Being Human: Rethinking Adaptation and Resilience

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Adaptability, resilience, and sustainability have become buzzwords that refer to notions about the properties of something, and an objective to be achieved and maintained, as well as human intentionality in processes of change. They are notions that were transferred between and beyond academic disciplines in the health and medical sciences, natural and physical sciences, and human and social sciences; and they are currently used in everyday language. How these notions are used regarding ecological hazards, financial risks, health threats, and social perils is influenced by numerous variables including individual and communal human factors. This article rethinks common interpretations of adaptability and resilience in the context of sustainability. It posits that human ecology provides a conceptual framework incorporating the diversity of their meanings and uses in a complex and heterogenous world. The article highlights that many contributions from authors in various disciplines have borrowed concepts and ideas from ecology, biology, and systems analysis but they have discounted the fundamental nature of being human, even when socio-ecological systems are studied. Then, the article explains the ingredients of an anthropo-logic, a core constituent of human ecology, which includes cultural and societal variables while recognizing individual and group differences. These variables can account for the diverse sometimes conflicting ways people perceive, understand, and respond to risks and threats to their lives and habitats. The article applies core principles of human ecology to comprehend contrasting responses to global change (including extreme weather events and repeated flooding in cities) in an increasingly polarized world.

Keywords: Adaptation, agency, anthropo-logic, culture, human ecology, resilience.

1 Introduction

Being human, we share the inherent characteristic of change with all living organisms, ecosystems and the biosphere. The origins and drivers of change involve both internal and external variables that nurture and sustain or threaten and eradicate life. History confirms that living organisms may or may not be sustained by the ways they interpret and respond to internal and external variables that influence their habitats and living conditions. Change can be either gradual and predictable, or abrupt, radical, unpredictable, and perhaps disruptive. In recent decades, this approach has been associated with adaptation, resilience, and sustainable development.

Current and recent crises, including extreme weather events and repeated flooding in cities in several countries north and south of the Equator, for example, illustrate the incapacity of human societies, notably

national and local authorities, to respond effectively to risks from 'natural' hazards. Emilio Moran [1] and John Bennett [2] agree that diverse responses to ecological, economic and health threats have highlighted the capability of different societies to respond to risks in both short- and long- term perspectives. This is illustrated by different sometimes conflicting responses to data and information about climate deregulation and the increasing frequency of extreme weather events in several regions of the World [3]. This case will be used to illustrate ideas presented in this article.

In this global situation, academic papers and policy briefs have championed resilience [4, 5]. A socio-ecological systems approach has often proposed that individuals, households and societies can respond effectively to global threats, such as climate deregulation, and also foster sustainable development [5, 6, 7, 8]. However, the underlying questions of 'why' and 'how' this occurs have often been overlooked. Academic researchers and policy makers have endorsed the concept of resilience without asking critical questions about causes of, and responsibilities for, persistent problems and risks to human and natural ecosystems. Therefore, authors rarely consider how shifts to fair, just, and equitable situations will be achieved in the future. Notably, resilience for sustainability rarely incorporates concepts of justice, democracy and redistribution, even though they are foundations of social sustainability incorporated in the first principle of sustainable development.

Researchers and policy makers should consider fundamental questions about why numerous initiatives intended to respond to the risks of climate deregulation and extreme weather events, or to threats of epidemics of contagious diseases, or to increasing economic, housing, and health inequalities between countries and within large cities, are not being implemented where and when they are most needed [3].

Some authors have assumed that changing individual and collective behaviors can provide effective responses to these hazards and risks [4, 5, 6]. These kinds of contributions have been criticized by social theorists who reject the way that biological analogies have been applied uncritically to human societies while discounting human agency and cultural predispositions, political authority, power structures and social injustice [9, 10]. Moreover, Joseph argued that arguments of some authors are aligned with neo-liberalism and particularly how principles of individual liberty should guide personal and collective behaviors rather than institutional change and societal transformations [11].

Despite criticism, resilience has become a normative concept for researchers and policy makers [12]. Collectively, both groups have ignored or rejected epistemic divergences and asymmetries of power that are the foundations of increasing polarized interpretations and responses to ecological, health, financial and social risks in a globalized world with rapid urbanization [9]. This article explains why a human ecology perspective is pertinent and necessary to critically rethink adaptation and resilience as cultural predispositions. It posits that core concepts of human agency, including choices, intentions, and fundamental values, provide a human-centred framework for reconsidering adaptation and resilience using a much broader conceptual framework than that delimited by biological analogies. The article posits that core ethical, cultural and political principles of human ecology provide foundations of a transdisciplinary conceptual framework to better understand the nature of being human in a world that is constantly changing in both predicted and unpredictable ways.

