Prashasan July 2024, Vol. 56, Issue 1, No. 139, 104-122

https://doi.org/10.3126/prashasan.v56i1.67333
www.mofaga.gov.np/prashasanjournal
ISSN: 2565-5043 Print / ISSN: 2822-1974 Online

Socio-Anthropological Analysis of Vulnerability Assessment and Polycentric Disaster Governance

Kedar Satyal§§§

Abstract

Vulnerability signifies deficiencies resulting from hazardous events that affect individuals, organizations, and networks within society. Assessing vulnerability aims to raise awareness among individuals in society and is estimated through indicators/indices, mostly pertaining to sociology and anthropology. Various socio-anthropological and scientific models/frameworks are utilized to assess and estimate disaster vulnerability during hazardous times. Polycentric disaster governance (PDG) can be more effective through adaptability, accountability, multiplicity (of organizations), etc., along with co-planning, co-designing, and co-implementing policies and provisions to minimize property destruction and loss of life caused by disasters, utilizing vulnerability data. Nepal's complex topographic structure and diverse practices contribute to higher vulnerability to disasters. Through PDG, both de-jure independence (decision-making) and de-facto autonomy support the achievement of SDGs targets and prosperity. In Nepal, three tiers of government and other entities are involved in co-planning and co-implementing disaster governance strategies.

Keywords: *Vulnerability, models, collaborate, polycentric, disaster governance.*

Background

Vulnerability, as a relative concept, is defined as the danger of disrupting normalcy in people's daily lives even as they are affected by disasters unevenly. It is also considered a symbolic outcome of deficiencies in daily life within society (Voss, 2008). Watts and Bohle (1993) define vulnerability as the tripartite international processes of entitlement, empowerment, and political economy that produce vulnerability. They analyze a unique explanatory model in hunger and famine applied to a comparative vulnerability study, including South Asia over space and time (Cutter, 1996). Vulnerability is created due to a lack of potentiality between empowerment and entitlement, exposure to political economy, and entitlement, and a lack of capacity for enfranchisement/empowerment and political economy (Watts & Bohle, 1993). Successful governance of vulnerability in modern socio-technological systems requires a shift from a control-oriented strategy for reducing risks to a response-oriented strategy for enhancing the resilience/robustness of these systems (Hommels, Mesman, & Bijker, 2014).

§§§*Under Secretary, Government of Nepal*
Email: sushilketo@gmail.com

Governance, as a process, involves diverse actors and levels of decision-making and is independent from central power, whereas polycentric systems are characterized by multiple governing authorities at differing scales rather than a mono-centric unit. Polycentric governance involves many decision-making centers that are formally mutually independent (Finka & Kluvánková, 2015) with autonomy, while a mono-centric governing system becomes functionally less effective due to power centralization (Kim, 2019). Thus, a polycentric approach to governance focuses on actors, problem-perception, and corresponding governance vision (Dorsch & Flachsland, 2017), adoptable in disaster governance. Government officials and non-governmental actors play critical roles in governance with diverse decision-making centers, either with de-jure independence or de-facto autonomy (Stephan, Marshall, & McGinnis, 2019), which characterizes polycentric governance (PG).

Disasters impose destructive and differential effects on social systems in human societies, creating uncertain disruptions and subduing them with their power (Quarantelli, 1998). They are affected by social power structures, generating exposure to risk unequally (Hommels, Mesman, & Bijker, 2014). Disasters are essentially exceptions to the regular social order, where order follows routines of actions and interactions that may be repeated over a specific time unit (Quarantelli, 1998).

Geography, geological position, climate change impact, rapid, unplanned urbanization, and environmental degradation have further intensified (Center for Excellence in Disaster Management & Humanitarian Assistance, 2020). Unstable political will and poor disaster risk reduction performance and governance make Nepal extremely vulnerable to disasters, exacerbated by low levels of income and human development (Jones, Oven, Manyena, and Aryal, 2014), although among the federal units, private, and other community organizations. Hence, PDG would be more effective, inclusive, and accountable throughout the disaster cycle.

Socio-Anthropological Analysis

Social-anthropology provides understanding about how people live in societies and the ways they make their lives meaningful, while anthropological perspectives aim to study how culture and societies are organized. So, socio-anthropologically, multiple decision-making centers co-plan and co-design for disaster governance in PDG backed by the facts obtained from vulnerability assessments.

Vulnerability and Vulnerability Assessment

"Vulnerability" originates from the Latin root verb "vulnerare" (wounding) and the noun "vulnus" (wound). Thus, "vulnerable" refers to being "able to be easily hurt, influenced, or attacked" based on general, medical, and military interpretations. Anthropologically, vulnerability has three implications for bioethical discourse: universality, passivity, and positivity (Have, 2016). The vulnerability of a system denotes a loss function, defined and measured in common economic terms of varying intensities of a given event. It is also known as susceptibility to incidents that can result in serviceability loss (Ayyub, 2011), and the experience of potential harm due to exposure to either perturbation or stress (Haque & Etkin, 2012) to socio-cultural institutions. Exceptional occurrences like disruptions, interruptions, and breakdowns of order result in highly varied social systems and differentiation (Wisner, Blaikie, Cannon, & Davis, 2003). The incapacity to choose or the loss of

control and power over the resources and properties where people live determines their vulnerability (Have, 2016).

Social Systems Vulnerability is related to their adaptability and stability to damage and change. A systems approach to identify vulnerabilities shows the connectivity and hierarchical representation of the system by examining vulnerable failure scenarios systematically (Ayyub, 2011). The vulnerability viewpoint is imperative to comprehend the social contexts that underpin varying outcomes with the physical effects of disasters. Since vulnerability is ingrained in intricate social interactions and processes, it is best understood as a social issue requiring social solutions (Phillips, Deborah, Thomas, & Fothergill, 2010). To make it more contextual, further illustration would be best. Vulnerability occurs from the individual to global levels of analysis and is determined by social hosts, physical factors such as gender, race, ethnicity, etc. (Phillips, Deborah, Thomas, & Fothergill, 2010). People's exposure to systematic variations, the quality of the structures in which they live and work, and their likelihood of experiencing social impacts (Lindell, 2013), even when controlling for exposure and structural vulnerability, are the key aspects for identifying vulnerability.

