceive as their responsibility and what they believe government's role should be. There may be a lack of alignment between governance of flood risks and "legal responsibility, accountability, or moral responsibilities" as they actually exist. This should give all practitioners and researchers profound concern about the cavalier use of public participation

and talk of governance in resilience preparation, because the research implies that the basic understanding of vulnerability and personal responsibility is in many cases simply not there. Without a foundation upon which to build, an educational aspect to any resilience effort is crucial.

With the caveat that past events are not necessarily indicative of future occurrences [27], modeling floods and potential impacts using past events might at least assist governments and communities with raising awareness of hazards. Such efforts can help quantify the cost in terms of potential loss of life and economic loss to property from a hazard [49]. Seeing an impact visually, even in a computer model or image, can perhaps make a difference to a public that might otherwise be apathetic to such information.

Lara and del Moral presented an especially troubling consideration of flood risk and resilience in the case of Seville, Spain, highlighting a seeming amnesia about a long history of flooding against a top-down program of infrastructure that inadequately considers public participation, while showing path dependence and shortfalls in data, awareness, and skill in "integrated, adaptive forms of management" [50], and an inattention to social vulnerability, among a host of other points [50]. Zimbabwean riparian communities were shown to be unprepared for flood disasters, lacking public participation in reducing vulnerability, adequate communication about risk, and evacuation planning [25]. The literature has seemed to center on these factors thematically.

Because community resilience can help spur populations to think about risk and begin making plans, the research does show that awareness and even some anxiety about a flood event can yield positive results in terms of preparedness, as shown in a case study of Lagos [51]. However, causing too much anxiety in a population may result in the public becoming angry and averse to emergency management preparation efforts, including actively avoiding further warnings, as a more recent event in Florida showed [52].

In the case of Malawi, a community-based approach found that as long as populations could continue to access the source of their livelihoods, they were amenable to relocation to reduce risks associated with flooding [53]. Prioritization of approaches to address "population pressure, gender, and social services" was also found in the study to improve resilience, noting significant vulnerability in those areas, but there was less support for directly dealing with the matter of flooding itself—removing populations from the flooding areas [53]. In that instance, life jackets would apparently be preferred to being removed from an area that regularly floods. This poses an interesting general problem for resilience: when a population has apparently adapted to a level where it finds a risk acceptable, but where society generally cannot or should not afford such a risk from a variety of perspectives, what is the best way forward to allow for the self-determination of the community, and management of the threat and cost to society at large?

An important point to remember is that hazard events like floods do have an impact beyond the individual. A flood has a negative impact on community functioning that may persist for a period of many years, so while it is good to have strong community resilience to bounce back from a flood, it is also better to not have a flood at all. Infrastructure improvements that can avoid an event impacting an area would be preferred to people having to engage in coping skills, but improvement in both infrastructure and "social cohesion" are warranted [54].

When populations cannot or will not leave flooding areas, it is important that governments nevertheless provide for ways to address persistent vulnerability. Providing for evacuation routes and flooding shelters can assist in supporting some measures of resilience [55]. A Ghana-located study found that gender was indeed a factor in affecting resilience, with women-headed households being less resilient to flooding events; the study suggested that this variance is due to "family sizes, number of dependent children, intra-household employment levels, and housing characteristics" [56]. This finding should give pause to emergency practitioners as a point for additional support and encourage additional research into this potential vulnerability in other cases.

New research has examined changing circumstances, including impacts expected from climate change at more granular levels of study, such as at the village level, in various risk zones to provide actionable information for policy and practice [57]. Significant hazard events can lead to great improvements in planning, such as with Thailand and flood risk reduction, but gaps can remain, including lack of stakeholder participation and preparedness activity. Efforts might be limited to physical infrastructure, which could make use of spatial analysis tools [58] but ignore the essential human element of resilience.