The article concludes that different, contrasting, and (sometimes) conflictual fundamental values attributed to people and nonhuman constituents of ecosystems have strongly influenced how individuals, groups, and societies make choices to ignore or respond to diverse hazards and threats. The article highlights that cultural predispositions and political dimensions of human groups have largely been ignored by scientific research including many recent contributions in sustainability science that are claimed to be humanistic. This shortcoming has been corrected by contributions in the field of ecological theology and political ecology that have challenged common interpretations of resilience and sustainability [12].

2 Method

This article is based on the author's theoretical contribution to human ecology and inter- and trans-disciplinary research over several decades. The sources for this article include personal research and

practice, including contributions in human ecology and the documentary analysis of statistics and reports about people-environment relations. These documents have been analyzed; since the 1990s they indicate incidences of negative impacts of urban living conditions and lifestyles on urban populations, and growing inequality stemming from intra-urban differences. The research for this article includes the selection and analysis of numerous publications that record diverse disciplinary and interdisciplinary contributions about adaptation and resilience in the context of implementing sustainable development since the 1990s. Other official documents indicate ineffective societal responses to global challenges (including climate deregulation, loss of biodiversity, poverty, and malnutrition) at international and national levels, despite concordant empirical data and increasing scientific knowledge about them. In contrast, the author's collaboration with some international programs since the 1990s has documented numerous achievements at the level of local authorities. Moreover, the author's review of the Global Sustainable Development Report 2019 [13], on behalf of the Swiss Academy of Sciences, indicates that international diplomacy and national political agendas can provide contextual conditions for effective responses to societal challenges at the geopolitical level of cities and local authorities. Hopefully, linking these initiatives to core principles of human ecology, including adaptation and agency, can serve as a catalyst for moving forward.

The next section briefly describes the conceptual framework of human ecology developed from the 1970s, which preceded the socio-ecological frameworks proposed since the 1990s.

3 Conceptual Framework

Conceptual frameworks are representations of a real-world subjects, or situations, that identify and define their core components and the multiple interrelations between them using concepts, principles and rules [14]. Conceptual frameworks are applied in both theoretical and empirical research to improve understanding of complex subjects; for example, the Social-Ecological framework proposed by Elinor Ostrom [15] was derived from interdisciplinary research about people-environment-biosphere relations. This systemic framework facilitates a shared vocabulary of concepts and definitions about the basic components of social-ecological systems (e.g., the sense of community in animal biology can be contrasted with the meaning of this term in urban anthropology and sociology). Given that diverse conceptual frameworks of the same subject coexist, convergence, communication and dialogue are necessary to develop mutual understanding about differences and especially why they coexist.

The term 'ecology', from the ancient Greek words *oikos* and *logos,* denotes science of the habitat. There is a large consensus that Ernst Haeckel (1834-1919), a German zoologist, used this term in 1866 [16]. The word ecology commonly designates a science that studies the multiple interrelationships between organisms and their surroundings. However, it has been interpreted in numerous ways including general, human, political and urban ecology [16].

The UNESCO Encyclopedia of Life Support Systems published in 2001, includes an entry on Human Ecology [16]. It explains why the contribution of the Chicago School of Sociology used an inappropriate biological analogy to discuss the life, habitats and reproduction of humans by comparing them with animals and plants. It also noted that the search for correlations between biological, economic and geographical variables that excluded fundamental human values (including ethical and spiritual values, worldviews, and political authority) could not explain the multiple meanings, geographical layout and social organization of urban environments, especially why different residential areas coexist in the same city.

3.1 Anthropo-logic: Foundations of Being Human

The term anthropo-logic denotes compound knowledge domain of human groups and societies, including their aesthetic, conceptual, ethical, and technical knowledge, as well as their technical and practical know-how, and other ways of knowing [16]. The term is derived from *anthropos,* which designates what is specifically human; logic is derived from the ancient Greek word logos and designates thought, reasoning, and discourse. The proposed anthropo-logic is derived from a holistic and systemic conceptual framework

of human ecology that includes the content and symbiotic interrelations between an eco-logic and a bio-logic in addition to an anthropo-logic [16]. Anthropo-logic is the primary focus here because, in general, sustainability research and policy has not attributed sufficient attention to core cultural dimensions of the themes or situations studied, including the diversity of cultural, social and personal interpretations of global change including climate deregulation and loss of biodiversity.