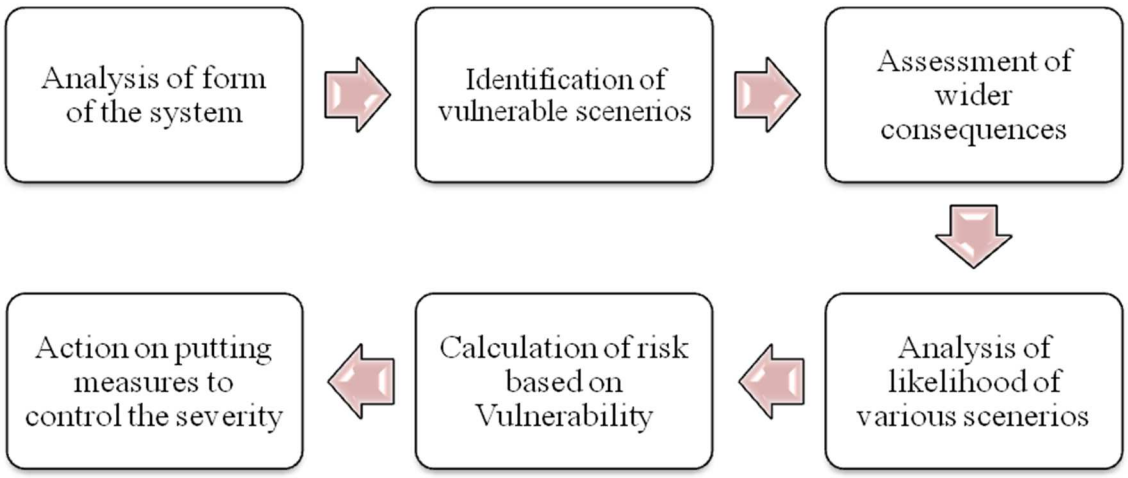
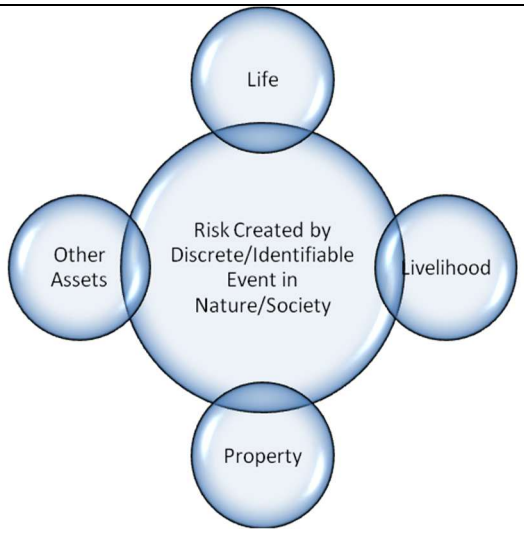


Figure: System approach in Vulnerability (Ayyub, 2011).

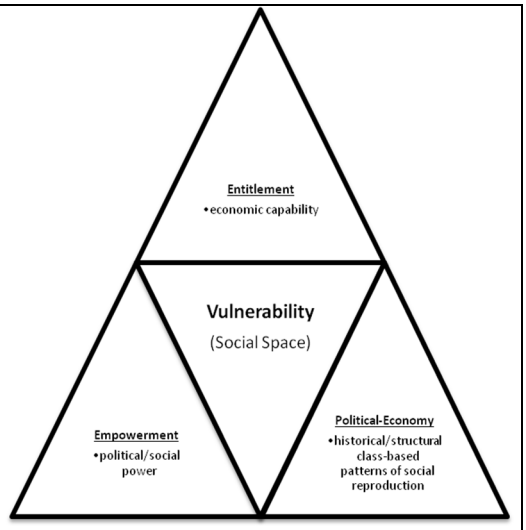
Dimensions of vulnerability can illustrate different aspects such as the number of persons (individual or community), types (physical or social), and conditions (internal or external) affecting human beings (Have, 2016). Vulnerability is key to understanding the risks associated with breaking away from human society's overly technocratic attitude and its relationship with the environment (Bankoff, Frerks, & Hilhorst, 2004). There are distinct worldviews regarding the relationship between humans and nature that help understand vulnerability and responses to hazards and disasters within the society-nature relationship. Firstly, the nature's theory portrays people as subservient to nature, where humans are at the mercy of nature. Secondly, the collective harmony theory depicts people as living their collective lives in harmony with nature. Lastly, the human's theory posits that people dominate nature through manipulation of the natural world (Phillips, Deborah, Thomas, & Fothergill, 2010). Theoretically, the collective harmony theory best fits the human-nature

relationship for reducing vulnerability, disaster preparedness, and enabling effective disaster governance.

Deterioration in environmental and economic circumstances results in serious harm to its inhabitants, necessitating genuine concerns for human vulnerability (Have, 2016). At its core, vulnerability, encompassing climate and cultural groups, is measured in vulnerability assessments (Rivera & Kapucu, 2015). Vulnerability (disaster/environmental) is considered a function of exposure, sensitivity, and adaptive capacity, where philosophical perspectives articulate sensitivity and political perspectives emphasize exposure and adaptive capacity (Have, 2016). Exposure to vulnerable events includes social responses and location, understood through three processes: entitlement, empowerment/social power, and political economy/class-based patterns of social reproduction (Weichselgartner, 2001), created due to the lack of potentiality in these sectors (Watts & Bohle, 1993). By vulnerability, we mean the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard (Wisner, Blaikie, Cannon, & Davis, 2003).



(Wisner, Blaikie, Cannon, & Davis, 2003)



(Watts & Bohle, 1993)

Attention must be paid to vulnerability issues related to social construction and the cultural context of human perceptions and interpretations, where vulnerability is perceived negatively and resources are seen as positive, often overlooking unintended side effects. Vulnerability assessments/estimations identify the processes that produce vulnerability and associated variables with the potential to measure differential susceptibility (Rivera & Kapucu, 2015). A sociological/anthropological understanding of vulnerability shows the probability of suffering from the negative effects of hazards and disasters and navigating the recovery process. Social vulnerability can also be influenced by access to resources, beliefs, customs, history, relationships, processes, and other factors (Arcaya, Raker, & Waters, 2020). Vulnerability assessments should be

context-specific, require understandable indicators, and vary in relation to each other (Nguyen, Bonetti, Rogers, & Woodroffe, 2016). Structurally, the vulnerable suffer from chronic poverty, and proximate vulnerability changes with time, with people often confused by ongoing transformations in livelihood systems (Alwang, Siegel, & Jorgensen, 2001).