5. Resilience of Rural Areas

Research on resilience in rural areas is still relatively less common [8]. While our understanding of rural areas and their development has evolved, there is a need to recognize the limitations of such areas, particularly with regard to economic resources and path dependence, which might undermine resilience [59]. Resilience research must pay special attention to the uniqueness of rural areas, which are unlike urban areas in a variety of important ways; having noted this, some of the same failings in resilience may occur regardless of context, most notably failures of collaboration among groups involved in resilience planning [8]. It is wise to make special note of the value of indigenous knowledge that may contribute greatly to resilience [60,61].

Smallholders suffer from a lack of resilience because of a range of vulnerabilities, but they are particularly affected by agricultural drought, which in turn affects food security for the larger society. In a South African case, government intervention was not shown to be effective at addressing smallholder needs, leaving significant shortfalls with land access difficulties, weaknesses in water supply, poor access to credit, little or no savings, and deficiency in diversification [62]. Smallholders have employed a variety of approaches to addressing needs, many of which are reactive and not all of which have worked well. Recommendations have included "capacity building, technological demonstrations, and greater dissemination of knowledge", including reliance on extension education, but there is an awareness that circumstances may demand that smallholders simply give up agriculture at some point and engage in other work [63].

De Falco and Fiorentino [64] raised the interesting predicament of inner (rural) areas of Italy as precariously placed and abandoned, subject to political whims and especially vulnerable in the face of crises and emergencies, such as what was experienced with COVID-19. Rural areas have critical vulnerabilities that are made worse in the case of an emergency, but attention during a crisis may be fleeting, with essential services not provided in alignment with need.

In Pakistan, research has noted that building structures are poorly built by marginalized people that lack the knowledge and resources necessary to build appropriately and in line with standards to resist hazard events. Resilience may be improved by sharing information, for example about construction standards to withstand seismic events, and that this information should be shared through a wide variety of media, both internet-enabled and more traditional in nature [65]. Information shared by community-based organizations in rural areas can be helpful in achieving resilient outcomes [31].

Rural areas are often vulnerable to hazards, with governments unable to assist effectively, but as Khan, Gong, and Shah have noted, more research is needed on particularly vulnerable countries like Pakistan [66]. A key to resilience in rural areas is a positive attitude toward adaptive measures, including using special varieties of crops or different sized farms. Exploring non-farm jobs and using climate-resilient approaches to agriculture have both been deemed as examples of disaster risk management [67]—this is a telling sign given the rapid advance of climate change and its very real impacts upon agriculture and human life. A review of research on vulnerability and climate change suggests a variety of opportunities for additional research [68]. Studies that consider gender in rural areas have been recommended [69].

Saputra and colleagues [70] pointed out that areas of lower economic growth and instability in income, such as developing countries, show lower resilience, which in turn

affects recovery rate in responding to pandemics or other disasters. Having a greater incidence of events in an area also leads to increased vulnerability, due to low access to services and infrastructure [14].

The problems of vulnerable areas are even more frustrating because of tendencies toward self-defeating behavior. Mutanda wrote of the experience in responding to COVID-19 in Zimbabwe, including the challenge presented by Africans that believed they were naturally resistant to the disease [71]. While overoptimism is a typical vulnerability and tends to undermine resilience, it is nevertheless shocking when it appears, and in the damage that it can cause to people and whole societies. Resilience can also be undermined by the presence of maladaptive behaviors, which include "wishful thinking, denying the risk of floods, and fatalism"—these were present in a case study of Bangladesh flood risk, which may be rooted in culture, but have the potential to prevent adaptive behaviors [72].

Looking at mid-level officials' (termed professional stakeholders) views on institution of preventative-type planning, Dvir and colleagues [73] found that there was appreciation of the need for preventative strategies, but less willingness to fund those approaches with direct resources; instead, a prioritization of recovery is highlighted, which does not put an emphasis on resilience. This is disappointing as addressing vulnerability vis à vis management of risk can have real benefits; with recovery approaches, costs are pushed down the road, but the result is not actually cheaper. Nikolakis and Roberts similarly found a disconnect between recovery and resilience, with an inattention to wildfire vulnerability in a Canadian case [74].

Digitalization (shifting processes to computer-aided and supported versions, making use of internet, GIS, and global positioning) may be an aid to support adaptability in both rural and urban places in agricultural applications, to reduce vulnerabilities increased by climate change impacts [75].