Culture, derived from the latin word '*colere*' (to cultivate), does not have a consensual definition among anthropologists. In general terms, it denotes the long-standing cognitive structures, communal norms, and behavior patterns of human groups that have been transmitted between generations by communication and learning as Clifford Geertz (1973) explained 50 years ago [17]. Culture traits include beliefs, knowledge and know-how; meanings, norms and rules; symbols, customs and values, as well as material artefacts. These physical and immaterial traits are applied implicitly and explicitly in everyday life. In recent decades, homogenous, monolithic, and static interpretations of culture have been challenged by processes of globalization, mass migration flows, and social media and telecommunications. Collectively, these trends have led some conventional interpretations of culture to be replaced by more dynamic evolving ones because the same ethnic group living in different local communities in the same country may have different culture traits. Therefore, these traits should be identified in precise localities.

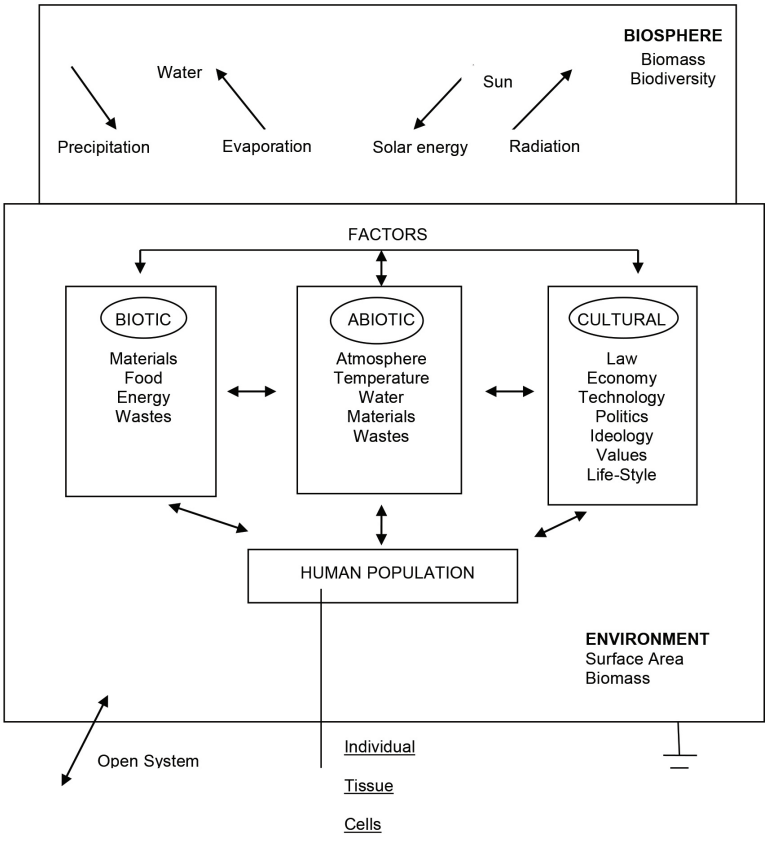

Figure 1: *The holistic framework of a human ecology perspective which illustrates the fundamental principles of co-action between the core constituents including cultural variables. (Source: Author, 2001).*

The conceptual framework shown in Figure 1 represents the systemic interrelations between sets of biotic,

abiotic and anthropogenic factors that are combined together forming a web of components and connections. It considers this synthetic whole as a referent for people-environment relations, and it acknowledges the function of each component and its connection to others. This systemic framework is applicable for different geographical areas (e.g. neighbourhoods, cities, and metropolitan regions). It is a synchronic representation of a dynamic human ecosystem that is a metabolism open and linked to others. This framework should be used at different times to explicitly address both short- and long- term perspectives, because it can identify change to specific components as well as the interrelations between them.