Different models are used to predict vulnerability using different indices like regions, demography, and awareness and monitoring, where indices can help identify and prioritize vulnerable regions, sectors, or population groups, raise awareness, and form part of a monitoring strategy based on models. Participatory, simulation-model, and indicator-based approaches are more practical (Nguyen, Bonetti, Rogers, & Woodroffe, 2016). Measures of community vulnerability to natural hazards comprise physical and structural information, social and population data, as powerful tools (King, 2001), and their livelihood vulnerability includes risks, shocks, and stressors externally, and defenselessness, a lack of means to mitigate/cope without incurring losses internally (Alwang, Siegel, & Jorgensen, 2001).

Vulnerability measurement/risk assessment is needed to provide appropriate information about the most vulnerable infrastructures and advise planners about the systematic consideration of risk and vulnerability aspects in planning and practical decision-making processes. It should focus on the human/environmental factors that jointly or independently determine the vulnerability of the receptor. Through this anticipation of future conditions and reduction of complexities, vulnerability assessment combines information identification of property and population at risk (Rivera & Kapucu, 2015) during disasters, pushing socio-cultural arrangements into danger. Vulnerability is the output of the combination of class, gender, ethnicity, etc., factors that require understanding society as a transdisciplinary approach and realization of differentiating processes and considerations with a temporal dimension (Bankoff, Frerks, & Hilhorst, 2004). Thus, vulnerability assessment stresses the roles of social, economic, and political interactions in creating hazardous conditions in a particular region, incorporating insights from the physical world. The social distribution of risk and the reasons why certain populations are more vulnerable to disasters than others are the subjects of vulnerability analysis (Phillips, Deborah, Thomas, & Fothergill, 2010).

Model, Approaches and Methods of Vulnerability Assessment

The comprehensive theory of vulnerability includes interrelated dynamics of social structure, human agency, and the environment, with capabilities to address them central to vulnerability analysis (McLaughlin & Dietz, 2008). Vulnerability is a key element in the social construction of risk and is a complex, multifaceted system due to its measuring complexity (Sorg et al., 2018), with macro-economic/worldwide threats as macro-vulnerability and differential impacts on economic ladder, vulnerability costs, poverty, and destitution as micro-vulnerability (Tesliuc & Lindert, 2004).

The Socioeconomic Vulnerability Index (SeVI), calculated using an index-based model, comprises three sub-indexes and seventeen proxy variables applicable to common natural disasters. The Demographic-Social Index (DSI) includes six population-related and social variables, the Secondary-Damage-Triggering Index (STI) includes indirect damage caused by disasters, and the Preparation-Response Index (PRI) includes the ability to prevent and respond to natural disasters with distinct weightage of sub-indexes (Park et al., 2016). The Integrative Vulnerability Approach includes the Unit of Reference (from individuals to ecosystems), Interaction, Hazard/Exposure

(frequency, duration, magnitude of risks), and Resilience (abilities to cope with, absorb, or deal with stressors and perturbation), in which the choice and weighting of factors are crucial (Voss, 2008).

The Methods for the Improvement of Vulnerability Assessment in Europe (MOVE) framework measures vulnerability through exposure, susceptibility, and lack of resilience. Population vulnerability is determined by their degree of susceptibility, including individual lack of resilience. Expert-based modeling and statistical modeling approaches are used to develop SeVI, where multivariate analysis is used in statistical approaches and traditional budget allocation assessment for expert-based approaches (Hagenlocher, Delmelle, & Casas, 2013).

The BBC (Bogardi and Birkmann: 2004 and Cardona: 1999/2001) framework, as a meta-framework, outlines preventive measures and disaster management as potential ways of reducing disaster risk/vulnerability based on three objectives: linking vulnerability, human security, and sustainable development; an integrated approach to disaster-risk assessment needs; and developing causal frameworks for measuring environmental degradation in the context of sustainable development (Birkmann, 2008).

Demographics, the built environment, social capital, economy, and the individual are key factors for estimating social vulnerability (Turesson et al., 2024). It is assessed through the weighted average of five composite sub-indices: economic well-being and stability, demographic structure, institutional stability and strength of public infrastructure, global interconnectivity and dependence on natural resources. The aggregate figure will therefore be a number between 1 and 0, where 1 represents the highest vulnerability/highest relative vulnerability and 0 represents the lowest absolute human vulnerabilities or being slightly better off compared to other countries/places (Vincent, 2004).

Table: Different Vulnerability indices and their attributes

Vulnerability Index	**Areas**	**Sub Areas**	**Developed by (Author)**
BBC framework	a. Preventive measures b. disaster management	A1.introduced before an event strikes societies from raising awareness A2.moving people out of hazardous zones. B1.limiting the impact of catastrophes B2.managing crises with anticipating risk and taking action	Birkmann, 2008

Vulnerability Index	**Areas**	**Sub Areas**	**Developed by (Author)**
MOVE framework	a. Exposure b. Susceptibility(SUS) c. Lack of resilience(LoR)	A1.Unit of assessment B1.Predisposition of elements at risk to suffer harm C1.Limitation of resources to respond hazard	Hagenlocher, Delmelle, & Casas, 2013
Social vulnerability index (SVI)	a. economic well-being and stability-20% b. demographic structure - 20% c. institutional stability and strength of public infrastructure (version A/B) -40% d. global interconnectivity - 10% e. natural resource dependence-10%	a1. Standard of Living/Poverty a2. Change in Urban Population (%) b1. Dependent Population b2. Proportion of Working Population Affected by HIV/AIDS c1. Health Expenditure as a Proportion of GDP c2. Telephone Accessibility c3. Corruption Perception d1. Trade Balance e1. Rural Population	(Vincent, 2004)
Socioeconomic vulnerability Index(SeVI)	a. DSI :31% b. STI : 34% c. PRI : 35%	A1. Age Distribution (13.8%) A2. Workforce Vulnerability to Disasters (26.4%) A3. Population Density (24.4%) A4. Percentage of Foreign Residents (6.8%) A5. Level of Education Attainment (9.4%) A6. Housing Composition (19.2%) B1. Number of Government Offices (14.7%) B2. Road Infrastructure Coverage (25.8%) B3. Availability of Electrical Supply Facilities (28.2%)	Park, Pradhan, Kim, Kim, & Kim 2016)

