

Article

The Principles of Design for Vulnerable Communities: A Research by Design Approach Overrunning the Disciplinary Boundaries

Emanuele Giorgi ^{1,*} , Tiziano Cattaneo ^{2,3}  and Karol Paulina Serrato Guerrero ¹

¹ Tecnológico de Monterrey, Escuela de Arquitectura, Arte y Diseño, Campus Chihuahua, Chihuahua 31300, Mexico

² Department of Civil Engineering and Architecture, University of Pavia, 27100 Pavia, Italy

³ College of Design and Innovation, Tongji University, Shanghai 200070, China

* Correspondence: egiorgi@tec.mx

Abstract: Current changes are making communities, cities, and territories increasingly vulnerable. Urban architectural interventions have the power to intervene this situation, directly reducing vulnerabilities or backing social initiatives. Urban and architectural interventions, however, are also those that take a longer time to be implemented and to impact society. For this, these interventions must be sustained by broad and transversal visions, as well as referring to the temporal context of the coming decades. For these reasons, the research project “Design for Vulnerables” aims to define which methodologies should be adopted to reduce urban vulnerabilities in the coming decades. A design workshop, set in a vulnerable community in the northern Mexico, was organized, documented, and analyzed. Based on the research by design methodology, the research highlighted current issues, transversal to urban-architectural design, which influence urban vulnerabilities. This multidisciplinary approach made it possible to generating a set of principles of Design for Vulnerables, graphically represented by a re-interpretation of the Krebs cycle.



Citation: Giorgi, E.; Cattaneo, T.; Serrato Guerrero, K.P. The Principles of Design for Vulnerable Communities: A Research by Design Approach Overrunning the Disciplinary Boundaries. *Buildings* **2022**, *12*, 1789. <https://doi.org/10.3390/buildings12111789>

Academic Editors: Liyin Shen, Jorge Ochoa and Haijun Bao

Received: 3 September 2022

Accepted: 13 October 2022

Published: 25 October 2022

Publisher’s Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Keywords: urban vulnerabilities; vulnerable communities; multidisciplinary approach; disciplinary boundaries; design workshops; research by design; Design for Vulnerables; Krebs cycle design

1. Decades to Come: Challenges for Urban Vulnerable Communities

The current crises, which are impacting contemporary society and which, in the coming decades, will turn into important global challenges, make it urgent to deeply consider what characteristics cities and territories must adopt [1,2]. Undoubtedly, the city, the place of maximum expression of human phenomena [3], need be placed at the center of a discussion that concerns different scientific and humanistic disciplines [4–9]. Cities must again be the place that allows human flourishing and the enhancement of the communitarian environment [10]. This has important implications for policies makers, designers, architects, engineers, and, more in general, for all those people who have an impact on the built environment. It is inappropriate to think that society can address the current challenges with the current processes and policies, which partially are the generators of many of the problems themselves [11]. This implies having to define new working methodologies that must be even more innovative when it comes to intervening in vulnerable communities [12]. These contexts and the concept of vulnerability itself are studied and discussed by the international scientific community, which highlights (1) how it is more appropriate to indicate this situation with references to the plural vulnerabilities and (2) how all living beings are subject to some levels of vulnerabilities.

1.1. Urban Vulnerabilities

All the new contemporary challenges imply developing new considerations on “being vulnerable”, which has become an ever more varied and complex concept. Each academic field developed a specific concept of vulnerability (related to its own way to study the

social and natural environment) and a theoretical definition—more specific than the vague “measure of possible future harm”. In the scientific literature, the concept of vulnerability is a very complex one, because it can be used in different fields to analyze specific aspects of different disciplines, with definitions serving specific methods and indicators [13]. Thus, innumerable facets of vulnerability can be met, and therefore it can be safely referred to as “vulnerabilities”, to correctly indicate these different aspects that can be assessed. In general, we can refer to the concept of vulnerabilities as those conditions by which an event can be detrimental to the physical, emotional, or economic well-being of a person or community [14]. The observation by Wolf et al. helps in understand a common pattern in the assessing methodologies of different disciplines, which can be grouped into three types: “evaluate harm for projected future evolutions, evaluate the current capacity to reduce harm, or combine the two” [15].

Moreover, in academic literature, the concept of vulnerability is often associated with environmental risk [16]. This allows us to highlight how these events are the ones that endanger the psychophysical well-being of a person or a community more than any other. However, it is wrong to consider that the concept of vulnerability should be limited to these environmental risks. In contrast, reflecting on the state of vulnerability means analyzing social, economic, or cultural aspects that are at the base of the well-being of people and individuals.

Due to the complexity of this concept [15,17], the importance of its contextualization [18], the relativity of the concept itself [19] and the goal of this research, the authors tried to keep the approaches to vulnerability as wide as possible. Differently from other studies, which aim to define design principles for specific situation of vulnerability (environmental risks, flooding, earthquake, climate change, etc.), this research aims to keep in sight several concerns (political, economic, social, and health, among others). All these social problems are further aggravated in extreme conditions, where the lack of social ties is added to serious basic problems, such as overcrowded housing, ethnic discrimination, poverty, or unemployment. Furthermore, as also shown by the COVID-19 outbreak and the need for social distancing, the lack of social ties led to several serious situations, such as domestic violence or isolation [20,21].

For all these reasons, the scientific disciplines refer to “vulnerable communities” (urban or rural) as those communities that are more limited in being able to respond to changes that will impact the society [22,23] and they represent that sector which will increasingly suffer from changes in the short and long term. Therefore, designing for these contexts requires a new way to approach the concepts of “design” and “vulnerabilities”. The authors consider that considering—during this specific research—very specific conceptualizations, definitions, or assessments of vulnerabilities, could limit the spectrum of applications. Even if several definitions, as those of W. Neil Adger, require that to define vulnerability in communities, indicators must be considered along the time [17], for the purposes of this research, the authors considered specific indicators in a defined moment.

1.2. Definition of Urban Vulnerability used by the Research

According to the previous analysis, a universal definition of “vulnerability” can be considered as a “potential state, whose equilibrium can be compromised by a disturbing event”. Based on this general definition, everyone must be considered vulnerable. Nevertheless, persons with less political, economic, or technological power must be considered more vulnerable than those who have the power to reduce the imbalance introduced by the disturbing event.

Moreover, to be not too restricting or too vague, to define a “vulnerable community”, for the purposes of this research, a community should be based on these characteristics:

- Limited economic resources;
- Limited political weights and excluded from the principals political decisions;
- Scarcity of basic services (light, water, sewer system, etc.) and public services (transportation, garbage management, etc.);

- Environmental emergencies (pollution);
- Social isolation and segregation for the formal city.

1.3. Looking for a Definition of “Design for Vulnerables”: Current Gap, Research Objective, and Contribution

Currently, in vulnerable communities (as previously defined), it is not easy to outline guidelines for the design. In particular, it can be common to start with a wrong approach and set up an inappropriate community interaction strategy. Recent approaches comprehend community participation as the main way to an appropriate sustainable development design in vulnerable communities [24–26]. However, the current reality makes this approach no longer sufficient: new complexities (1) of the urban and social phenomena (which imply a new design vision) and (2) of the possible futures (which make forecasts unpredictable) make it urgent to update the methodology of how design should approach these vulnerable contexts. It is necessary to update methodologies that can lead a designer during the initial stages of the project, to properly define needs, hopes, strategies, and solutions. Based on this interpretation of the current design problems in vulnerable areas, the research project “Design for Vulnerables” was started, with the aim to understand which dimensions must be considered when planning urban-architectural interventions in these contexts. A multidisciplinary approach is an urgent need to define the first approach to planning and design in vulnerable communities. This research aims indeed to understand how design solutions and methodologies should evolve to propose suitable solutions for all these kinds of communities, where new environmental stimuluses can create uncertain futures and potential harms.

This hypothesis, supported by the results, is represented at the end of the paper, through a four steps map—challenges, understanding, focusing, and strategies. The process of “Design for Vulnerables” must contemplate different scales (global and local) and act with different focuses (goals and tools). The goal of this representative hypothesis is to establish an interrelation between these steps, scales and focuses, where Anthropocene, technology, person, and environment are the four main connectors in multiple dominions.

2. Knowledge Gap and Emergencies That the Research Aims to Fill

According to the previous considerations, the relevance of this research is mainly related to the current existing gap in the academic literature and to the need to fill it. Thus, the development of a new methodology for design can be facilitate. This section explains why the Design for Vulnerables research project aims to define which design methodologies should be adopted to reduce urban vulnerabilities in the coming decades, generating a set of principles of Design for Vulnerables, graphically represented by a re-interpretation of the Krebs cycle.

2.1. Existing Knowledge Gap

Currently, the academic literature does not collect texts and research that (1) investigate the role of design in “vulnerable contexts”, as defined in this research, or (2) are based on an inter-disciplinary vision of the concept of “vulnerability”.

The authors performed a deep review of the academic literature, looking for the existing knowledge in the field of design for vulnerable communities. Scientific publications and outreaches were analyzed to understand the relevance of the research project. The lack of holistic and multidisciplinary approach is particularly relevant in the most cited articles on this topic, in the areas of social sciences, environmental sciences and arts and humanities. Among all the studied material, for clarity and readability, the authors decided to present here just the 10 most cited articles, which represent the most significant resources for the academic knowledge. In fact, if we consider the most cited Scopus indexed articles, based on these limits (TITLE-ABS-KEY (architecture AND vulnerable AND community); from 2015 to present; Subject Area: Social Sciences, Environmental Sciences; Arts and

Humanities; Document Type: Article, Conference Paper, Book Chapter), we can observe how the concepts relating “vulnerability” and “design” are limited to very specific aspects:

1. “2011 AERA Presidential Address: Designing Resilient Ecologies: Social Design Experiments and a New Social Imagination”—2016, 58 citations, vulnerable ecologies and nondominant communities [27];
2. “Queering women, peace and security”—2016, 50 citations, sexual and gender-based violence [28];
3. “Survey, HBIM and conservation plan of a monumental building damaged by earthquake”—2017, 18 citations, conservations and earthquakes [29];
4. “Citizen science-informed community master planning”—2020; 15 citations, flooding [30];
5. “Importance of soft canopy structure for labrid fish communities in estuarine mesohabitats”—2017, 13 citations, habitat and fishing [31];
6. “Utilization of the Maryland environmental justice screening tool: A Bladensburg, Maryland case study”—2019, 12 citations, environmental justice and GIS [32];
7. “Policy innovations for pro-poor climate support”—2020, 9 citations, climate adaptation and infrastructures [33];
8. “Slum upgrading and climate change adaptation and mitigation: Lessons from Latin America”—2020, 8 citations, Climate change and Informal settlements [34];
9. “The governance of adaptation financing: Pursuing legitimacy at multiple levels”—2017, 7 citations, climate adaptation and governance [35];
10. “Sunshine, temperature and wind: Community risk assessment of climate change, indigenous knowledge and climate change adaptation planning in Ghana”—2020, 6 citations, climate adaptation and indigenous knowledge [36].