Notably, anthropo-logic includes institutional, legal, and political frameworks [16, 18]. Environmental, health and other social problems are meant to be overcome by legislation, public policies and economic measures (e.g., taxes or subsidies) that are meant to change or regulate the impacts of human production and consumption patterns stemming from uses of resources and the discharge of wastes. This instrumental perspective has been complemented by an ethical one that has addressed property rights including the rights of Nature. Property rights are social arrangements between people that define the rights, entitlements, obligations and duties of persons, companies, or an authority (the right holder) in relation to a specific entity (for example, a forest or a lake). Property rights stipulate how the right holder and other parties (non-property holders) are morally and legally required to act [19]. They create interdependence between people and resources as well as addressing distribution and fairness.

Human ecology incorporates principles including agency, co-action, co-evolution, cultivation, and symbiosis [16, 18]. Agency is a concept used in our research to denote whether people are considered as active beings capable of making their own choices about activities, behaviours and relations with others. Agency has commonly been used in discipline-based research to study the influence of age, gender, socio-economic status on human cognition, behavior and opinions. Our research enlarges these influences to also account for fundamental beliefs, values and worldviews. These fundamental constituents of being human express mutual interactions between the ecological, biological and cultural constituents inherent in human habitats summarized in the next section on adaptation.

4 Rethinking Adaptation

Adaptation by human groups was discussed by Julian Steward (1902-1972), an American anthropologist who coined the term 'cultural adaptation' to denote how human groups adjust or change their subsistence activities to accommodate changes in local environmental conditions and resources [20]. His original contribution has been enlarged to include how adaptation is influenced by economic, social and political activities and technological innovation. Being human can be characterized by the kinds of regulators individuals and groups commonly use to define, modify, and control their behavior and living conditions [1, 2, 20]. Humans have several physiological processes that enable them to adapt to changes in environmental conditions. These mechanisms include thermo-regulation and circadian rhythms, that ensure and maintain vital needs, such as nutrition. However, fundamental needs are not only guaranteed by biological and physiological mechanisms; for example, food must be accessible and affordable because cultural rules and social practices (that vary between ethnic groups, within societies and across cultures) are also used to define what natural resources are edible or taboo, and when resources can be consumed [21]. After replacing local and national farming and food processing, the agro-industrial sector has eradicated food sovereignty and failed to provide food to all households in many countries [22]. Therefore, research on resilience and sustainability should consider the core reasons for local populations not having access to nutritious food; in sum, why should individuals and households adapt rather than change the root cause of the persistent problem? This kind of question helps explain why people must adapt or die from famine which is sadly the case for many vulnerable populations according to the United Nations [22].

Adaptation is a set of interrelated processes that sustains being human in the context of global and locality specific change [1, 2, 23, 24]. Evolutionary adaptation refers to processes of natural selection. It is only applicable to populations, and it is trans-generational. Innate adaptation is genetically determined and do not dependent on learning [25]. Cultural adaptation refers to adaptation by selective cultural customs

and norms and that are not innate, such as legal measures, the built environment and infrastructure, institutional and organizational measures, and changes to lifestyle [23, 24]. Adaptation can occur before, during or after a shock. Preventive measures can be used before a predicted shock in order to mitigate impacts. The outcome of adaptation depends on a complex set of biological, ecological, cultural, societal, and individual human processes that evolve and are not always predictable.

Consequently, adaptation and resilience are complex and compound constituents of being human. Both may include purposeful proactive behaviors, not just reactive responses to risks or threats. A human ecology perspective does not borrow concepts that only refer to animals and plants. For example, successful adaptations to ecological, financial, or other kinds of constraints, such as confinement during an epidemic, include different means and measures that depend on multiple variables prescribed by the anthropo-logic [16]. Although there are some genetic sets of adaptive processes that are similar among humans, animals and plants, the crucial role of human culture and social customs underlying human adaptability should not be underestimated. Dyball and Newell [18] noted that human ecologists have accounted for values, but they have often interpreted the term narrowly, referring to a numerical amount, magnitude, or monetary value of objects, or a quantity of material resources (e.g., the stocks of ecosystems). This is equally applicable to much research on socio-ecological systems (see later). Common interpretations of value should be enlarged to include aesthetic, cultural, moral, and spiritual values, because these are embedded in the core principles of sustainable development that endorses human rights, as well as environmental and social justice. Unfortunately, even anthropocentric interpretations of sustainable development and sustainability have discounted the primary role of culture, and thus ignored the influence of fundamental values, political authority and responsibility, and human intentionality [26]. These constituents of being human should be addressed in critical thinking about adaptation and resilience.