Vulnerability Index	**Areas**		**Sub Areas**	**Developed by (Author)**
			B4. Proportion of Land Allocated for Schools (11.4%) B5. Ratio of Commercial and Industrial Zones (19.9%) C1. Preparedness and Response Index (PRI) (35%) C2. Frequency of Disasters (12.4%) C3. Internet Accessibility Rate (8.6%) C4. Quantity of Disaster Prevention Facilities (25.8%) C5. Perception of Safety (27.8%) C6. Number of Healthcare Practitioners (13.2%) C7. Financial Autonomy of the Municipality (12.2%)	
PEARL vulnerability framework	a.-Susceptibility (current condition/status exposed, Infrastructure) b.-Adaptation (enable societies to transform by dealing with negative impacts) c.-Coping (strengths and resources for direct actions leading to reduce in the consequences of a hazardous event)		a1. Demographics a2. Health a3. Poverty and Income a4. Housing b1. Government and Governance b2. Social Networks b3. Economic Conditions b4. Medical Services b5. Emergency Response b6. Information and Awareness/Preparedness c1. Education and Research c2. Gender Equality c3. Environmental Conditions c4. Investments	Sorg, et al., 2018
PAR Model to Vulnerability Assessment	pressure on people and resources	root causes(RC)➞ dynamic pressures(DP), ➞unsafe conditions (UC) apply pressure	limited access to power and resources(RC) ➞ inadequacies in training, local institutional systems, or ethical standards in government(DP) ➞ Physical(locations, buildings) and social(local economies, inadequacies	Wisner, Blaikie, Cannon, & Davis, 2003

Vulnerability Index	Areas		Sub Areas	Developed by (Author)
			in disaster preparedness measures) environments (UC)	

Note: ➞ shows the stage after previous, figures in bracket of sub areas is the weightage of each areas (a,b,c)

The Pressure and Release (PAR) model illustrates the intersections of two opposing forces: generating vulnerability on one side and physical exposure to hazards on the other when a disaster occurs (St. Cyr, 2005). It demonstrates how the causes of vulnerability can be traced back from unsafe conditions through economic and social ("dynamic") pressures to underlying root causes, outlining a hierarchy of causal factors that together constitute the preconditions for a disaster. Described as a pathway, "progression of vulnerability," or "chain of causation" (Wisner, Blaikie, Cannon, & Davis, 2003), pressure can be released on those vulnerable to risk by decreasing or eliminating various root causes, dynamic forces, and/or unsafe conditions that are prevailing or observed (St. Cyr, 2005). It explains the relationship between processes that enhance unsafe conditions (exposure) and interactions with disaster results, focusing clearly on the dynamic pressures and underlying driving forces that give rise to vulnerability in the first place (Cutter, 1996).

The PEARL Vulnerability Index (PeVI) framework uses a robust index that includes a multifaceted picture of societal components like areas of susceptibility, adaptation, and coping with vulnerability. Susceptibility refers to citizens' exposure and infrastructure to certain hazards of a society, consisting of four components. Coping is related to strengths and resources for direct actions leading to a reduction in the consequences of a hazardous event, constituted by seven areas. Adaptation/Adaptive capacities deal with negative impacts of future disasters, enabling societies to transform, and includes four categories (Sorg et al., 2018).

Nepal is situated in the Hindu-Kush Himalayan Range with a complex geological structure, rugged mountains, steep landscape, highly variable climatic conditions, active tectonic processes, and continued seismic activities (Khanal, 2020), making it highly prone to multiple non-natural and natural hazards (Ministry of Home Affairs, 2018), as shown in the table below.

Table: Nepal's Vulnerability

Vulnerability	Rank in the World	Source
Multi-disaster	20th	UNDP, 2005
Climate-Change	4th	Climate Change Vulnerability Index 2011, maplecroft
Earthquake	11th	UNDP/BCPR 2004 (out of 198 countries)
Water-Related	30th	UNDP/BCPR 2004

Disaster and Polycentric Disaster Governance

The term "disaster" originates from the Italian word "disastro," meaning "ill-starred" or "bad planet" (Saltman, 2007). Disasters can be defined in various ways, but in all cases, they involve destructive events that overwhelm all available resources, as the earth can both supply essentials and wreak destruction (Kieffer, 2013). Disasters can arise from natural forces or human intentional or accidental actions (Monios, 2019). Sociologically, disasters are perceived as natural phenomena, as they only harm people when socially constructed. Conceptually, disasters are seen as exogenous shocks whose potential targets and level of effects cannot be predicted, becoming significant based on development, community and individual reactions, and eventual closure (Voss, 2008). People suffer physically from natural hazards, such as personal property damage from floods or fires directly, or indirectly from the loss of critical public infrastructure like roads and water supply (Birkland, 2006). A hazard includes both risks and dangers, representing an ongoing environmental risk that has the potential to become a disaster, which occurs when the hazard's potential is realized, involving extensive social disruption and loss (Voss, 2008). Sociologically, culture shapes interpretations and responses in a more naturalistic manner, while social forces shape the causes, course, and consequences, which are often critical but overlooked, along with the accountability of organizations in disasters (Tierney, 2019). Disasters can be temporally defined by three periods: pre-impact (in which mitigation and preparedness mostly occur concurrently), trans-impact (difficult to identify/indicate), and post-impact (during which emergency response and disaster recovery overlap) phases/periods (Lindell, 2013). Governance implies the absence of a single center, with multiple centers involved, and governing can be viewed as the totality of interactions among diverse actors aimed at solving societal problems or creating societal opportunities (Takahashi, 2019). It encompasses all processes, including the application, implementation, interpretation, and alteration of rules and procedures within defined groups. Government officials are not only formal actors but also include external factors such as private individuals, professional associations, community-based organizations, and voluntary/non-profit/non-governmental organizations, etc., during the disaster cycle (McGinnis, 2016). For disaster governance, disaster triage (the sorting and processing of victims based on the severity of their condition) and decision-making processes regarding who is to be treated first during a disaster (Beach, 1952) are vital considerations. Polycentric governance is related to functionally interdependent but formally independent decision-making (Thiel & Moser, 2019) by the authority, and its normative conception supports collective problem-solving, performing better than centralized governance, with the provision of collective goods performing well in the medium to long term (Thiel, 2023). Michael Polanyi first used the term "polycentricism" to describe a method of social organization in which individuals are free to pursue their objectives within a general social system, and polycentric systems adhere to the rule of law (where the rule involves notions of legitimacy, power, or multiplicity of decision centers) and freedom of expression (Tarko, 2015), with some operational degree of autonomy. This seemingly inefficient configuration of political units could achieve greater efficiency in the production and provision of public goods and services than a centralized government (Carlisle & Grubby, 2019). Polycentricism opposes monocentric systems, functioning effectively in managing commons, with the possibility of mutual adjustment and alignment of global institutions for collective goals and net positive interactions between independent governing authorities after meeting certain conditions (Kim, 2019). The following table shows the differences between polycentric and monocentric governance systems.