As can be observed, these major scientific products have a very specific slant and do not address the issue of design challenges in vulnerable communities for the coming decades, based on a holistic and multidisciplinary approach. A scientific product recently published by the same authors is “Design for Vulnerable Communities” [12], which makes an effort to collect the interdisciplinary visions generated by the Round Tables, which are part of this research. However, the book does not present the results of this research and does not reach the conclusions presented in this paper, since the purpose of the two publications are radically different.

Based on this important gap in the academic literature, it seemed timely to develop this research. This necessity comes, in particular, by the fact that the initial hypothesis is that Design for Vulnerable Communities represents an urgent call to our discipline, for which analysis and proposals can no longer be derived from activities confined within disciplinary boundaries.

2.2. Emergencies for Vulnerable Contexts

Although the contemporary global condition is absolutely the best in the history of mankind (long life expectancy, smallest percentage of people living in extreme poverty, etc.), the contemporary world is literally altered by epochal changes that have a huge qualitative and quantitative impact on the planet and the humanity [37]. Climate change and uncontrolled technological development offer important elements for reflection to understand contemporary conditions of vulnerability and think of effective intervention solutions. Climate change already counts with a structured academic literature relating design solutions and vulnerable communities. Technological development is still barely discussed in the academic literature of design for vulnerable communities.

2.2.1. Impact of Climate Change on Vulnerable Communities

Anthropogenic changes in the natural environment have been known since the earliest human activities (agriculture and early rural settlements) [38]. The enormous quantitative change of recent decades, however, has maintained this catastrophic impact, shifting its effects from a limited and almost insignificant scale to a global and extremely significant

dimension and with important repercussions in many fields, from the environment to society. This is such a strong impact that the economic and social systems that led to this situation are strongly questioned [11,39]. The change in climatic phenomena can be observed, among other things, in the increase in temperatures, in a new distribution of extreme atmospheric phenomena (hurricanes, storms, etc.) or in changes in sea currents [40]. All these phenomena, beyond causing deleterious changes in the natural environment, are contributing to social changes that, although little studied at this time, have very deleterious effects on the structure of society and on the well-being of vulnerable communities [41]. Due to climate change, the world of production is changing and will change more and more, both agricultural production [42] (for example) and the production of services. There are many implications for poverty [43], for well-being and health (clean air, clean water, enough food and safe shelter) [44,45], as well as on migratory processes [46] and on community security [47]. It is very clear how necessary and indispensable it is to consider these changes when an urban-architectural intervention is going to be proposed.

2.2.2. Impact of Uncontrolled Technological Development on Vulnerable Communities

If the exponential growth of human activities is producing unprecedented changes in the ecosystem, the impetuous technological development is shaping many scenarios that were unthinkable until a few years ago. Thus, nowadays, this is a highly debated topic because, day by day, it has increasingly important repercussions on everyone's life and because it questions many of the certainties upon which contemporary society has been formed (production, social relations, services, spatial dimensions, temporality of life, etc.).

An interpretation of technological development has connotations of positivity and considers that the relationship with technology will be directed to a support for a healthy human flourishing; in contrast, a second interpretation sees in the unbridled development of the technological system even a threat to the entire humanity. Regardless of these two interpretations, although they have a more long-term perspective and are extremely relevant in other contexts, what must be highlighted here is how, for the most vulnerable communities, technological development is the key to getting out of conditions of vulnerability, where physical and environmental dimensions are a barrier [48,49]. If vulnerable communities lose this opportunity to take advantage of technological development to get out of their vulnerable condition, their vulnerability will become even stronger and the social, economic, and cultural differences could be insurmountable. Technological ignorance is presented as one of the serious dangers that hang over the future of vulnerable communities, showing itself, perhaps even more dangerous than illiteracy. In both cases, the urban-architectural design has very important responsibilities in proposing environments that are useful to face these changes. This leads to the need to discuss the current concept of urban vulnerabilities and what the role of the designer should be. In the last decades, starting from the works of Giancarlo De Carlo in Italy, participative design is considered as one of the most appropriate and sustainable ways to approach design in communities. However, the complexity of the contemporary challenges implies going over these methodologies and defining new ways to interact with vulnerable communities.

2.3. Contemporary Design and Multidisciplinary Dimensions

Moreover, although the world of construction is one of the human activities that is most slowly aligned with social transformations, architectural design has always represented one of those human activities that is most sensitive to changes in culture and social phenomena. For this reason, given the upheavals that are taking place, it is very essential that urban-architectural design be able to question itself, become an active recipient of new needs, and thus prove to be capable of rethinking its being, its strategies, and its methodologies of work. Economic aspects, related to design, have a core role in this vision [37,50]. Of course, also anthropological studies [51,52], geographical issues [53,54], environmental sciences [40], or urban studies [55–59] have generated much knowledge that can apport to the discussion. For this reason, understanding the phenomena that characterize our

territories is a priority: as these realities are becoming increasingly complex, the question that the research project Design for Vulnerables aims to understand is “how can design contribute to empowering vulnerable communities in the years to come?” As Papanek wrote in his seminal book in 1973 (originally, in Sweden, in 1970) [60], “in an era of mass production in which everything must be planned and thought through, design has become the most powerful tool with which man shapes things. his tools and environments (and, by extension, society and himself). This demands great social and moral responsibility from the designer. It also calls for a greater understanding of people on the part of design practitioners and a greater understanding of the design process on the part of the public. [...] Design must become an innovative, highly creative and interdisciplinary tool that responds to people’s true needs. It needs to be more research-oriented, and we need to stop desecrating the earth itself with poorly designed objects and structures”.

As Papanek shows, in addition to being innovative and creative, design must become an interdisciplinary tool in order to find solutions that respect people and the planet. Today, in a society in which the fields of knowledge, responsibilities, and relationships are more complex than in 1970s, having an interdisciplinary design becomes an even more current requirement. This means leaving purely disciplinary works/knowledge: all those that deal specific questions and problems with the same method and approach [61]. The approaches that are not limited to a single area of knowledge, the “non-disciplinary knowledge” [62] and that have acquired special importance in the medical and nursing fields [63], they can assume various characteristics depending on the relationships that are structured between the different disciplines. In this context, characterized by new challenges for the planet, by unprecedented concepts of vulnerabilities, and by new responsibilities for design practice, a “non-disciplinary” approach can help to understand the state of vulnerabilities and to propose suitable solutions in vulnerable communities. This research aims to understand how much the design practice results receptive of an initial “non-disciplinary” approach.

3. Materials and Methods: Research by Design

The research presented in this paper is the result of the first year of work in the vulnerable community Paso del Norte (Chihuahua, Mexico). The deep interaction with residents and the wide participation of designers and interdisciplinary experts have been the main characteristics of a design workshop that allowed to generate a final definition of Design for Vulnerables. To understand what dimensions must be considered in order to propose urban architectural interventions in vulnerable contexts, a design workshop was held based on three fundamental actions (Figure 1): (1) Design groups, composed by international designers and residents in the vulnerable community, (2) Experts Round Tables, carried out by international experts, to introduce interdisciplinary perspectives about vulnerabilities, and (3) Real Life Web Lab, which allowed permanent communication between designers and members of the community during the pandemic. Results have been validated and compared to synthesis the principles of Design for Vulnerables.

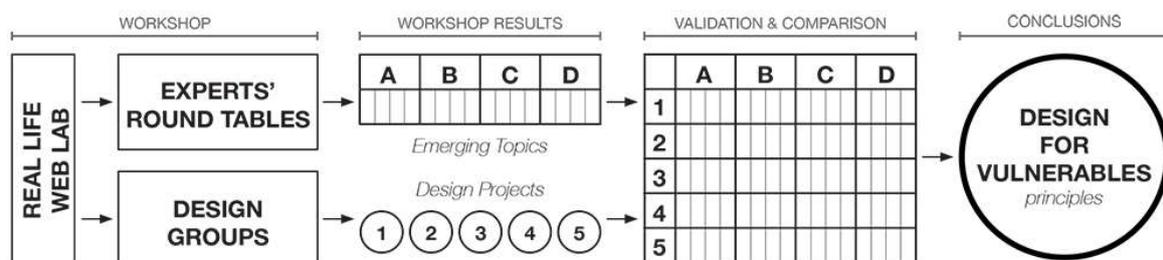


Figure 1. Scheme of the research flow.

3.1. Research by Design

This research, which uses the design workshop process and results as a research laboratory, is based on the research by design methodology. This methodological approach aims to use design as a process to foster dialogue between stakeholders (designers, citizen

legislators, and researchers) and to sensitize both local government authorities and citizens about possible design solutions that are determined based on environmental, social, and economic patterns, and not merely on land use [64]. The research by design approach developed from Dutch practice at the Faculty of Architecture in Delft [65]. The research by design approach was defined by Hauberg [66] and Roggema [67] as follows: “*Research by design is a type of academic research through which design is explored as a method of inquiry, through the development of a project and also exploring the different means with which a project is carried out: sketches, mapping, among others*”. Furthermore, research by design is a strategy, as Hauberg (2011) stated: “*It is used to describe the various ways in which design and research are interconnected when new knowledge about the world is produced through the act of designing. The methodology aims to generate desirable, perhaps unexpected, urban prospects rather than likely, but less desirable, urban developments*” [35]. Nassauer and Opdam [68] asserted that design is a common ground for researchers and practitioners to bring scientific knowledge to decision-making on landscape change, demonstrating that the pattern-process paradigm should be extended to include a third part, called “design”. In this research project, the research by design method was applied for the regeneration of the Paso del Norte community.

According to Schoonderbeek, the term “research by design” can move to indicate three different situations or categories of relationship between research and architecture: (1) considering design as an act of research; (2) considering the design as the object of the research that is developed according to a controlled methodological process or (3) considering the design as a possible beneficiary of a research process that can provide useful information to the design process [69]. In the case of Design for Vulnerables, what the authors wanted to achieve was that, through design, they could activate research activities on the urban quality of the Paso del Norte neighborhood. Thus, the methodological process of research by design, in this case, must be understood under the first category of design as an act of research: a design based on defined methodological processes and specific instruments that can, thanks to the observations that are generated in the process and to the comparable data that are obtained, provide answers to a specific research question.

3.2. Design for Vulnerables Research Project

Design for Vulnerables is a research project supported by the Observatorio de Ciudades de Tecnológico de Monterrey (Guadalajara, Mexico), started in 2021. A first context of study was the vulnerable community of Paso del Norte, in the city of Chihuahua (Guadalajara, Mexico), which will be followed by studies in other locations in the same state of Chihuahua (Ciudad Juárez, Mexico) and in the southern state of Chiapas (Guadalajara, Mexico).

Several universities and laboratories participate in the research project as promoters, as well as two different faculties of the Tecnológico de Monterrey (which is the host institution): the School of Architecture, Art and Design and the School of Humanities. The Design for Vulnerables activities can be observed on the project web page: “<https://www.designforvulnerables.com/>” (accessed on 15 August 2022) [70].