5 Rethinking Resilience

Resilience is an ambiguous concept with a long history that has been interpreted differently when transferred and used in different disciplines [27, 28]. Consequently, there are multiple definitions and interpretations of resilience that coexist [5, 29]. Numerous disciplinary domains have borrowed resilience from its origins in physics and engineering, including medical and health sciences [30, 31]; human development including psychology and psychiatry [32, 33]; ecology and environmental sciences [34, 35]; economics, political and social sciences [36, 37]; and risk and disaster management [38, 39]. This article is not meant to present a review of numerous contributions that coexist in these different domains. However, based on published critical reviews [9, 10, 11, 12], this article argues for an innovative transdisciplinary approach that incorporates core principles of human ecology.

In general terms, resilience is a concept used to study the response of human and other living species to global and changes in habitats, especially those having negative impacts on their sustenance. It is commonly agreed that resilience denotes the capacity of living organisms to overcome difficulty or negative experiences and to rebound or recover quickly from adversity, change, or threats to their sustenance. Both predicted and unpredicted changes that have consequences across diverse geographical and temporal scales have been addressed. However, resilience can also denote persistence and incapacity to adapt (see later), as well as much broader transformability of multidimensional people-environment interrelations. A social-ecological systems interpretation of resilience recognized that individual, communal and societal sustenance are embedded in human-centered barriers or obstacles to change.

The World Resources Institute defined resilience as "the capacity of a system to tolerate shocks or disturbances and recover" and argues that this depends on the ability of people to "adapt to changing conditions through learning, planning, or reorganization" [40]. This report also defined resilience as the capacity to thrive in the face of risks or threats, but it did not decipher and explain the roles and responsibilities of private enterprises, public institutions and government in contributing to achieving this fundamental objective, thus confirming the criticism of Joseph [11].

Power is the ability to influence or control the actions of others [41]. It can impact on the way actors

and institutions participate in communal activities that support or hinder change. Rosendahl et al. (2015) [42] challenge the lack of attention to the hidden agendas of stakeholders during projects that involve collective action, including those meant to implement sustainable development. Key issues about the power and control of elected officials and property owners, or other potentially dominant stakeholders, can be addressed using the core concepts of the theory of structuration. The theory of structuration proposed by Anthony Giddens (1986) [43] has been reviewed and enlarged by integrating the systemic and holistic principles of human ecology [44].

In contrast to homeostasis, socio-ecological resilience often posits a dynamic state of equilibrium in socio-ecological systems [6, 7, 8]. These systems are interpreted as complex adaptive systems that have an inherent capacity to adapt to change, but the precise ways that threats of instability are counteracted by processes including reorganization are rarely explained in detail. Unlike resilience of materials and structures in engineering and physics which emphasize how physical things return to a stable steady state, resilience often denotes an inherent property of human and ecological ecosystems that enables them to absorb external disturbances and, perhaps, even benefit from change. For example, fire is usually not always a short-term disaster for grassland ecosystems; it can also become one means to maintain them by regeneration processes over the long-term [18]. The way that an ecosystem responds to a planned or unexpected external disturbance depends on the nature of the shock and its impact, and the internal properties of the ecosystem including its vulnerability. If the ecosystem is elastic, then accommodation processes will absorb change without modifying its initial state. If the ecosystem is plastic, then assimilation processes will deal with change by altering the initial state of the ecosystem. Examples in industrial societies include an explicit change in the local economy of a region, or the productive output of a factory in response to changes in the supply of raw materials, or a falling demand for the produced artifacts [18].

A common assumption of natural scientists is that ecological systems strive for a dynamic equilibrium state that results in climax [34]. This assumption is based on the idea that the carrying capacity of the environment defines viability limits for the optimal size of populations in a specific ecosystem. Disturbances and imbalances can occur through predicted or unforeseen changes either internal or external to the ecosystem. It is claimed that owing to efficient negative feedback processes an ecosystem will revert to its previous state once the agent of change has been removed, or counteracted, irrespective of the magnitude of that agent. A contrasting view argues that there is a high degree of instability in ecological systems, but that they are sustained by their diversity – (including many types of components, different kinds of non-linear relationships between them, and spatial variety and structure) – as well as their capacity to accommodate external resources.