6. Urban Areas

Urban areas pose a unique context for resilience researchers and special problems for planning and response. Gonzalez and colleagues observed that "spatial agglomeration improves [urban] Resilience indicators, but...size hides inequalities" [76]. Urban areas present from the perspective of resilience. Hu, Wu, Wu, and Zhang conducted typhoon disaster chain analysis in urban spaces and found that rainstorms and typhoons present special problems for responses in urban areas, including electricity outages yielding cascading effects. Differences in modes of collaboration exist; "complex adaptive systems thinking" [77] should be cultivated to improve resilient responses.

Urban areas during the pandemic were a focal point because of the potential for the spread of illness. Thinking in terms of resilience, urban areas have potential to incorporate healthy design as a vital part of urban planning efforts, as suggested by Jevtic and collaborators [78]. Healthy design can include opportunities for outdoor activities and improving subjective well-being, which can provide community resilience.

Sheehan and colleagues [79] connected climate adaptation to the building of community resilience, by exploring public health roles in city adaptation plans; health-related activities, such as plans to address heat exposure, infectious disease modeling, preparedness, and surveillance, have been shown as promising features to include in resilient planning, but to date, not all cities include such aspects.

In a case study examining the experience of Iranian hospitals [80], it was observed that disaster management is not treated seriously to the level necessary; further, crises are exacerbated by well-intended volunteers who are nevertheless mismanaged or ill-prepared to deal with an emergency scenario, leaving the situation ripe for chaos. Lack of preparation for emergencies does not serve the hospital and its employees, the injured or sick, or would-be volunteers.

7. Development and Sustainability for Resilience

It is generally considered that there is value in planning for resilience, such as along coastal areas prone to flooding where climate change has created concerns for the future of settlements and sustainability of development. It has been considered a cost-effective approach to deal with future scenarios in advance, rather than simply responding to hazards as they destroy communities and lives. This noted, the course of adaptation and development of plans for resilience is very much a process, with successes, failures, and opportunities to learn from feedback. For example, plans and intent for change may come to terms with budgetary and resource limitations—a common fact of life in government–citizen interactions regardless of the context—as well as the competing priorities of the involved stakeholders [81].

Infrastructure (capital) investments and education investments have been shown to be key factors in reducing community vulnerabilities; this in turn increases resilience. Strong infrastructure can improve the potential for resilience in response to exogenous shock. From the viewpoint of effective development, investment that prioritizes these aspects is both sustainable and resilient. Inequality in employment is a vulnerability that may also be addressed by government policy [82], but this requires political will and a desire to look beyond short-term political cycles to the potential of sustainability and long-run benefits.

The African continent provides an excellent example of an outsized concentration of vulnerability and great risk of hazard events, resulting in harm to human populations. Two-thirds of the top countries in the world for vulnerability were in Africa as of 2021, and 2000 natural disasters have occurred since 1970 [83,84]. Developing nations may lack resources to put toward infrastructure development, which affects resilience and the level of poverty among the population. In Ghana, poor governance and political crises top the list of destabilizing influences that may undermine resilience [84].

It would be a mistake to suggest that the literature on resilience is entirely suggestive of positive intents and outcomes. Emergencies and disasters provide both opportunity and cover for corrupt behavior, from pork-barrel spending to no-bid contracts favoring parties in power, as in the important paper by Tormos-Aponte and colleagues [85]. Privatization is often offered to make government more accountable, but in emergencies, skirting rules intended to provide for transparency and accountability results mostly in raiding the public till and affording significant returns for monied elite interests. Efforts to rein in corrupt tendencies fail because many protections and schemes are afforded official protection through process and policy, in tax havens and revolving door politics, with no consequences for bad behavior. The result is a public sector where lines are blurred, and the definition of legitimacy is itself questioned [85].

Further, changes for development infrastructure are not always positive for resilience. In some cases, attempts to change areas topographically can have results that are quite the opposite of resilience, with larger populations being placed in greater danger of hazards, as is the case in Guasave, Sinaloa [86].