Monocentric governance	Polycentric governance
Problems may arise based on the scale of government bodies (too large/small).	Better equipped to respond to complex, uncertain, and multiscale challenges by the authorities.
The state is the center of political power, authority, and decision-making structures.	Composed of multiple, overlapping, and nested decision centers.
Clearly bounded and organized political units are created with linkages established through constitutional and statutory means.	Across jurisdictions, which can theoretically create opportunities for multiple actors across multiple levels.
Power relations, whether centralized or involving some delegation, often prioritize conducting regular activities over initiating new solutions for national affairs.	Able to initiate and implement solutions to address complex socio-ecological issues in a participative manner.
The ideal scale can offer both governance capacity and citizens' trust.	Self-organization of actors can lead to social learning and the development of social capital.
The blurring boundaries between jurisdictions in coping with shared problems like climate change pose many challenges, with initiatives for better integration and cooperation between units being considered problematic.	Can foster partnerships, cooperation, and power-sharing among agencies to manage complexity and uncertainty.
The central authority steers society.	Provide opportunities for power-sharing between higher and lower decision centers.

(Mudliar, 2020, Termeer, Dewulf, & Lieshout, 2010)

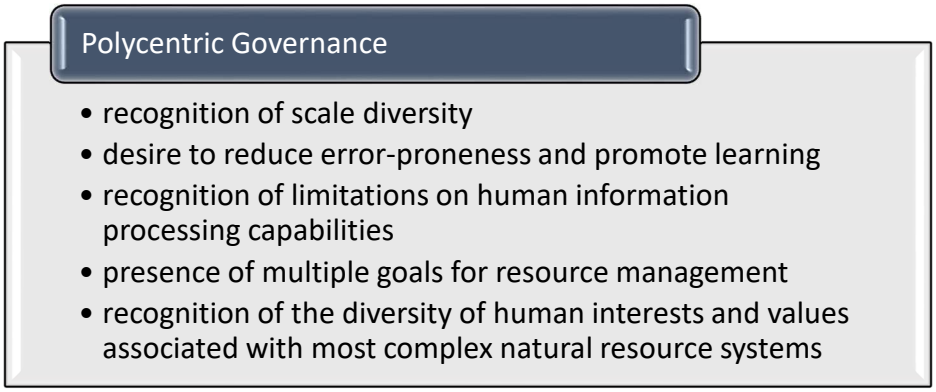
Polycentrism helps to tie together the enormous variety of actors, issues, and processes that are intertwined across subnational, national, regional, and global levels and reveals many power centers and connections in digital data governance. Polycentric perspectives bridge disciplinary divides in the analysis of digital data governance (Aguerre, Campbell-Verduyn, & Scholte, 2024) and can contribute to effective disaster governance. Polycentricity conveys more than just federalism as it is typically understood (Wright, 2012) and develops and enhances adaptive capacity, ensures good institutional fit, and mitigates risk through redundancy (Carlisle & Gruby, 2019).

Polycentricity is the descriptive concept of polycentric governance comprising three distinct but interlinked elements: a normative theory concerning what leads to polycentric governance as a whole, a positive theory that hypothesizes what elements determine specific types of governance, and an analytical framework that aims to examine both its normative and positive theory (Thiel, 2017). As per Ostrom et al. (1961), a polycentric political system is composed of many autonomous units formally independent of each other, choosing to act in ways that take account of others through processes of social interactions (Carlisle & Gruby, 2019). Polycentric governance (PG), even in the

absence of formalized and centralized control in emergencies (pre and post-transition periods), can offer an equitable, inclusive, informative, accountable, protective, and adaptable framework for promoting efficiency, fighting poverty, and improving security (Sovacool, 2011). It comprises structures (formation of actors), processes, or outcomes, network-based links, and other forms of interconnections. So, PDG would be more equitable and inclusive (Tuda, Kark, & Newton, 2020) and includes all cooperation, conflict resolution, and competition as social interactions (Vincent, Tiebout, & Warren, 1961).

PG has the ability to create a degree of uniformity and consistency to minimize and address inconsistencies and provide a minimum degree of predictability, yet without imposing homogenizing tendencies of centralized regulation, leaving local actors completely autonomous and free to act on the basis of rules (Sovacool, 2011). It reflects a complex combination of multiple levels and diverse organizations constituted from the public, private, and voluntary sectors with overlapping realms of responsibility and functional capacities. A federal system may consist only of a sequence of neatly nested jurisdictions at the tiers of government, while a polycentric system includes crosscutting jurisdictions (Monios, 2019).

Functional polycentric governance system refers to the capacity of governance to comport with three claims of natural resource governance: the ability to adapt to social and environmental changes, provide a good institutional fit for its complex systems, and mitigate the risk of institutional failure and resource losses due to the redundant teams of decision-makers employing diverse or redundant institutions (Carlisle & Gruby, 2019).



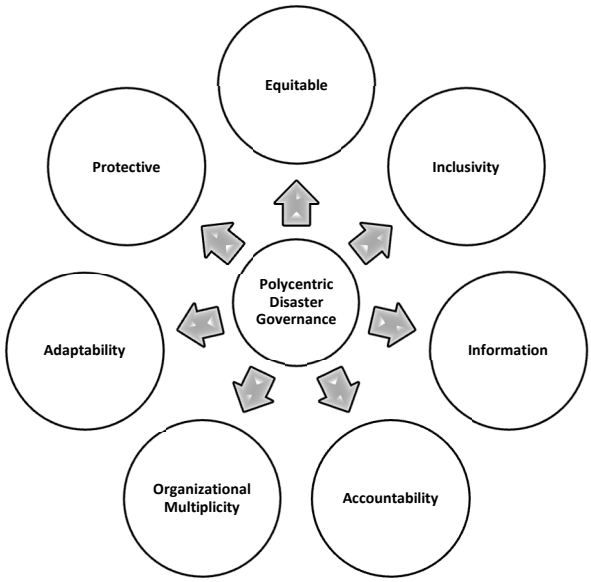
Source: Carlisle & Grubby, 2019

Disaster governance encompasses organizational and institutional actors from formal governments, private companies, and bodies of civil society, to informal organizations such as networks and elites, in which sets of rules, actors, and organizations configure horizontal and vertical governance arrangements (Sandoval & Voss, 2016) as part of polycentric governance, including interrelated regulatory frameworks within the disaster cycle.