3.2.1. Paso del Norte, Chihuahua, Mexico: A Vulnerable Community

The first study context of the project has been the vulnerable community Paso del Norte (PDN) in the city of Chihuahua. Chihuahua is the capital of the homonymous state, which is the largest one of the Mexican Federal Republic, located in the central border with the United States of America. For this reason, the state and the capital play an important role in the management of migratory phenomena that cross the American continent from south to north (and from north to south). Specifically, the city of Chihuahua, which is about 300 km from the border, is the scene of a transit migration. That is, most of the migrants who arrive in the city stop for a few days to rest, waiting to reach Ciudad Juárez at the border. This implies, unlike the border city, that the vulnerable communities of the capital Chihuahua are not urban areas that host important groups of migrants who move to the US, or who, in contrast, seek to return to their country of origin. In these communities, the

most relevant migratory phenomenon, on the other hand, refers to permanent or seasonal internal migration, with people moving from rural areas to cities, mainly to look for work.

Specifically, PDN is a peri-urban colony, where about 2000 people live. It has been formed over the last 70 years, alternating formal and non-formal processes, mainly thanks to the mentioned migration.

For Mexico, the main indicators, and criteria to define a vulnerable community come from the National Institute of Statistic and Geography (INEGI) (Instituto Nacional de Estadística y Geografía). Thus, today, PDN can be considered a vulnerable community according to the previously defined focus:

- Few economic resources: the majority of the population works in the industrial sector (with an average income of 250 USD/month [71] or in domestic cleaning (average income 200 USD/month) [71];
- Limited political weights and excluded from the principal political decisions: in the opportunities of “participatory budget” promoted by the municipality, Paso del Norte has been excluded from financing and the majority of public interventions have been financed and promoted by the community itself;
- Scarcity of basic services (light, water, sewer system, etc.) and public services (transportation, garbage management, etc.): less than the 30% of the streets are paved; there are no public transportation stops in the neighborhood; garbage collections comes irregularly once a week; around the 70% of houses has connection to drainage and 80% has connection to electricity [72];
- Environmental emergencies (pollution): the community is located between two canyons, which are used as illegal landfill (Figure 2), and is divided from the formal city by Sacramento River, which is showing higher and higher levels of pollution;
- Social isolation: the highway and the river divide the community from the formal city, creating a perception of division and isolation from the city of Chihuahua.

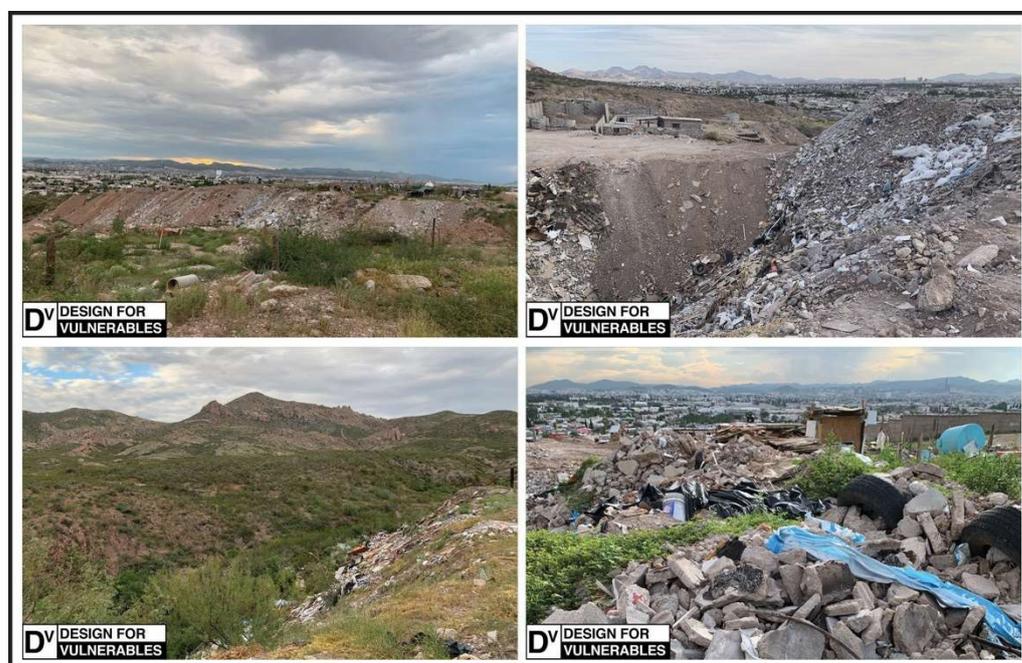


Figure 2. Canyons around Paso del Norte used as landfill.

For all the references and other details, please, visit the project web page www.designforvulnerables.com (accessed on 15 August 2022).

A characteristic of this community and one of the main reasons for its vulnerability is its semi-isolation from the formal city. PDN was set on the slopes of the mountains that defines the eastern border of the urban area of Chihuahua, located on the side of the

Rio Sacramento (one of the two main waterways of the city). Moreover, in recent years, alongside the watercourse, a high-traffic road was developed, contributing to relegating the community outside the formal urban area. This division means so much to the perception of belonging to a reality different from the formal city.

For some years, Tecnológico de Monterrey has been working in this community with social activities coordinated by the Professor Virginia Aceves and her association Accionética. These activities allowed to generate confidence in the educational institution, allowing to carry out research activities directly with the residents of PDN. In fact, as previously introduced, a key moment of this first study of the Design for Vulnerables project was the multidisciplinary workshop which was based on the possibility of constant dialogue between the participants (designers, interdisciplinary experts, and residents of Paso del Norte).

3.2.2. Real Life Web Lab

To allow this dialogue to take place in the best possible way, even during the isolation imposed by the COVID-19 pandemic, the research group structured a Real Life Web Lab. The purpose of this laboratory was to allow participants to be able to have an immersion, albeit virtual, in the life of the community, thus recreating that experience of approaching the reality of study, typical of the in-person workshops. The activities of the Real Life Web Lab began with a first Zoom broadcast from the community (December 2020), in which members of the research group showed the community to the participants, observing the most relevant urban areas and interviewing residents of the community. The activities of the Real Life Web Lab continued, mainly through WhatsApp groups, with constant discussions between participants outside the community and residents.

The Real Life Web Lab tool was created primarily to cope with the conditions imposed by the pandemic. Despite this, it has proven to be an excellent tool for allowing dialogue in a structured way and between people, who cannot coincide in the same place. In addition, the Real Life Web Lab allowed to record the interactions between participants and to document them in a more structured way. Indeed, the Real Life Web Lab compiled a series of videos, documents, and proposals that emerged from the working groups.

Throughout the six weeks of the workshop, the teams worked on five activities defined within the framework of the “Real Life Web Lab” (Appendix A). These weekly activities were necessary to guide the working groups in the development of a final proposal, standardizing the points of discussion, the methodology of analysis, and development of the proposal. This with the aim of being able to easily observe differences and similarities among the final proposals.

According to the research by design methodology, being able to use very clear and defined design instruments is key to having an objective and reliable research process [73]. For this reason, the authors decided to be very clear with the structuring of the design methodology. The required weekly activities were directed towards deep knowledge of the community and the development of ideas for the improvement of the future.

3.2.3. Interdisciplinary Round Tables

If the Real Life Web Lab aimed at providing participants with knowledge about the context, while not being physically present, the Interdisciplinary Round Tables aimed at providing participants with multidisciplinary knowledge, while not being experts in different topics. For this reason, four round tables, where at least one member of each design group should be present, were organized to present and discuss interdisciplinary issues. These four round tables were organized during the first two weeks of the workshop, in order to provide the design groups with the theoretical multidisciplinary foundations at the beginning of their activities. The goal was that designers could start their process with a theoretical basis expanded by discussion with interdisciplinary experts.

The structure of these round tables consisted of four moments (Appendix B): (1) presentation by the moderator of the round table, with introduction of the discussed

topic, paying particular attention to its relationship with planning in vulnerable communities and to the relevance that is expected in the next decades; (2) thematic presentations by experts, aimed at presenting both examples of studies or interventions in vulnerable areas, as well as providing a vision and a methodology to be able to interpret vulnerability; (3) discussion among the invited experts coordinated by the moderator of the round table to facilitate the emergence of points of contact between the different disciplines, and (4) moments of individual discussion between the experts and the working groups (by means of Zoom's breakout rooms), with the aim of discussing particular aspects of urban-architectural analysis in Paso del Norte.

All the round tables have been recorded and uploaded for free use in the project web page. These records represent the main activities' products, while the results of the interactions between experts and designers represent the activities' impact. The main output of the Round Tables is the list of "Emerging Topics" that has been synthesized by the authors. Since the goal was just to empower the designers with multidisciplinary views, no other documentation (surveys, reports, etc.) has been generated from these activities.

3.2.4. Design Groups

Deep knowledge of the area of study, given by the Real Life Web Lab, and deep knowledge of the global phenomenon that may interact with the reality of the vulnerable community, given by the Experts Round Tables, were the basis for the discussion of the proposal for urban-architectural intervention within the design groups. These working groups were defined before the beginning of the workshop. All the members of the design groups had different backgrounds, and it was sought to have in each team at least: (1) one resident of Paso del Norte, (2) an architecture student, (3) an architecture professor, (4) an active professional architect in Chihuahua, (5) a recent graduate of architecture degree, and (6) an active professional in a reality different from Chihuahua.

As members of the design groups, 28 people attended the workshop as members and 8 persons as mentors. They participated from:

- Professional practice (as professional designers or studios): 10 Mexican professionals (Chihuahua and León) and 1 Spanish professional (Barcelona).
- Universities: from Italy (University of Pavia) and Mexico (Tecnológico de Monterrey in Chihuahua, Tecnológico de Monterrey in León, ISAD, Universidad de La Salle)
- Laboratories and Schools: Sustainable Territorial Development (Tecnológico de Monterrey) and UPLAB (University of Pavia).

All the participants, who did not know the context of Paso del Norte, received introductions to the workshop topics thanks to the Real Life Web Lab (Appendix C). The reason for organizing the design groups with participants with different backgrounds came from the need: (1) to standardize the groups and to more easily compare the proposals; and (2) to offer, in each of the design groups, different visions coming from the different levels of the professional career (current student, recent graduate student, local professional, and international professional).

At the end of the workshop, each team submitted a formal proposal for intervention in the community. One aspect that assumes a very strong relevance in the Design for Vulnerables design workshop is the participation of residents in the discussion and design activities. Although participation, as a design methodology, is researched and applied on many occasions of theoretical and practical exercises, this is still a methodology that requires constant development and attention, in order to be effective [74]. According to Aish, in participatory design, two aspects must be considered: (1) satisfaction of the people for the final result and (2) "customized" balance among technical, functional, economic, social, and cultural concerns [74].

4. Results and Discussion

4.1. Interdisciplinary Round Tables: Emerging Topics

The Experts' Round Tables underlined several interesting outputs for the designers. These outputs can be observed as emerging topics that interdisciplinary experts consider as the most urgent issues according to their disciplines. For this reason, the main output of the Expert' Round Tables can be considered this list of emerging topics. With the aim to define this list, after the Round Tables, for several weeks, the authors carried out an in-depth analysis of the issues that emerged during the round tables. Starting from the recordings and the supporting graphic material (mainly the presentations), the authors extrapolated the themes that emerged and proceeded to group them according to the similarity of the conveyed message. Twenty categories came out from this grouping process (human impact on the environment, climate change and its consequences, energy poverty, etc.). Later, these twenty groups were clustered into four broader categories. This process made it possible to synthesize the messages that the interdisciplinary experts shared with the designers. The four categories that collect the twenty emerging topics are presented below. What is interesting to discuss, based on this list, is that, speaking of vulnerability, many disciplines traditionally away from architecture can propose useful reflections for the practice of architectural design. To facilitate the reading of this paper, just the four categories and the names of the twenty emerging topics are presented here. The whole definition of each one of them can be founded in Appendix D or on the research project's web page.