These two interpretations can be related to ecological research in diverse disciplines of the natural sciences. A wide range of contributions confirm that ecological systems include two types of adaptive processes that are meant to deal with change [45. 46]. The first type is dynamic equilibrium processes that operate to maintain a system from rapid, disruptive change. The second type include resilience processes that are meant to sustain a system. In both cases a beneficial adaptive process is one that contributes to the solution of a problem or a stressful situation. These processes can only be understood in terms of the inherent characteristics of ecological systems, and the nature and intensity of the agent instigating change.

Responses to disturbances of ecological systems are varied and unpredictable because they depend on the type and intensity of the external impact (e.g., a small, single incremental disturbance in contrast to a large, enduring impact) and the internal properties of the ecosystems [34]. These responses include short- and long-term change, with or without equilibrium states and internal transformations. In principle, ecological systems are not static but dynamic and change continually in terms of their composition, the interrelations between their components and their equilibrium conditions. The dynamic nature of ecological systems is partly related to their diversity and their variability. Some changes to ecological systems stem from external sources such as unpredictable climatic events (e.g., frosts, hurricanes, or droughts). Ecological systems must adapt to these events in order to survive by self-regulation. These internal responses account for the magnitude of the disturbance and the degree of variability that it has experienced historically.

6 Synthesis

The transfer of adaptation and resilience from biology and ecology to the field of socio-ecological systems incorporated a shift from mechanistic, linear thinking to systemic thinking. However, although humans were included, fundamental cultural and psychological variables were not considered as equally important as biological variables. The development of socio-ecological systems in fields of sustainability science rarely prioritized core principles of human being [26]. This is one reason why cultural and psychological dimensions of adaptation have been discounted even though they have been a core concern of many disciplinary contributions about resilience. This is unfortunate given that the variability of personal and collective responses to problematic situations has been documented [9, 47].

This article posits the need to distinguish between proactive and reactive human drivers of adaptation and resilience, by deciphering personal and collective perceptions, intentions, motives, and values which may enable or inhibit human activities that respond to risks and threats, or undesirable situations [26]. For example, individuals and groups make choices regarding increasing risks to their lives from climate deregulation and extreme weather events, the propagation of infectious diseases, and access to affordable energy supplies which are influenced by a multitude of internal and external variables. Although individuals, households and local communities have little influence on external variables contributing to these exogenous changes, they do make conscious choices between optional responses to them. These choices are framed by their personal and shared position regarding each problematic situation, which has specific characteristics in precise societal, geographical and temporal settings. This has been explained regarding the diversity of responses to systemic risk from Covid-19 [48, 49]. It will by illustrated in the next section regarding predicted risks from more frequent extreme weather events using the case of hurricane Katrina in New Orleans in 2005. Unfortunately, the tragic case of New Orleans has not served as a warning to many other cities since then.

6.1 Lessons from Systemic Risks of Flooding since Katrina

Climate deregulation has increased systemic risks from both predicted and unpredicted extreme weather conditions that threaten the sustenance of long-established human habitats by flooding and landslides [50]. The dykes in the Netherlands are one example of how the risk of flooding by the North Sea has been perceived and dealt with by scientists, professionals, policy decision-makers and the general public over many generations [51]. The dykes were constructed as a protective barrier to sustain human settlements constructed on sites that are vulnerable to flooding. Today, approximately 27 percent of the Netherlands is actually below sea level. This area accommodates about 60 percent of the country's population of 15.8 million people. Although the perceived risk of flooding is omnipresent, actual incidences have been rare during the last century because the Dutch society have applied adaptation measures to reduce their vulnerability. The case of Katrina and its impact on New Orleans can be mentioned to show how societal responses to the same kind of risk can vary considerably.

Cyclones and hurricanes are extreme weather events that are predictable in many localities, especially those in tropical regions including the Gulf of Mexico during specific periods of the year. When Katrina impacted on the state of Louisiana during the last days of August 2005, the negative impacts on New Orleans surpassed all estimates even though the strength of the hurricane had slightly diminished [52]. This catastrophe damaged natural ecosystems, agricultural production, tourism, buildings and infrastructure, while the consequences for human life and well-being were tragic (1833 deaths - mainly persons over 70 years – and over 250'000 displaced persons), plus widespread damages estimated at over US $100 billion. These multiple consequences illustrate the vulnerability of people-environment relations in that region. Notably, meteorologists had predicted the intensity of the hurricane; doubts about the resilience of levees to retain the stormy sea were documented; the risk of flooding was known to decision makers employed by state and city authorities. More than a decade after this catastrophe, daily life in New Orleans, especially for the poorest groups of the resident population, has still not been re-established to its former state. Hence, it is not unfair to claim that the resilience of the city of New Orleans is low because adaptation was

not implemented effectively even though the risks were known, and remedial measures remain incomplete [52, 53, 54].