Although polycentric governance (PG) is criticized for being too complex, redundant, and lacking central direction in a static view, the dynamic view reflects the simple-systems perspective, which

has considerable strengths, and the complex-systems perspective, which concerns the vulnerability of governance systems to disturbances (Finka & Kluvánková, 2015). PG results in high transaction costs and a loss of democratic accountability, not least because of the complexity of decision-making processes (Thiel, 2017), such as determining which decision-making centers need to be considered, what is aggregated to a unit (a sub-unit may decide and implement), and determining the boundaries of each center, creating overlap due to functional interlinkages within a system (Schröder, 2018). PG focuses on static structures of governance without giving much emphasis to the way they are enacted (Thiel, 2017).

Polycentricity, which focuses on social interrelations, intra-/interdependencies, and interactions among centers, considers competition, coordination, contractual and cooperative agreements, and conflict resolution mechanisms. To overcome and solve the above-mentioned problems/critiques, it is better to consider human, cultural, and social contexts based on problem/goods, task, and level/scale specificity (Schröder, 2018). Two highly effective learning systems/measures for disaster management are constellation analysis, which helps gain insights on actants' potential to cause damage, and integrated analysis on a supra-regional level to identify important factors for disaster losses and track their changes (Voss & Wagner, 2010).



Potential co-generating ideas by PDG to actor (Sovacool, 2011)

Disasters evoke horror not only because they make chaos and suffering visible but also because they reveal shocking disorder in socio-technical systems (Gusterson, 2011). Forensic anthropologists can play a vital role in assisting in the Disaster Victim Identification process, including at the scene, in the mortuary, in ante-mortem data collection, in reconciliation, and in debriefing (Blau & Briggs, 2011) of the events. Sociologically, the culture of risk and risk culture determine the disaster experience and have transformed with new research becoming more diversified, taking on distinct

forms such as the culture of prevention or disaster subculture, encompassing all knowledge, rules, values, and measures taken at all levels of social organization (Revet & Langumier, 2015). Transformation and modern practices would help facilitate effective disaster governance.

Nepalese Scenario of Disaster Governance

The Constitution of Nepal embraced a federal structure of government comprising seven provinces and 753 local governments. At the local level, the governance structure resembles more of a monocentric nature compared to the remaining tiers, with local governments possessing their own legislative, judicial, and executive powers to provide basic state facilities and fulfill duties related to service delivery (Vij, Russell, Clark, Parajuli, Shakya, & Dewulf, 2020). Multiple state and non-state actors, as shown in the following figure, compete over resources, and there is an ongoing administrative struggle to promote different disaster governance paradigms. However, the decentralization process is expected to reduce disaster risk for vulnerable communities (Pokhrel,2022).

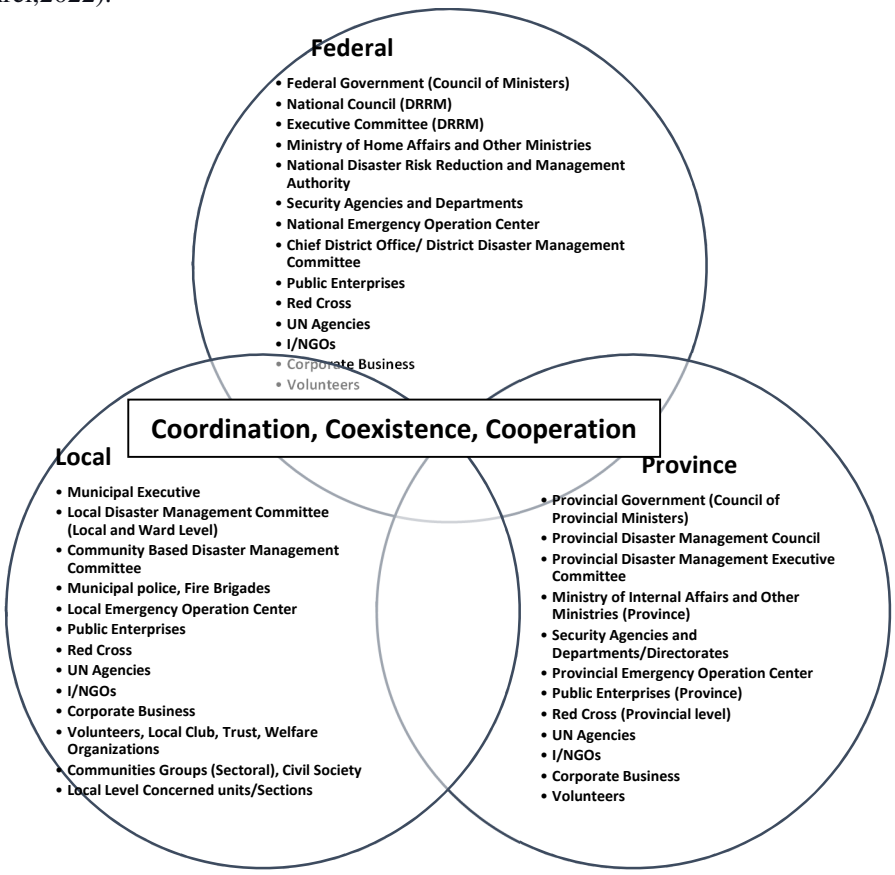


Figure: [Polycentric] Disaster Governance Mechanisms (Disaster Risk Reduction and Management Act)

Discussion and Conclusion

The social vulnerability school suggests the need to alter power structures and ideologies to reduce disasters, providing special assistance to weaker sections before, during, and after disasters (McEntire, 2005). Vulnerable people affected by hazardous events are identified through vulnerability assessments, and decision-making centers collaborate in co-planning and co-implementing, supported by varying degrees of autonomy in governance. Various frameworks, approaches, and models support disaster governance by different authorities, sharing roles in planning, implementation, design, and vulnerability assessment throughout the disaster cycle. Disaster management literature recognizes that vulnerability includes elements of risks and responsiveness to risks, dividing vulnerability into disaster preparedness and disaster relief aspects (Alwang, Siegel, & Jorgensen, 2001). Assessing the degree of vulnerability supports governance.