Challenges: to Design for Vulnerables, it is important to have in mind the new changes (and uncertainties), originated in the new geological era of the Anthropocene, that hit people and vulnerable communities. Defining the challenges helps to lead the understanding of the global phenomena. (C1) Human impact on the environment; (C2) Climate change and consequences; (C3) Health environment; (C4) Technological development; (C5) Political responsibilities.

Understanding: to Design for Vulnerables, it is important to understand the phenomena and the variants that define vulnerable conditions. Understanding global phenomena helps to define the focus for vulnerabilities in local communities. (U1) Human Development Index (HDI); (U2) Economic poverty; (U3) Energy Poverty; (U4) Strategic Alliances.

Focusing: to Design for Vulnerables, it is important to define the focus on the local dimension, to observe this phenomenon on a smaller scale. Focusing helps to elaborate strategies at local level. (F1) Digitization and Remote Sensing; (F2) Business Awareness; (F3) Social inclusion; (F4) Urban food system; (F5) Segregation and socio-spatial justice.

Strategies: to Design for Vulnerables, it is important to elaborate strategies to solve the challenges present in local vulnerable communities. (S1) Temporary relief and lasting solutions; (S2) Technology as instruments of citizen participation; (S3) Holistic approach; (S4) Integration with the formal environment (S5) Heritage and residual spaces; (S6) Opportunities for entrepreneurship.

Based on this list of emerging topics, one of the main peculiarities of this research can be observed: challenges, understanding, focusing, and strategies highlight issues that are already addressed by the academic literature in the field of design. The peculiarity to be underlined here is that these issues have never been considered together and within a process of design with vulnerable communities.

4.2. Design Groups: Design Projects

As a result of the activities that the design groups developed along the workshop, five proposals for intervention in vulnerable communities resulted. These represent, then, a set of five strategies to empower vulnerable communities. These strategies were presented as a formal intervention proposal in front of the community and the moderators of the round tables. Regarding the design process, it is important to underline as these five approaches have been directly defined by the five design groups. No thematic input has been given

by the authors to the designers: these approaches are the results of different analysis and research promoted within each single group.

These five approaches, which, as said, have been generated by each design group without any input by the authors, could be summarized as follows:

- Team 1 seeks to enhance visual and physical connections and rehabilitate existing public spaces, to increase community resilience, thus fostering a sense of belonging and community;
- Team 2 wants to promote the local sense of belonging to innovate social relations, promote circular economy activities, working with a new neighborhood council, the community involvement of young people, and regenerating infrastructure and public spaces in Paso del Norte;
- Team 3 designs effective management and social cohesion strategies, reorganizing the Neighborhood Council and proposing social self-motivation activities, and optimizing shared public spaces, and proposing a community pavilion that can serve as a place of cohesion and community management;
- Team 4 focuses on the reforestation of large areas of the community, as it seeks to enhance the natural heritage of Paso del Norte, understanding it as a “common good”, a cohesive element of the community, and an opportunity for territorial integration. Thus, a territorial corridor is created as a source of new social activities, coordinated from a community “operation” center;
- Team 5 wants to take advantage of natural and landscape resources to offer new business opportunities. Resorting to ecotourism strategies, use of social media and incentives for a natural evolutionary change, it seeks to promote a natural community empowerment to improve the sense of belonging and, finally, provide instruments to reduce the vulnerability of the community.

4.3. Validation and Comparison between Design Projects and Experts Round Tables

Once the workshop was completed, and the design solutions presented, it was possible to proceed with a comparison between the Experts Round Tables’ outputs (synthesized by the authors in 20 emerging topics and grouped in 4 categories) and the five design proposals.

This comparison is, therefore, a post-project exercise that has the three objectives: (1) deepening the relations between the four categories of the emerging topics (hereinafter referred to as “The relations among emerging topics”); (2) understanding which typologies of design solutions are considered relevant by designers when intervening in a vulnerable reality (hereinafter referred to as “Typologies of design solutions”) and (3) understanding the receptivity to integrate emerging topics in the proposals (hereinafter referred to as “The receptivity of the emerging topics”).

These three goals allow us to converge, therefore, towards a synthesis of the principles of Design for Vulnerable Communities, which is the ultimate goal of this research. The results contributed to generate the graphic synthesis of the Krebs cycle of Design for Vulnerables. Starting from these results, the experimentation of this synthesis will start through the application to some similar projects already scheduled in Mexico for the second half of 2022 (Ciudad Juárez, Chiapas, Chihuahua city center).

4.3.1. Validation

This comparison served as a process for validating the results too. In fact, the same designers made the association between the principles that emerged from the round tables and the design principles adopted by their design teams. Therefore, the designers validated the “emerging themes” summarized by the round tables and they directly validated the synthesis of the project proposals. If the authors of the research had been the ones who had carried out the synthesis of the project proposals, errors would have easily been created and could have missed some project nuances, thus limiting, or exaggerating the complexity of the proposals.

4.3.2. Comparison

The comparison was made by means of a matrix defined by the emerging topics, grouped in the 4 main categories (columns) of challenges, understanding, focusing and strategies and the 5 design projects. After the workshops, these projects have been analyzed, by the designers itself, through the categorizes of “goals” (G), “interventions” (I) and “elements” (E) (lines) to facilitate the association between design solutions and emerging topics. To avoid erroneous associations between design solutions and emerging topics, the authors asked to the design groups to analyze their own projects. Since the purpose of this research is to define the dimensions and the relations involved in the general process of “Design for Vulnerables”, the authors intend this exercise of comparison as a way to extract principles, synthetizing characteristics and relations among the four main emerging topics. The results are summarized in the following table (Figure 3). Here, the matches between emerging topics and design solutions are represented by the filled cells (1.1, 1.2, 1.3, etc.), whose full meanings are unfolded in Appendix E, in order to facilitate the reading of the paper.

In addition, even just with the present/absent quality shown in Figure 4, some considerations for each project can be raised.

Project 1 “Networks and nodes”

The project proposes some clear objectives, reducing environmental contamination, moving the attention of the local government toward the community, and integrating the community (to the formal city and within itself). Sustainable and regenerative approaches guide the interventions to reach these goals, while the river and the landscape become the two most relevant elements to work with. For this first team, some considerations deserve to be highlighted. No references have been made to: (1) Climate change and its consequences; (2) Technological development; (3) Human Development Index; and (4) Resilience of the Urban Food System, while, differently from other groups, they pay attention to Digitalization and Remote Sensing as a way to focus on the design for vulnerable communities.

Project 2 “Sense of belonging”

This team focuses its attention on challenges of Human Impact on the Environment, Health Environment, and Political Responsibilities. According to their proposal, kids’ participation in the communitarian life and public gardens have a principal role in the design for vulnerable communities. In addition, no attention is given to the issues of: (1) Climate change and its consequences; (2) Technological development; (3) Digitalization and Remote Sensing; (4) Resilience of the Urban Food System; and (5) Technology for Citizens’ participation.

Project 3 “Community management”

This third group defines four priorities related to global challenges: (1) control of the garbage management; (2) renovation of hygienic infrastructures; (3) technology as means of training the community; and (4) strong partnership with local government. To reach these goals, particular relevance is given to temporary relief (at least, design, financing, and construction) and lasting solutions (hub for workshops and teaching). Furthermore, as most of the other groups, no attention is given to the issues of: (1) Climate change and its consequences; (2) Digitalization and Remote Sensing; (3) Resilience of the Urban Food System. Moreover, differently to the other projects, this group does not consider the issues of (4) Energy Poverty; (5) Social Inclusion and Health; and (6) Integration with the formal environment.

Project 4 “Ecological corridor”

The fourth group centers on the challenge related to the “Human Impact on the Environment”, focusing on “Business Awareness” and “Social Inclusion and Health”, while proposing strategies mainly related to “Heritage and Residual Spaces”. In particular, the

environmental issues are related to the design of an ecological corridor which can connect the community with the formal environment, enhancing the existing the cultural and natural landscape heritage. As the other groups, no attention is paid to (1) Climate change and its consequences; and (2) Resilience of the Urban Food System. Moreover, no attention is given to (3) Technological development; (4) Human Development Index; (5) Technology for Citizens’ participation.

Project 5 “Tourist route”

This fifth project refers mainly to the development of a route for tourism connecting the community to the natural resources in the natural landscape surrounding the community. The main goals refer to creating awareness about caring for the ecosystem and to improve the social environment, as well as enhancing technological capacities and political responsibilities. As in almost all the other groups, references are missing to the (1) Climate change and its consequences; (2) Digitalization and Remote Sensing and (3) Resilience of the Urban Food System.

DFV	Challenges					Understanding				Focusing					Strategies						
	Human impact on the Environment	Climate change and consequences	Health Environment	Technological Development	Political Responsibilities	Human Development Index	Economic Poverty	Energy Poverty	Strategic Alliances	Digitalization and Remote Sensing	Business Awareness	Social inclusion and health	Resilience of the urban food system	Segregation and socio-spatial justice	Temporary relief and lasting solutions	Technology for citizen participation	Multidisciplinary and holistic approach	Integration with the formal environment	Heritage and residual spaces	Opportunities for Entrepreneurship	
Project 1	Goals		1.2		1.3													1.13			
	Interv.	1.1					1.4		1.6		1.4	1.8			1.10		1.12		1.14		
	Elem.							1.5		1.7				1.9		1.11				1.15	
Project 2	Goals	2.1		2.3		2.5		2.9				2.14		2.17					2.21		
	Interv.	2.2				2.6		2.10	2.11		2.13	2.15			2.19		2.20			2.23	
	Elem.			2.4		2.7	2.8			2.12		2.16		2.18					2.22		
Project 3	Goals	3.1						3.6						3.9	3.10						
	Interv.			3.2	3.3				3.7						3.11	3.12				3.15	
	Elem.					3.4	3.5										3.13		3.14		
Project 4	Goals	4.1		4.4							4.9	4.11								4.19	
	Interv.	4.2				4.5		4.6		4.8					4.14		4.15		4.17		
	Elem.	4.3							4.7					4.13				4.16	4.18		
Project 5	Goals	5.1		5.2				5.6				5.8	5.9								
	Interv.					5.4	5.5					5.8			5.10	5.11			5.14	5.15	5.16
	Elem.				5.3				5.7							5.12	5.13				
TOT	8	0	6	2	7	3	6	4	4	1	7	7	0	6	6	3	5	4	6	5	

Figure 3. Table to summarize the comparison between round table outputs and proposals. Numbers are placed as references for detailed explanations (Appendix E).