8. Relationship of Resilience to Migration and Displacement

Resilience studies related to migration and displacement (homelessness, generally) have keyed in on the need for prevention rather than responses that focus on dealing with an emergency scenario [87]. Migration can reduce poverty for migrants, but the potential exists that they will have difficulty coping with their new context and integrating, potentially reducing resilience [88]. Migration can combine with other threats (floods, for example, climate change, and growth of populations) to worsen risk, as Mariano and Marino [89] noted. In Bangladesh, there is an increasing need to respond effectively to the problem of climate change as it concerns migrants and the requirements of low-income populations. Measures to alleviate poverty to improve overall societal resilience must focus not only on general infrastructure but on development that provides individually centered services appropriate for the intended populations. In their article on this topic, Alam and Endacott [90] emphasized that measures to serve migrant populations must be transparent

and fair; this point in itself may be regarded as an emerging theme in the nexus of resilience and governance, in seeking to reduce individual vulnerability in a way that benefits society as a whole.

Informal, migrant workers were especially affected by the COVID-19 pandemic because they have few employment protections; for these people, a lockdown is effectively a choice between health and malnourishment [91].

This topic was not as well-represented in the sampled literature, but it is important and deserves additional attention from researchers; there are opportunities for studies that move beyond case-oriented approaches, to derive understanding that may be applicable across contexts.

9. Conclusions and Opportunities for Further Research

Resilience is complicated, as the truth of it becomes apparent as a test of adaptation: it requires a mix of technical skills and the soft skills that support human networks; people must cope and adapt, as one without the other is not enough [12]. Comfort suggested that "The test of adaptation is whether the damaged community can effectively learn from the extreme event and integrate insights from that experience with previous knowledge of risk to rebuild the community a more constructive, resilient form to reduce future risk" [92]. Recovery is key to resilience, but more research is needed on topics like volunteer involvement and emergent groups in recovery [93]. Research connecting possible interventions with eventual policy and reduction of risk is needed [94].

Resilience is made more complex when confronted with the reality of extreme and unprecedented events [27], which regularly overwhelm existing structures, causing destruction and death. The paper by Kreibich and colleagues focused on droughts and floods, but society is regularly overwhelmed by extreme events of all sorts for a variety of reasons [28]; the term unprecedented at this point is either unreasonable or absurd. Recommendations for resilience studies to consider how best to consider these societal changes (from perspectives of infrastructure and otherwise) to respond to such challenges are especially well-founded. Climate change has particularly threatened areas in the Global South, necessitating individualized consideration of these fragile contexts [68]; this is also related to the still-emerging area of migration and displacement, discussed above, which has great relevance and importance for threatened areas and populations around the world.

Lee, Dodge, and Chen [95] rightly pointed out that examinations of vulnerability look at the concept in isolation, which does not allow for a comprehensive exploration of the costs of vulnerability to society; they note correctly that social vulnerability is either miscalculated or largely ignored from a financial perspective, which leads to a lack of clarity in understanding the real costs of responding to hazard events and disasters. Vulnerability is not a simple normative concept [95]; it has real-world implications that we continue to ignore at our peril. Opportunities abound for future research in this area.

Several authors [25,55,96] referred to evacuation planning, and understanding behavior under such circumstances in future studies would contribute to the resilience literature in practical ways.

There was not an attempt to generalize outside of the Pakistan case in the study conducted by Shaikh and colleagues [65]; additional research about the resilience of construction in rural areas is needed, as these structures present a major source of vulnerability in areas confronted by, for example, seismic events and flooding.

There has been increased attention to critical infrastructure resilience, but much attention has gone to cybersecurity, when the need for research in this area is quite broad; there is not widespread agreement among stakeholders about values and outcomes in resilient infrastructure. Specifically, the structure of public–private partnership arrangements in critical infrastructure and how these partnerships will build resilience have been identified as deserving of further study [97].

Disasters are excellent teachers, if one is willing to heed the lessons they bring, but the learning that occurs does not necessarily lead to one-size-fits-all answers to future hazards.

The research indicates a constantly evolving understanding of resilience, from theoretical and practical perspectives, with potential benefits for responding to a changing world.

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