McGinnis (2011) highlighted governance as a process by which the repertoire of rules, norms, and strategies guiding behavior within a given policy realm is formed, applied, interpreted, and reformed. Disaster governance includes patterns of government, multi-sector, and citizen interaction for disaster management (Sakamoto et al., 2016), addressing the conditions and requirements of people throughout the disaster cycle. Developing higher levels of mutual trust (Dorsch & Flachsland, 2017), governmental units both compete and cooperate, interact and learn from one another, tailoring responsibilities at different governmental levels to match the scale of public services (Cole, 2011) in pre-disaster, response, and post-disaster phases (Lindell, 2013). Co-construction and co-production based on network governance (as a part/tool of New Public Governance: NPG), requiring work at multiple levels with interwoven areas of responsibility and functionality (Sarker, 2020), would be vital for improving people's livelihoods.

Polycentricity refers to the nonhierarchical, institutional, and cultural framework structures and/or processes (Schröder, 2018), characterized by the coexistence of multiple decision-making centers with different objectives and values, where the degree of actors' autonomy/independence is considered multiple and crosscutting jurisdictions (Monios, 2019). Thus, polycentric governance is particularly well-suited to societies experiencing high cultural diversity (Algicia, 2014) for risk reduction and people's welfare.

Polycentricity (polycentric governance) is divided into type I and type II. In type I, power is shared in a federal context with hierarchically non-intersecting supranational, national, and subnational tiers of governance with general-purpose jurisdictions. Type II is more task-specific, involving multilevel governance with aligned jurisdictions and flexible designs in the absence of authoritative coordination to operate and involve in public service delivery (Bache and Flinders, 2004; Finka & Kluvánková, 2015). In disaster governance, type II would be more effective and people-friendly. Nepal, newly restructured as a federal state with defined exclusive and concurrent powers, including multiple levels of governance and located in a geographically vulnerable zone for multi-disasters, faces a yearly burden of infrastructure and lives loss. Due to its protective, adaptable, inclusive, and accountable nature, polycentric disaster governance would be more effective (Sovacool, 2011) in preserving assets and lives in hazardous situations, including in the federal context of Nepal.

References

Aguerre, C., Campbell-Verduyn, M., & Scholte, J. A. (2024). *Global Digital Data Governance: Polycentric Perspectives.* Routledge.

Aligica, P.D.,(2014). Institutional diversity and political economy: the Ostroms and beyond. Oxford University Press.

Alwang, J., Siegel, P. B., & Jorgensen, S. L. (2001). Vulnerability: A View from Different Disciplines. *SP Discussion Paper.*

Arcaya, M., Raker, E. J., & Waters, M. C. (2020). The Social Consequences of Disasters: Individual and Community Change. *Annual Review of Sociology, (46*) .pp.671-691.

Ayyub, B. M. (Ed.). (2011). *Vulnerability, Uncertainty and Risk: analysis, modeling and management.* Virginia: International Conference on Vulnerability and Risk Analysis and Management :ICVRAM and International Symposium on Uncertainty Modeling and Analysis: ISUMA.

Bankoff, G., Frerks, G., & Hilhorst, D. (Eds.). (2004). Mapping Vulnerability, Disaster, Development and People.

Beach, M. (1952). *Disaster Preparedness and Management* . Philadelphia: F. A. Davis Company.

Birkland, T. A. (2006). *Lessons of Disaster: Policy Change after Catastrophic Events.* Georgetown University Press.

Birkmann, J. (2008). Assessing Vulnerability Before, During and After a Natural Disaster in Fragile Regions:Case Study of the 2004 Indian Ocean Tsunami in Sri Lanka and Indonesia. *Research Paper No. 2008/50.* Helsinki: UNU-WIDER.

Birkmann, J. (Ed.). (2013). *Measuring vulnerability to natural hazards: Towards disaster resilient societies.*United Nations University.

Blau, S., & Briggs, C. A. (2011). The role of forensic anthropology in Disaster Victim Identification (DVI). *Forensic Science International* (*205*). pp.29-35.

Carlisle, K., & Gruby, R. L. (2019). Polycentric Systems of Governance: A Theoretical Model for the Commons. *Policy Studies Journal*. *47* (4).

Center for Excellence in Disaster Management & Humanitarian Assistance, (2020).Nepal Disaster Management Reference Handbook. Hawaii: Center for Excellence in Disaster Management & Humanitarian Assistance.

Cole, D. H. (2011). From Global to Polycentric Climate Governance. *Climate Law. (2). Pp.*395–413.

Cutter, S. L. (1996). Vulnerability to environmental hazards. *Progress in Human Geography 20* (4), pp.529-539.

Dorsch, M. J., & Flachsland, C. (2017). A Polycentric Approach to Global Climate Governance. *Global Environmental Politics. 17* (2). pp.45-64.

Finka, M., & Kluvánková, T. (2015). Managing complexity of urban systems: A polycentric approach. *Land Use Policy*. *42*, pp.602-608.

Gusterson, H. (2011). *Social Containment of Disaster.* The Insecure America.

Hagenlocher, M., Delmelle, E., & Casas, I. a. (2013). Assessing socioeconomic vulnerability to dengue fever in Cali, Colombia: statistical vs expert-based Modeling. *International Journal of Health Geographics*.pp.12-36.

Haque, C. E., & Etkin, D. (Eds.). (2012). *Disaster Risk and Vulnerability Mitigation through Mobilizing Communities and Partnerships.*McGill-Queen's University Press.

Have, H. t. (2016). *Vulnerability: Challenging Bioethics.*Routledge.

Hommels, A., Mesman, J., & Bijker, W. E. (Eds.). (2014). *Vulnerability in Technological Cultures:New Directions in Research and Governance.*The MIT Press.

Jones, S.; Oven, K.J.; Manyena, B. and Aryal,K., (2014).Governance struggles and policy processes in disaster risk reduction: A case study from Nepal. Geoforum (55).pp.78–90.

Kim, R. (2019). Is Global Governance Fragmented, Polycentric, or Complex? The State of the Art of the Network Approach. *International Studies Review*.

King, D. (2001). Uses and Limitations of Socioeconomic Indicators of Community Vulnerability to Natural Hazards: Data and Disasters in Northern Australia. . . . *Natural Hazards*. (*24*).pp.147-156.

Lindell, M. K. (2013). Disaster studies. *Current Sociology 61.* (5-6), pp.797-825.