5. Discussion Generated by the Comparison

As declared at the beginning of this paper, the research’s aim is to update methodologies that can lead a designer during the initial stages of the project in vulnerable communities to properly define needs, hopes, strategies, and solutions. The comparison presented in Figure 4 allowed us to discuss about new needed methodologies. Moreover, before discussing the outputs of this comparison, it is appropriate to make a consideration regarding the current approach to design in and for vulnerable communities, which is often characterized by the following aspects [60,75,76]:

- Vulnerable situations are seen as places where design is excluded, rather than situations that must be intervened in (for ethical responsibility) and “opportunities” to renovate the discipline;

- Technology is considered inappropriate to vulnerable contexts and seen as an imposition, rather than a strategic opportunity to improve the life quality in vulnerable communities;
- Design solutions mainly come from disciplinary field, rather than looking for solutions with a wider interdisciplinary sight.

Within this context, the comparison resumed in the table highlights how the role of the architects and the research methodologies for interventions in vulnerable communities need to radically change. While some of the emerging issues can be considered proper of the discipline, others are totally new. The comparison can highlight three aspects that are discussed in the following sections: (1) the relations among “emerging topics”, which allow to better understand their meanings and the theoretical principles of Design for Vulnerables; (2) the typologies of design solutions, which allow to understand which are the strategies that could be considered as guidelines for Design for Vulnerables; (3) the receptivity of the emerging topics, which allow to understand which interdisciplinary topics have been assimilated by the architectural practice and, instead, which still need more incentives for a proper Design for Vulnerables.

5.1. *The Relations among Emerging Topics*

New methodologies to drive the principles of design in vulnerable communities need to be based on emerging topics, coming from multidisciplinary fields of knowledge. The matrix validation process highlights how it is appropriate to condense the emerging topics into four categories. This structure also allows to highlight some aspects that are listed here:

- a. The four main emerging topics can be considered as working areas. This means that challenges, understanding, focusing, and strategies must be considered as key moment of the process of Design for Vulnerables. While emerging topics underline the interdisciplinary vocation of these four topics, the design projects underlined as these four topics are partially considered in the design processes.
- b. Interventions consider different scale of work. Design for Vulnerables does not mean focusing just on the local community because a global sight is required to clarify challenges and understanding vulnerabilities.
- c. Design for Vulnerables means to keep under control aims and goals.
- d. The importance given to formal environment, landscape resources, heritage, and public spaces represent an attitude of deep interest toward the potentialities of the context.
- e. Multidisciplinary analysis and research capacities are the basis of conscious interventions in emergency contexts.

As shown in the literature review, there is no prior research discussing this holistic view of the problem and an overall design method. The results of this research project highlight how this vision is appropriate and allows the development of a coherent and global discussion on emerging issues for design in vulnerable communities.

5.2. *Typologies of Design Solutions*

Any new methodology to drive the principles of Design for Vulnerables must be defined from some typologies of interventions. For this reason, the matrix can be useful also to propose a list of guidelines and project-actions for vulnerable communities. Of course, this section of typologies of design solutions strongly depends by the context and by the characteristics of vulnerabilities of Paso del Norte. Moreover—without being ultimate universal solutions—they can give an idea of topics and issues that can be useful to contemplate while approaching vulnerable communities. Therefore, these actions could (and should) contribute to a paradigm shift with respect to previous design approaches.

- a. Interests in enhancing the programs of users, be human beings, animals, plants, groups/communities, or any other human–nature combination.

- b. Abandonment of anthropocentrism and redefinition of human activities in mutual equilibrium with the environment, allowing landscape and natural resources to assume a central role in the regenerative development of the community.
- c. Inclusion and legitimation of different languages and aesthetic repertoires, accepting the ordinary. Designer should become “translators” and “educators” of the residents, who are the true participants and protagonists of the transformation.
- d. Proposing solutions which could allow solving multiple problems, minimizing the creation of new needs and maximizing new opportunities.
- e. Experimentation with the community to produce results or working hypotheses better than an exercise of mere theoretical application.
- f. All architecture deserves the attention of designers, no matter how small, peripheral, or academically irrelevant it may seem at first sight: it is the representation of a local culture rich in values, which should be valued as a heritage of knowledge and a genuine expression of relationships social and environmental aspects of a community.
- g. Promotion of the reuse and circular recycling of any waste or material already used to create new components for architecture, in combination with the sharing of skills and competences of local inhabitants. Likewise, attention to the architectural potential of public spaces and areas, whose rehabilitation within an urban-architectural process can help create new relationships with the formal city (services, connections, etc.).
- h. Design of spaces and architectures that can be transformed over time, adapting to change, and offering flexibility to the entire community.
- i. Rejection of a romantic/nostalgic attitude, so the use of any technology will be supported and encouraged, with the aim of real empowerment of communities and all inhabitants.

In contemporary scientific literature, there are several different approaches that introduces reflections such as those presented here in the previous points. Nevertheless, a methodology merging all these approaches is missing, since this research presents a new focus (vulnerable communities in the next decades) which has not been taken in consideration before. Moreover, in some cases, based on an old way to analyze design methodologies, these emerging approaches could seem even antithetic. For example, philosophies related to the abandonment of anthropocentrism arrive even to reject integration of technological devices in sustainable solutions, as highlighted by Cole [77] and Zhang [78]. In contrast, this research shows how integrating technology to “no-anthropocentric” solutions represents a valid method to design for vulnerables.

5.3. The Receptivity of the “Emerging Topics”

The new methodology that the research aims to define, must also be based on the receptivity that design groups show during the design process, so as to understand which emerging topics are willing to be considered and which ones need deeper discussion. Regarding the way the designers elaborated proposals containing references to the “emerging topics” that they approached during the round tables, it is appropriate to underline how some topics have been integrated to the proposals, while other have not. In the design phase:

- a. less attention has been dedicated to the issues of “climate change” and “digitalization”.
- b. more attention has been given to the issues of “human impact on the environment”, “political responsibilities”, and “social inclusions and health”.

The fact that no group has introduced any issue related to climate change can be considered quite strange since climate change was a recurring theme during the presentations and that, in contemporary design practice, great relevance is attributed to this topic. Perhaps the fact that in the studied context (Paso del Norte) the emergency is mainly connected to social aspects meant that attention was not focused on environmental emergencies and on the risks associated with climate change.

Even the lack of attention to the issue of digitization could seem something strange even if more understandable, since too little attention is given to the digital issue as a

phenomenon with a high impact for society: the consciousness of how much is necessary to integrate digitization both in the design process and in the functional program of spaces in vulnerable communities is still too low [79]. The lack of attention to issues of climate change and digitalization must raise alarm about the inability of the design world to meet the revolutionary and unprecedented changes (positive and negative) that are impacting society. This implies that more efforts must be made to encourage the integration of these issues into architectural practice. These results and concerns are in line with the results presented internationally [80,80–82].

On the other hand, the higher attention to the social aspects of an architectural intervention can reflect the fact that during the analysis of the context, the main emergencies that have been found are related to social problems and the lack of attention by the local political system. In fact, it could be said that these issues have been leaders in the international design landscape of the last decade.

6. Krebs Cycle of Design for Vulnerables: Discussion about Approaches to Design in Vulnerable Communities

Inspired by the principles of the Krebs cycle of creativity (KCC), by Neri Oxman [83], the authors want to abstract the principles that emerged from this research activity, considering that this tool must be superimposed on the contextual realities, as very well explained by Samantha Winter during the Round Tables [10]. In fact, the elements used to generate this abstraction come from exercises applied to a very specific study context (Paso del Norte). This means that with this abstraction, the authors aimed to summarize only the basic concepts for the “Design for Vulnerables”, their characteristics and relationships (Figure 4).

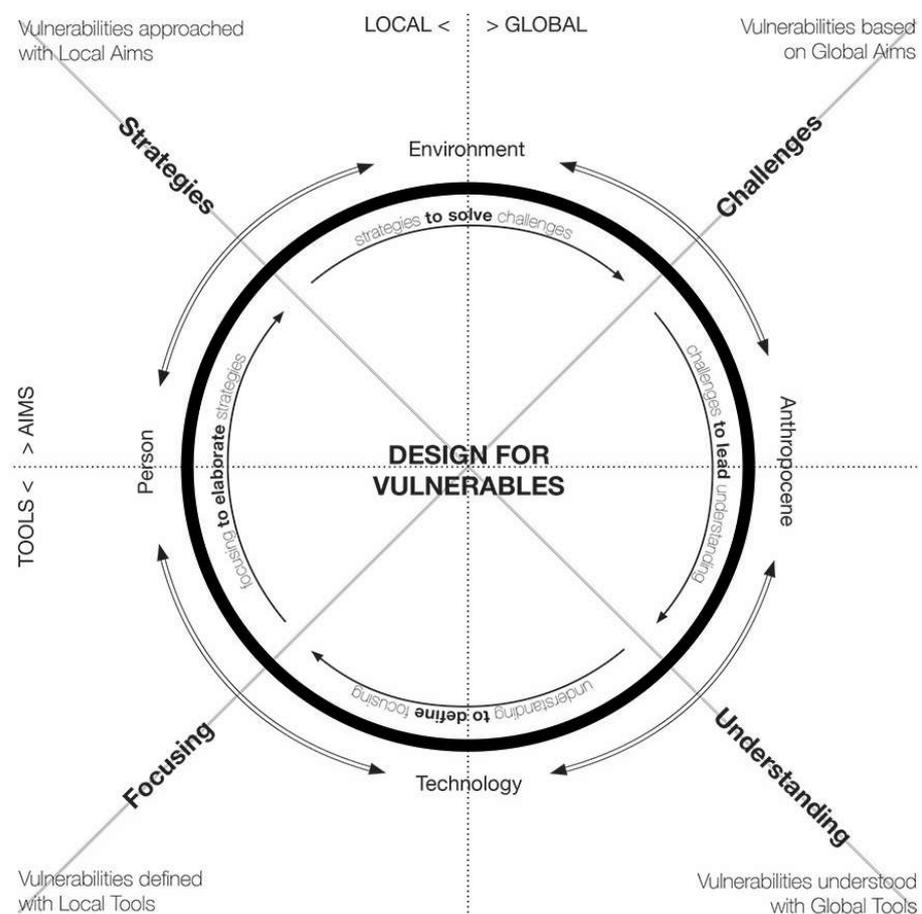


Figure 4. Krebs cycle of Design for Vulnerables.

As the matrix shows, the issues that emerged from the discussion with interdisciplinary experts, as well as the design process, revealed that there are four main work areas on which the “Design for Vulnerables” process should be based. The first area of work represents understanding the current challenges on a global level (challenges), followed by a second area of interpretation and measurement of phenomena (again with reference to global concepts) (understanding). A third area of work is related to focusing at the local level on the characteristics of the vulnerable community (focusing), so to be able to enter the fourth phase, when local solutions are provided to the initial challenges (strategies). The comparison exercise with the projects made it possible to highlight the characteristics and relationships of these areas. As in the case of KCC, these characteristics and relationships can be described with these aspects.