The example of hurricane Katrina illustrates some key principles presented in this article that may be applicable in localities that are at high systemic risk from flooding. These principles enable critical thinking about widespread flooding in the wake of hurricane Ian in the state of Florida, USA, in September 2022; and flooding elsewhere, including the western suburbs of Sydney, Australia, in 2021 and 2022. Likewise, repeated floodings of some cities in England as well as the southern region of Tanzania, and Pakistan.

Examples of repeated flooding underline core principles of human ecology presented earlier in this article. First, the biosphere and the Earth are a unified whole that involves combinations of and complex interrelations between natural and human-made ecosystems that are capable of disruption at local, regional, and international levels. The multiple impacts of severe extreme weather events like Katrina are not simply 'natural disasters'; they are manifestations of compound human and nature-based conditions forming a systemic risk that is not solely dependent on the nature of the shock. Knowledge and information prior to the event, human perceptions of threats and risks from known and previous shocks, and the pre-existent vulnerability of low-income residents exposed to risk should be considered critically [52, 53, 54].

Second, both natural and human-made ecosystems are not closed, finite systems; they have permeable boundaries that are transgressed by external forces of an ecological kind (notably flows of water whether rain or seawater); and an anthropological kind (such as infectious diseases). This means that humans should be prepared to adapt to external conditions and processes that impact their habitat in predictable and unpredictable ways. The key issue is how these risks are interpreted by humans and what measures, if any, are used to mitigate plausible impacts. Collective responses to risks and threats from climate deregulation and extreme weather events have become more polarized but that trend should not negate the responsibility of elected officials and public authorities to promote and sustain the public good [9, 55].

Third, responses to risk and vulnerability should endorse moral and just principles of 'the public good' rather than self-interest and personal benefit. When impacts of extreme weather events are added to extant vulnerability, especially poverty, then there are systemic impacts including accidental injury, illness and death, loss of employment, housing and household income, and damage to local infrastructure and community services. Preventive measures in New Orleans included the construction of levees to prevent flooding from high level sea water but this infrastructure was inadequate to prevent extensive flooding loss of life and economic collapse. These multiple impacts raise the question why more resistance was not provided by these constructions [56, 57].

Fourth, cases of flooding illustrate that change is a fundamental constituent of natural processes on Earth from the micro-scale of organisms to the largest scale of the biosphere. Transformation processes have been a historical feature of living organisms and especially human history on Earth. They should be contrasted with misconceptions about stability, reversibility and willingness not to change. Unwillingness to adapt and to increase resilience is common despite of more empirical knowledge about climate deregulation and extreme weather events. This subject has become part of national and local political agendas and illustrates power and authority that may override sustaining 'the public good' [9, 57, 58].

Fifth, humans are distinguished from other organisms by cognitive processes they use to define, modify, and control their living conditions. These include adaptive processes that enable them to adjust or mitigate changes if they wish. Here intentionality and purpose should be highlighted because there is ample evidence of inertia even though risks are known [52]. This was precisely the situation in New Orleans when Katrina was predicted, estimates of risk were communicated to the public and both public officials and citizens acted in diverse ways, sometimes not ensuring greater resilience to vulnerability from systemic risk. Barriers to collective and social change will be discussed in the next section before concluding this article.

6.2 From Adaptation and Resilience to Social Change

Christian Berg stated that barriers to achieving societal change for sustainable development have rarely been studied systematically [59]. He proposed an actor/institutional framework to help overcome the inertia restricting or prohibiting programs and projects from achieving their objectives. These include

ineffective institutional, legal, and political arrangements; growing neoliberal market economies with the subservience of politicians and public administrations to multinational corporations; and individual and collective lifestyles that champion consumerism and self-interest often at the expense of the public good.