McEntire, D. A. (2005). Why vulnerability matters: Exploring the merit of an inclusive disaster reduction concept. *Disaster Prevention and Management , 14* (2), pp.206-222.

McGinnis, M. D. (2016). Polycentric Governance in Theory and Practice: Dimensions of Aspiration and Practical Limitations. *The Vincent and Elinor Ostrom Workshop in Political Theory and Policy Analysis.*

McLaughlin, P., & Dietz, T. (2008). Structure, agency and environment: Toward an integrated perspective on vulnerability. *Global Environmental Change*.*18*.pp.99-111.

Monios, J. (2019). Polycentric port governance. *Transport Policy*.*83*.pp.26-36.

Mudliar, P. (2020). Polycentric to monocentric governance: Power dynamics in Lake Victoria's fisheries. *Environmental Policy and Governance*, pp.1-14. doi:10.1002/eet.1917

Nguyen, T. T., Bonetti, J., Rogers, K., & Woodroffe, C. D. (2016). Indicator-based assessment of climate-change impacts on coasts: A review of concepts, methodological approaches and vulnerability indices. *Ocean & Coastal Management.123*, pp.18-43.

Park, Y., Pradhan, A. M., Kim, U., Kim, Y.-T., & Kim, S. (2016). Development and Application of Urban Landslide Vulnerability Assessment Methodology Reflecting Social and Economic Variables. *Advances in Meteorology* .

Phillips, B. D., Deborah, S., Thomas, A., & Fothergill, L. B.-P. (Eds.). (2010). *Social Vulnerability to Disasters,*Taylor and Francis Group, LLC.

Quarantelli, E. L. (Ed.). (1998). *What is Disaster? Perspectives on the question.* Routledge.

Revet, S., & Langumier, J. (Eds.). (2015). *Governing Disasters Beyond Risk Culture.* (E. Rundell, Trans.) Palgrave Macmillan.

Rivera, F. I., & Kapucu, N. (2015). *Disaster Vulnerability, Hazards and Resilience, Environmental Hazards.*Springer International Publishing.

Rivera, F. I., & Kapucu, N. (2015). Geography and Resilience. In *Disaster Vulnerability, Hazards and Resilience, Environmental Hazards.*Springer International Publishing.

Sandoval, V., & Voss, M. (2016). Disaster Governance and Vulnerability: The Case of Chile. *Politics and Governance.4* (4), pp.107-116.

Schröder, N. J. (2018). The Lens of Polycentricity: Identifying polycentric governance systems illustrated through examples from the field of water governance. *Environmental Policy and Governance*,*28* (4), pp.236-251.

Sorg, L., Medina, N., Feldmeyer, D., Sanchez, A., Vojinovic, Z., Birkmann, J., et al. (2018). Capturing the multifaceted phenomena of socioeconomic vulnerability. *Natural Hazards*, *92*, pp.257-282.

Sovacool, B. K. (2011). An international comparison of four polycentric approaches to climate and energy governance. *Energy Policy*, *39*, pp.3832–3844.

St. Cyr, J. F. (2005). At Risk: Natural Hazards, People's Vulnerability, and Disasters. . *Journal of Homeland Security and Emergency Management*,*2* (2).

Stephan, M., Marshall, G., & McGinnis, M. (2019). *An Introduction to Polycentricity and Governance.* National Science Foundation.

Takahashi, T. (2019). Governing and societal media for building resilience: A sociocybernetic study of the disaster recovery in Japan. *Current Sociology*,pp. 1-17.

Tarko, V. (2015). *Polycentric Governance: A Theoretical and Empirical Exploration.* George Mason University.

Tesliuc, E. D., & Lindert, K. (2004). Risk and Vulnerability in Guatemala: A Quantitative and Qualitative Assessment. *Social Protection Discussion Paper Series.* Social Protection Unit, Human Development Network The World Bank.

Thiel, A. (2023). Polycentric Governing and Polycentric Governance. In F. Gadinger, & J. A. Scholte (Eds.), *Polycentrism.* Oxford University Press.

Thiel, A. (2017). The scope of polycentric governance analysis and resulting challenges. *Journal of Self-Governance and Management Economics*,*5* (3), pp.52-82.

Thiel, A., & Moser, C. (2019). Foundational aspects of polycentric governance: overarching rules, social-problem characteristics and heterogeneity. In *Governing Complexity.*

Tierney, K. (2019). *A Sociological Perspective on Disasters.*Wiley.

Termeer, C. J., Dewulf, A., & Lieshout, M. v. (2010). Disentangling Scale Approaches in Governance Research: Comparing Monocentric, Multilevel, and Adaptive Governance. *Ecology and Society, 15*(4).

Tuda, A. O., Kark, S., & Newton, A. (2020). Polycentricity and adaptive governance of transboundary marine socio-ecological systems. *Ocean and Coastal Management* .

Turesson, K., Pettersson, A., Herve, M. d., Gustavsson, J., Haas, J., Koivisto, J., et al. (2024). The human dimension of vulnerability: A scoping review of the Nordic literature on factors for social vulnerability to climate risks. *International Journal of Disaster Risk Reduction*, *100*.

Vincent, K. (2004). Creating an index of social vulnerability to climate change for Africa. *Working Paper 56.* Tyndall Centre for Climate Change Research.

Vincent, O., Tiebout, C. M., & Warren, R. (1961). The organization of government in metropolitan areas: a theoretical inquiry. *American political science review*, *55* (4),pp. 831-842.

Voss, M. (2008). The vulnerable can't speak. An integrative vulnerability approach to disaster and climate change research. *Behemoth. A Journal on Civilisation*, *3*, pp.39-56.

Voss, M., & Wagner, K. (2010). Learning From (Small) Disasters. *Natural Hazards* .

Watts, M. J., & Bohle, H. G. (1993). The space of vulnerability: the causal structure of hunger and famine. *Progress in Human Geography*, *17* (43), pp.43-67.

Weichselgartner, J. (2001). Disaster mitigation: the concept of vulnerability revisited. *Disaster Prevention and Management*, *10* (2), pp.85-94.

Wisner, B., Blaikie, P., Cannon, T., & Davis, I. (2003). *At Risk: natural hazards, people's vulnerability and disasters.* Routledge.

Wright, B. E. (2012). Reflections on Vincent Ostrom, Public Administration, and Polycentricity . (M. D. McGinnis, & E. Ostrom, Eds.). *Public Administration Review, 72* (1), pp.15-25