6.1. Each Area Is a Different Combination of Scales (Global and Local) and Focuses (Goals and Tools)

The quadrant is divided vertically between a local scale (left) and a global scale (right): “Challenges” and “understanding” belong to the global scale, since both areas deal with global issues; in contrast, the areas of “focusing” and “strategies” bring the work to the local level of the community. Similarly, the quadrant is divided horizontally between “aims” (top) and “tools” (below): “Challenges” and “strategies” are found in the quadrants of the “aims”, as the work in both areas is specifically dictated by the pursuit of goals (contemporary challenges and people’s well-being, respectively). “Understanding” and “focusing” are in the quadrants of the “tools”, as they need technical tools to define vulnerabilities levels (Figure 5A).

6.2. Each Area Has a Different Purpose

The role of challenges is to clarify the main issues that are creating potential conditions of vulnerabilities in our contemporary society (climate change, technology, politics, etc.); it “converts” environmental conditions into Anthropocene questions. The role of “understanding” is to measure the vulnerabilities, based on global indexes and scales (energy, poverty, development, etc.); it “converts” Anthropocene questions into technical measurements. The role of “focusing” is to measure the vulnerabilities on a local level, where technical tools are applied to the life and the daily activities of people (entrepreneurship, social inclusion, food systems, etc.); it “converts” the technical measurements into person’s necessities. The role of “strategies” is to define the best way to reduce vulnerabilities on a local level; it “converts” person’s necessities into environmental conditions, representing the data that initiated the KCC in Challenges (Figure 5B). At this ‘Cinderella moment’—when the hands of the KCC strike midnight—new environmental conditions inspire new challenges. The last sentences are a re-elaborated version from Age of Entanglement, by Neri Oxman [83].

6.3. Each Area Provides Additional Value to the Design Process

It is unthinkable to consider that an intervention can focus exclusively on one area of the process: all depend on the previous one and allow the next one to develop. It is impossible to “understand” the phenomena of vulnerability if the contemporary “challenges” have not been clarified. Similarly, it is impossible to “focus” on the vulnerability characteristics of the local community without “understanding” the phenomena of vulnerability. Therefore, intervention “strategies” cannot be defined without knowing the vulnerability characteristics of the local community. Finally, global “challenges” cannot be solved without knowing which strategies are necessary to intervene at a local level (Figure 5C).

6.4. The Relationship between Two Contiguous Areas Passes through a Conceptual Dimension

The connection between two contiguous workspaces is a specific conceptual dimension. “Challenges” and “understanding” are linked by the dimension of the Anthropocene, which represents the new reality to which humanity must get used to. “Understand-

ing” and “focusing” are connected by the dimension of technique and technology, which “normatively” characterizes (today) the system of evaluation of reality. “Focusing” and “strategies” are connected by the “person”, or rather the “community”: as the focus becomes local, they have the person as a dimension of implementation. Finally, “strategies” and “challenges” relate to each other by the environment dimension, which represents the place of implementation of the “strategies” and the dimension in which the “challenges” take place (Figure 5D).

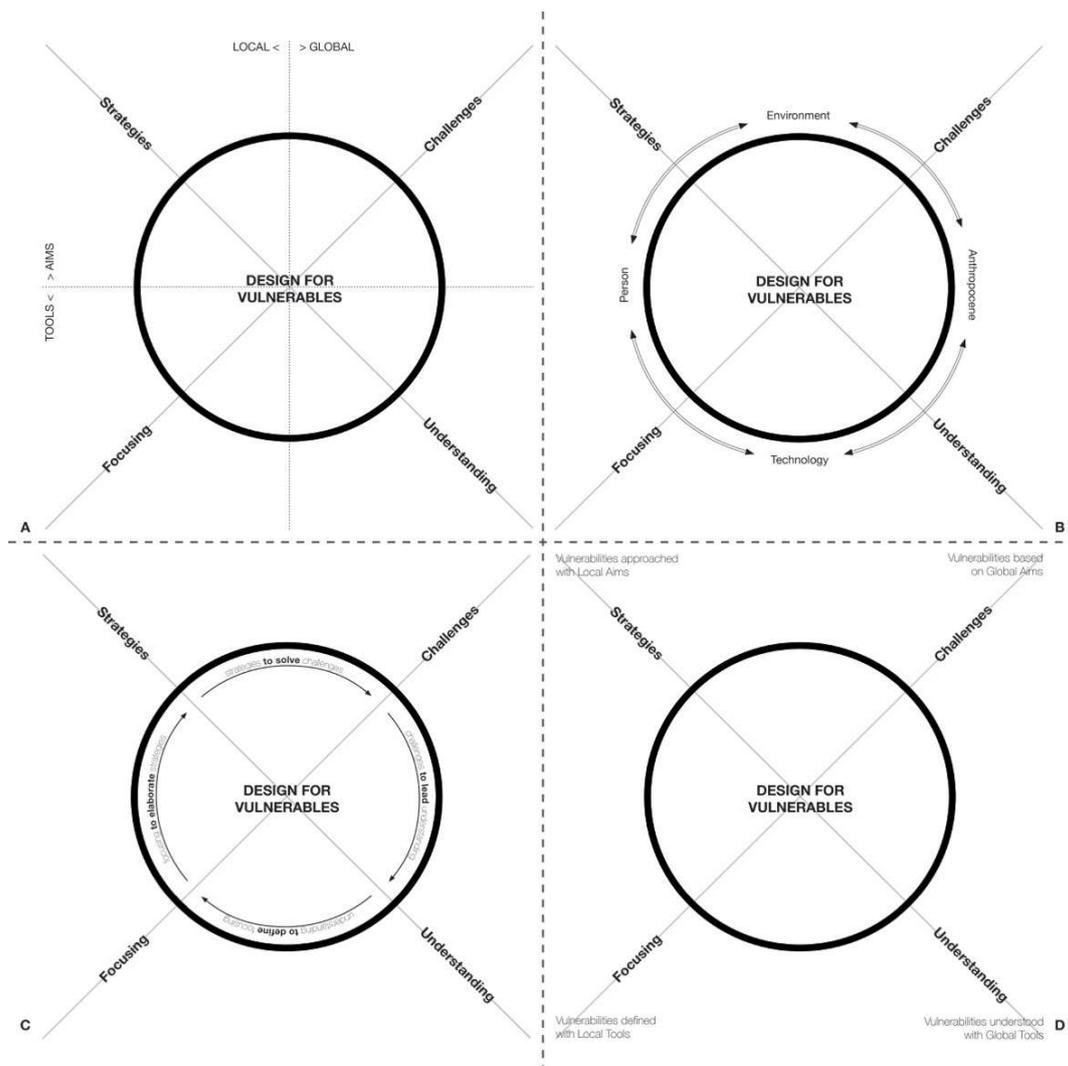


Figure 5. Four reading of Krebs cycle of Design for Vulnerables: (A) Each Area Is a Different Combination of Scales (Global and Local) and Focuses (Goals and Tools); (B) Each Area Has a Different Purpose; (C) Each Area Provides Additional Value to the Design Process; (D) The Relationship between Two Contiguous Areas Passes through a Conceptual Dimension.

7. Conclusions and Recommendation

7.1. Contribution and IMPACT

The contributions of this paper lie in proposing a new methodology to approach the first steps of Design in Vulnerable Communities. While the academic literature and the design practice have both important gaps when considering design approaches in vulnerable communities, with an interdisciplinary view and a long-term focus, this research project works in this gap and allowed to analyze the issue of design in vulnerable communities in the coming decades. As shown in the existing knowledge gap, the so-called “challenges”, “understanding”, “focusing”, and “strategies”, have been already addressed

in different fields of knowledge. Moreover, no research is considering them together to define a methodology for design in vulnerable communities.

The project results, graphically expressed by the reinterpretation of the Krebs cycle", show how the process of "Design for Vulnerables" must contemplate, in particular in the first stages, different scales (global and local) and act with different focuses (goals and tools). Issues related with Anthropocene, technology, person, and environment are the four main connectors, in multiple dominions, between different steps, scales, and focuses. Operating with multidisciplinary view in each of the four "working areas" (challenges, understanding, focusing, and strategies), can enrich the process with potential energy, allowing to easier define the aims or better decide the appropriate tool to approach vulnerabilities. In this process, we can appreciate the analogy with the Krebs cycle, where each compound generates energy (and values) to the process.

7.2. Research Limitations

Of course, there is a basic aspect that is worth tracing again: the need to superimpose an abstract tool such as this one, on local realities. Thanks to this overlap, the Krebs cycle of Design for Vulnerables will highlight which challenges, issues, or opportunities will be the most relevant for each context. The importance of the context is absolutely not to be forgotten, since it is the basis of any approach to the issue of vulnerability. During one of the round tables, Samantha Winter (Columbia University, New York, NY, USA) masterfully described this necessity of contextualizing the studies when indagating for vulnerabilities [10].

Some limitations exist in the development of the research. Some of them may lie in the very methodology of "research by design" [73,84]: for the knowledge creation process to be considered research, the methodology must be explicit, openly communicated, and reviewed [85]. In some cases, this communication with the participants may have been limited, in particular with the residents of the vulnerable community—due to the limitations in the availability of technology in the neighborhood and to the pandemic. In different circumstances, when the workshop could have been carried out face-to-face, the participation could have been more effective, in terms of collaboration, exchange, and creation of knowledge.

In this research, suitable solutions are not tested against uncertain futures. This limitation will be overcome through future research, by applying approaches similar to those of Salas and Yepes [86] and Hall et al. [87]

7.3. Research Development

The results obtained so far, however, show how design for vulnerable communities must be considerably open to interdisciplinary knowledge and discussions. Future developments of this research will be directed towards a deeper understanding of (1) the role that multidisciplinary engagement plays in the changing reality of contemporary vulnerable communities and (2) the role that technology will play in facilitating these much-needed new design practices. For this reason, the very next step will be consolidating the Krebs cycle of Design for Vulnerables. To do this, the authors will apply in the following semester the same methodology and the circle to other cases, with different characteristics: Ciudad Juárez (city in the border with USA), Chiapas (southern state of Mexico), and Chihuahua city center (in an urban context). Then, the authors will adapt the circle according to the new concurrent data structures and, finally, they will ensure that the circle is mature enough to be usable for external users. Moreover, some interventions are planned in all these communities and the authors are committed to measure the results obtained with these interventions. Therefore, the ultimate step will be making the Krebs cycle of Design for Vulnerables digital.

Author Contributions: Conceptualization, E.G. and T.C.; methodology, E.G. and T.C.; validation, E.G. and T.C.; formal analysis, E.G. and T.C.; resources, K.P.S.G.; data curation, E.G.; writing—original draft preparation, E.G.; writing—review and editing, E.G., T.C., and K.P.S.G.; visualization, E.G. All authors have read and agreed to the published version of the manuscript.

Funding: The research presented in this book was performed thanks to the support of all the residents of Paso del Norte community and funded by the Fondo de Investigación 2020–2021 of Observatorio de Ciudades” of the School of Architecture, Art and Design of Tecnológico de Monterrey—2020/2, through the research project “Design for Vulnerables”, with a duration from October 2020 to December 2021.

Data Availability Statement: The data presented in this study are openly available in the project webpage www.designforvulnerables.com.