Notably, the Global Sustainable Development Report 2019 acknowledges the need for intentional change but continues to propose current institutional, fiscal, and legal arrangements and mechanisms for implementation [13]. That report, written by an independent group of scientists, has followed the thinking of academic authors of many other documents that presented the major pressures that threaten natural and human-made ecosystems, health, and well-being without analyzing the root causes of these pressures thus sustaining the status quo.

Here we apply a different reasoning, by extending the contribution by Joern Fischer et al. on behalf of the Earth Stewardship Initiative [26]. Their contribution indicated why contributions of scientific research had not served as a catalyst for societal change towards sustainability. They concluded that the primary barrier to societal change was not lack of data, information, and knowledge about persistent problems; instead, inertia is grounded in human behavior, intentionality, preferences, values, and worldviews. Hence, societal change is dependent on "reflecting on deeply held value and belief systems, which fundamentally shape behaviour" [26, p.153]. We live in a value-laden world; therefore, it is the personal and shared experiences, perceptions, and values associated with persistent problems and global challenges that count, not just the addition of the number of people concerned. Until current fundamental values are identified, counteracted, and replaced, there will be no "social avalanche" [26, p.158].

We argue that until barriers to social and change are understood, they cannot be removed. The case of inadequate adaptation and resilience to repeated flooding in cities confirms the need to combine and coordinate a synthetic framework for collective action that includes three key components of an anthropo-logic. First, multi-level governance at national and local government levels. Governance denotes the way that governments, public administrations, private enterprises, and community associations interpret and respond to societal challenges including climate deregulation and risks from extreme weather events. Understanding risk relies on public access to factual data and information from reliable sources in a post-truth world. Then, the synthesis of interdisciplinary information and knowledge, professional know-how and understandings, and public perceptions and values is crucial. This enlarged and shared understanding can be used to define the appropriate allocation of many types of resources required to implement effective adaptive actions. Cities have a major role and responsibility in responding to global challenges, but our research indicates many have not accepted this responsibility since 2005 for all population groups. This highlights extant inequalities, inequities, and vulnerabilities in many cities.

The second prerequisite condition for more effective adaptation to extreme weather events is the importance of communication and dialogue about specialized knowledge and professional know-how to create a contextual understanding of vulnerability and risk in precise sites within and around cities. The different impacts of extreme weather events both between and within cities remain largely unknown. The diverse unknowns about risk from extreme weather events, such as the increasing incidence of flooding and its impacts on population health urban infrastructure and economic activity, should be identified and publicized. Communication and dialogue are needed to improve awareness and develop a shared understanding about diverse plausible futures.

The third prerequisite condition that influences effective city and communal responses is individual, household and community adherence and respect for administrative and behavioral norms and rules regarding adaptation and mitigation in cases of flooding. Some interventions by governments and public administrations focus on regulating personal behavior, such as being displaced from home elsewhere before, during or after the shock. We know that public adherence to these social prescriptions cannot be assumed owing to cultural, social and psychological factors, including place attachment, group identity and the notion of individual liberty.

Collectively, these three key components of an anthropo-logic have been largely discounted by research on socio-ecological systems. They should be addressed more responsibly in the future to implement more comprehensive, ethical, and just adaptive measures to threats from extreme weather events before, during, and after they occur.

7 Conclusion

Adaptation and resilience are complex multidimensional concepts that have been interpreted differently according to diverse disciplinary approaches. There is some general agreement about resilience but, above-all, there is a lack of cross-disciplinary collaboration that could provide an enriched understanding of its meaning and purposes in precise situations. Our research of publications in diverse disciplines indicates that resilience lacks any compound meaning in relation to either the functioning of socio-ecological systems or the anthropo-logic of the human condition. The conceptual basis of resilience derived from biology, ecology and psychology is supplemented by descriptions of the sustaining human life and well-being in an a-political context of global change. However, approaches of this kind cannot advance the cause of promoting and sustaining human health and well-being until human perceptions, intentions, values are explicitly addressed. Future directions for transdisciplinary inquiry include how adaptation and resilience are defined in different cultures, and by different human groups in the same country or city. More research is needed about individual and collective responsibility as key components of human agency. Finally, our research confirms the importance of defining the geographical (local/national/global) and temporal scales (immediate, short- and long-term biological or ecological time frames) of being human because experiential human time and space coexist at micro-scales in a world of meso- and macro- scales. The interrelations between climate deregulation and extreme weather events illustrate this global challenge.

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