Acknowledgments: The research project was performed within a long-term international collaboration among the School of Architecture, Art and Design of Tecnológico de Monterrey (Mexico), the China Lab. for Architecture and Urban Studies of the University of Pavia (Italy), and the Environmental Futures Lab. at the College of Design and Innovation, Tongji University in Shanghai (China), under the supervision of Tiziano Cattaneo and Emanuele Giorgi. Special thanks to the colleagues who participated in this project: Arq. Pablo Hernández Quiñones, Arq. Pablo Rentería-Rodríguez, Ing. Alfredo Mauricio Flores Herrera, and Virginia del Socorro Aceves Tarango.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Appendix A presents the activities performed by the design groups along the six weeks of workshop (Figure A1).

“Mapping Paso del Norte” (week 1): based on knowledge of the area and discussion with residents, each group analyzed and mapped some characteristics of the community (colors, sharing, history, landscape, and production) with the aim of understanding its implications in the life of the colony. Based on the team’s topic (team 1—colors; team 2—landscape; team 3—shearing; team 4—history; team 5—production), the participants have to: (1) produce a thematic map of Paso del Norte; (2) relate it to “community” issues.

“Here is where we live” (week 2): the members of the community presented where they live and the public spaces where they spend their free time, what they do, what their work and skills are. So the activities consisted in mapping: (1) use of public and private space; (2) relationship with neighbors; (3) mobility and connections; (4) dreams and nightmares.

The results of these first two phases were shared among all the working groups. So, to start the proposal phase, which took the three following phases.

“Paso del Norte today” (week 3): had the purpose of providing various analyzes on the current state of the community, in order to highlight the aspects in which intervention is most needed. With reference to the contemporary situation, the participants have to prepare: (1) SWOT analysis; (2) mapping of urban phenomena; (3) mapping of the main actors; (4) analysis of community levels.

“Paso del Norte tomorrow” (week 4): consisted in considerations over the community in near, median, and far future, developed with the same analysis tool as the previous week. The aim is to highlight the most urgent aspects to intervene. With reference to an expected situation (2025, 2030, and 2050), the participants had to prepare: (1) SWOT analysis; (2) mapping of urban phenomena; (3) mapping of the main actors; (4) analysis of community levels.

“Let’s do it” (weeks 5 and 6): formal development of an intervention proposal (urban, architectural, economic, etc.). The participants must develop an intervention proposal composed of: (1) description; (2) objectives; (3) reasons; (4) methodology and actors; (5) impacts; (6) phases; (7) costs; (8) promotion.

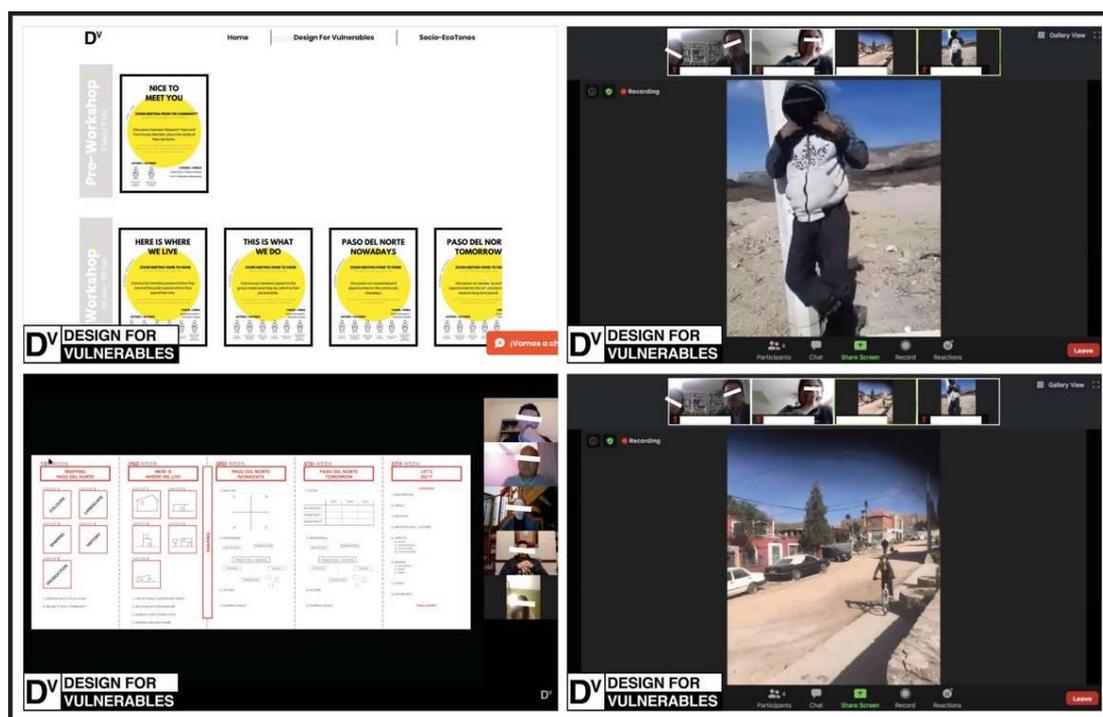


Figure A1. Real Life Web Lab activities.

Appendix B

The four round tables that were organized are presented in Appendix B and the phases of the round tables, as well as the interaction between experts—designers—community is represented in the picture (Figure A2).

The meaning of vulnerability (Thursday, 7 January 2021) served to present the main interpretations of the concept of vulnerability, under different disciplinary perspectives. At the table, mainly theoretical aspects were presented, with several demonstrations of real and application cases. Moderator: Miguel Ángel Montoya (Tecnológico de Monterrey, School of Architecture, México). Participants: Samantha Winter (Columbia University, USA); Ardeth Barnhart (Boston University, USA); Viviana Barquero (Tecnológico de Monterrey, EAAD, School of Architecture, México); Luis Fernández (Tecnológico de Monterrey, Sustainability, México); Gustavo Merino (Tecnológico de Monterrey, Escuela de Gobierno, México); Marco Morandotti (University of Pavia, Italy).

Strategies (Friday, 8 January 2021) was a moment to discuss what strategies design practice has been adopting in recent years to solve problems in vulnerable communities. Moderator: Aleksandra Krstikj (Tecnológico de Monterrey, School of Architecture, México). Participants: Ersel Kripa (Texas Tech El Paso, USA); Stephen Mueller (Texas Tech El Paso, USA); Carlos Gotlieb (ENSAP Bordeau, posgrado Rebuilding the Wolrd, France); Nivaldo Andrade (Bahia Federal University, Brazil); Giulio Verdini (Westminster University, UK); Ioanni Delsante (Huddersfield University, UK); Carlo Berizzi (University of Pavia, Italy).

Global to Local (Thursday, 14 January 2021) allowed to analyze how global problems come to impact the life and well-being of communities and people. Moderator: María Elena de la Torre (Tecnológico de Monterrey, School of Architecture, México). Participants: Simone Lucatello (Instituto Mora, México); Mariajulia Martinez (Tecnológico de Monterrey, SDGs Initiative, EGADE, México); Jeremy Cheval (École Urbaine de Lyon, France); Christiane Molina (Tecnológico de Monterrey, EGADE, México); Roberto De Lotto (University of Pavia, Italy); Andrea Marinoni (Artic University, Norway); Paolo Ceccarelli, (ILAUD, Italy); Pilar Guerreri (ILAUD, Italy).

Social Entrepreneurs (Friday, 15 January 2021) It was an occasion to present social entrepreneurship solutions in vulnerable contexts, with examples from China and Mexico.

Moderator: Pablo Hernández (Tecnológico de Monterrey, School of Architecture, México). Participants Jingyi Lu (PINWU studio, Deputy Director of Rong Design Library, China); Ni Mingqing (Directora DESIS LAB, Tongji University, China); Cindy de la Torre (Tecnológico de Monterrey, Emprendimiento, México); Alejandro Delgado (Busuleba A.C., México).

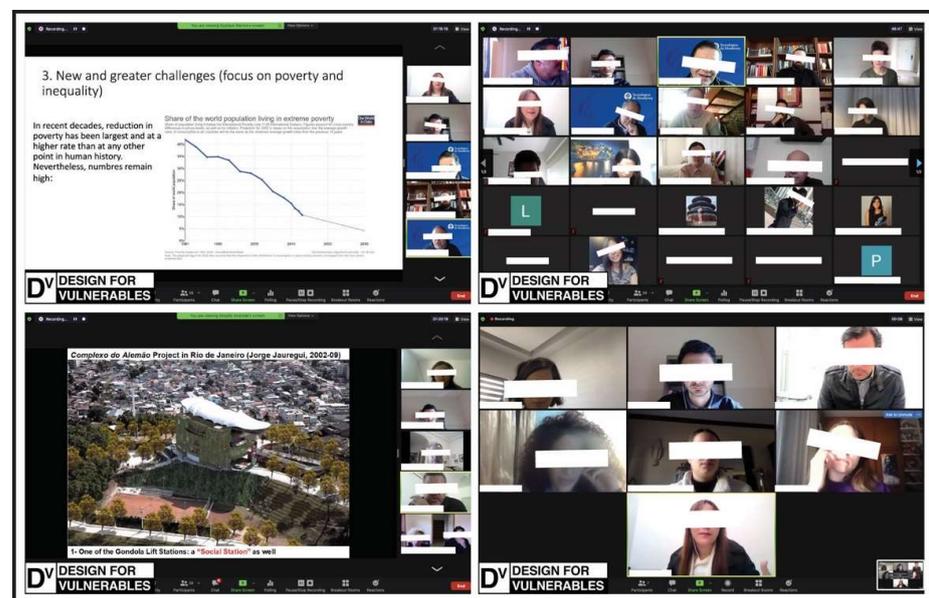


Figure A2. Interactions between experts and working groups during the experts' round tables.

Appendix C

Appendix C presents the summary of the projects elaborated by the design groups and presented to the community. In the figure, some pictures of the presentations are shown (Figure A3).

Project 1: "Networks and Nodes"

The community of Paso del Norte is undoubtedly characterized by very strong community ties stemming from a long history of residents with their community. However, environmental risks, insecurity, and pollution are causing these ties to weaken. The disintegration of these relationships also has repercussions on the community's public spaces, which are becoming less used or neglected. The main need in Paso del Norte is to recreate a sense of community that allows residents to face contemporary challenges together. To achieve this, however, it is necessary to revalue the physical spaces in which the community was formed. Therefore, the proposal focuses on the urban quality of public spaces (streets, plazas and urban fronts) trying to allow universal accessibility to the whole community, providing a strong identity.

Design Project 2: "Paso Del Norte, new generations and sense of belonging"

The proposal starts from a social observation about the importance of the youngest segment of the population: to recover a strong sense of belonging to the community that lasts for a long time, it is necessary to organize activities to involve the youngest groups of residents in the life of the community to (1) give them a sense of responsibility towards the social environment of their neighborhood, which will allow them to be more responsible towards the common good, (2) value them and make them feel that they are an important part of the community. The sense of belonging is the main aspect to work in this proposal and the strategy to achieve it is the involvement of people, starting with the youth. This involvement can be facilitated through physical interventions in the neighborhood, starting with the basic services that should be guaranteed to all neighbors, the cleaning of the filthy and polluted areas of the neighborhood and the regeneration of common spaces.

Design Project 3: “Restructuring of the neighbors’ council and community pavilion Paso del Norte”

To address the existing problems in Paso del Norte community, this proposal takes into account: (1) a restructuring in the organization of the neighbors’ council so that all residents can feel part of this structure, (2) having more responsibilities inside the life of the neighborhood to (3) increase the number of activities that take place within it. More activities and more community life in the neighborhood require more dignified and effective meeting spaces. Therefore, the organizational proposal goes hand in hand with (4) the proposal of a pavilion that can host the most important activities of the community. By strengthening the community within, the proposal also seeks (5) to implement opportunities for connection with external associations, thus ending marginalization.

Design Project 4: “Paso del Norte, Ecological Corridor”

The natural resources of the neighborhood are the opportunities to strengthen the community identity of Paso del Norte. The Sacramento River is no longer considered a barrier to the city and a segregation reason, it has become a natural element of opportunity to insert Paso del Norte into a territorial scale system. Likewise, the Nombre de Dios mountain range ceases to be the landscape background of the neighborhood and becomes part of an ecological corridor that detonates the economic development of the community, its visibility at a territorial level and the improvement of the environmental quality of the context. Re-establishing the floral and landscape “functionality” of this corridor brings the need to consolidate the physical elements of the neighborhood, particularly infrastructure and services. In addition, a community center is envisioned in the neighborhood to facilitate meetings and activities among neighbors, as well as a “center of operations” of the corridor.

Design Project 5: “Paso del Norte Route”

Considering the advantages of territorial and landscape connections of Paso del Norte towards the Sierra Nombre de Dios, this proposal indicates the development of a hiking area a possible strategy for the strengthening of the Paso del Norte community. The natural context becomes a tourist attraction that allows residents in the community to develop economic activities, starting on the main street of the neighborhood (José Fierro Street) and extending throughout the community. The eco-tourist activities, promoted by social networks and organized in the context close to the colony, are intended to become an economic spillover for the community.

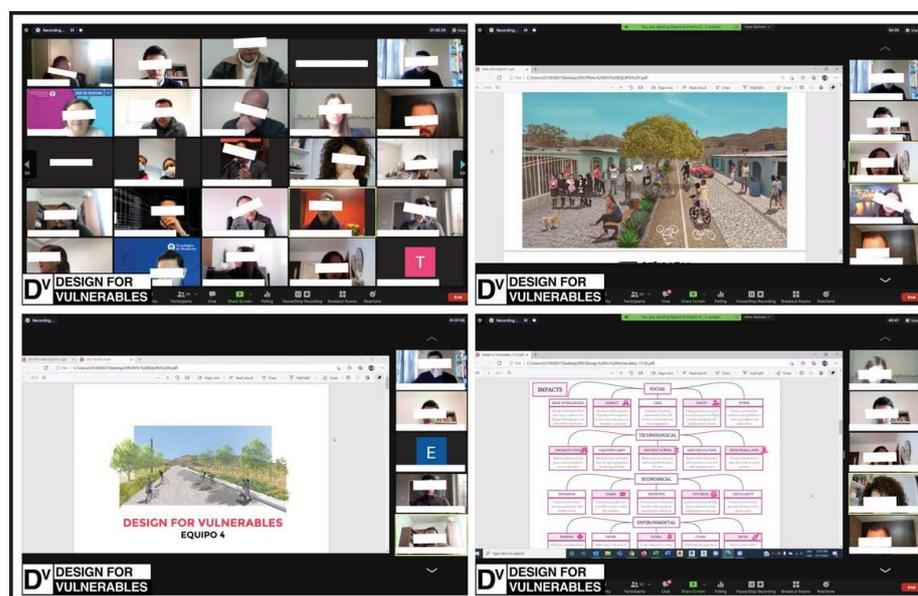


Figure A3. Design activities and presentation of the final proposals.

Appendix D

Challenges

C1—Human impact on the environment: since the potential impact of human actions increases more and more, the influence they can have on the social and environmental context is always greater. Knowing how to propose actions that limit potentially negative impacts on the environment appears, therefore, to be a challenge for interventions in vulnerable communities.

C2—Climate change and consequences: mitigation, adaptation, and resilience are the main three concepts for responding to the consequences of climate change (COP23) [88]. Knowing (1) how to choose which of these three options best suits to the intervention context and (2) which strategy is the most appropriate to the vulnerable reality, is a challenge that will become more and more relevant in the coming decades. In fact, the effect of climate change in vulnerable communities is undoubtedly a global emergency. Therefore, knowing how to consciously intervene in these situations is (and will increasingly be) a main challenge in these contexts.

C3—Health environment: The uncontrolled development during the recent decades has seriously endangered the quality of the environment in which most vulnerable communities live. Pollution, lack of basic services, and poor education are the main causes of environments with poor levels of health. Improving the environment and raising awareness on healthy quality of life represent new challenges for the society in the coming decades.

C4—Technological development: The technological capabilities, which are becoming more and more preponderating, open a panorama of unprecedented opportunities for vulnerable communities and a worrying scenario of an increased gap between the more and the less vulnerable sectors of the society. For this reason, offering interventions able to bring technology closer to vulnerable communities takes on a very important role in the community empowerment processes [89,90].

C5—Political responsibilities: Political attention to vulnerable communities is often reduced due to the low weight that these realities can assume at the electoral level. This situation, added to an increasingly scarce decision-making power represents a very significant challenge for interventions in vulnerable communities. In fact, these interventions must propose solutions capable of activating processes of political responsibility.

Understanding

U1—Human Development Index (HDI): to understand the state of vulnerability, it is proposed to use an index capable of defining the state of well-being of people and the social (as well the natural) environment where they live. The aim is to count with better tools to understand the actual needs of the community and the emergency fronts to intervene with priority. With the HDI, we refer to the dimension of a healthy life, knowledge and decent standard of living.

U2—Economic poverty: an essential dimension to understand the level of vulnerability is the economic poverty. This type of poverty, in fact, limits the resilience of communities, weakening the ability of people to cope with sudden changes which, it is assumed, will be increasingly frequent in the near future. Furthermore, understanding when a community is in situations of economic poverty allows us to understand how much it is possible to propose entrepreneurship initiatives in the context.

U3—Energy Poverty: one of the dimensions of poverty that must be assumed to understand the state of vulnerability is the energy poverty. In a world that consumes more and more energy, in fact, being able to count with the availability of reliable energy resources will be increasingly necessary. This means being able to count on a local and clean production, independent, as much as possible, from external resources.

U4—Strategic Alliances: the fact that the concept of “partnership” represents the objective that completes the list of 17 SDGs represents how strategic alliances are a key aspect for promoting community improvement initiatives and projects. This is even more true if we want to understand vulnerabilities in local communities, where strategic alliances

can make visible the invisible demands and can attract resources for the implementation of interventions.

Focusing

F1—Digitization and Remote Sensing: in the most vulnerable communities, technology does not find a fertile environment and, often, these contexts deny technological innovations. Nonetheless, count with technological tools that allow better focusing on vulnerable communities is fundamental. Digitization and remote sensing allow a better use of resources, already scarce in vulnerable communities, providing a technological apparatus that can even be used remotely.

F2—Business Awareness: to inform and to inspire about the benefits that small business activities can have for the most vulnerable people is a key piece to implement self-sustaining interventions. Moreover, the awareness on entrepreneurial possibilities is also relevant to promote initiatives that strength community relations and lead to an improvement in the livability of a community. For these reasons, focusing on the business awareness of a local community becomes a key moment before to elaborate strategies of intervention.

F3—Social inclusion: focusing on the social relationships which are active within a community, is important since a healthy community environment becomes essential when undertaking improvement processes in a vulnerable community.

F4—Urban food system: the resilience of the production, distribution, and storage food systems is key for the easy and healthy access to food. Moreover, healthy systems create job opportunities, while encouraging and promoting healthier diets and lifestyles. For these reasons, focusing on the resilience of the urban food system becomes a key moment before to elaborate strategies of intervention.

F5—Segregation and socio-spatial justice: focusing on segregation and socio-spatial justice is central since an urban system, capable of integrating with the context and offering opportunities for connection with local services and resources, becomes a fundamental principle for strategies aimed to solve the challenges in vulnerable communities.

Strategies

S1—Temporary relief and lasting solutions: urban-architectural intervention aimed at reducing the vulnerability of a community can address two main strategies. On one hand, the need to intervene with a temporary solution that is easy to implement, so to provide the solution to an emergency, without the need for it to last beyond the initial moment of the crisis. On the other hand, the need to have an intervention that can accompany the community to gradually emerge from the condition of vulnerability.

S2—Technology as instruments of citizen participation: the possible support of technology tools is considered a very relevant strategy to facilitate discussion and emancipation of the most vulnerable communities. Technological resources must not and cannot be considered extraneous to these contexts.

S3—Holistic approach: strategies to generate effective solutions must consider phenomena from different perspectives to allow problems and opportunities to be perceived from different points of view.

S4—Integration with the formal environment: reducing vulnerability in the communities passes from the possibility of interacting in an official way with the more formal (and less vulnerable) communities present in the closest context. This strategy aims of reducing the perception and the effective segregation of vulnerable communities.

S5—Heritage and residual spaces: strategies based on the possibility of regenerating existing environments with cultural or historical value, as well as residual spaces within a community, represent an opportunity to activate social initiatives and the feeling of belonging to the community, which can reduce vulnerability levels.

S6—Opportunities for entrepreneurship: creating opportunities for people to develop local entrepreneurship initiatives is an excellent strategy to reduce the levels of vulnerability in a community. Counting with an environment that offers opportunities to start

some business (albeit small), as well as spaces where to hold professional consultancy, is very important.

Based on this list of emerging topics, one of the main peculiarities of this research can be observed: challenges, understanding, focusing, and strategies highlight issues that are already addressed by the academic literature in the field of design. The peculiarity, to be underlined, here, is that these issues have never been considered together and within a process of design with vulnerable communities.

Appendix E

Project 1 “Networks and nodes”

- 1.1 The community is supposed to clean the river, which currently is a great source of contamination, and the new tourist corridor, which should bring visitors to the community.
- 1.2 Paso del Norte is currently a place with high levels of pollution due to an unconnected drainage system, which becomes a source of diseases.
- 1.3 Currently, the local government promotes a participatory fund for the decision about some public sources management. The project seeks for the government to look at the community again, paying attention to the distribution of resources.
- 1.4 In the corridor, people have the possibility to sell products made by them.
- 1.5 Interventions in the community (particularly in public spaces) will be accompanied by sustainable lighting, mainly for safety (currently there is an important lack of lighting).
- 1.6 The project aims to find an agreement with the church to create dynamics between the community and outsiders, taking advantage of the important space of the “Church House”.
- 1.7 Digital elements to control the cars’ speed and for security are supposed to be installed in the community.
- 1.8 Along the corridor there are opportunities for social interaction between different ages of the population. A lot of attention was paid to disabled people in wheelchairs.
- 1.9 Tourist corridor aims to reduce the segregation of the community and the perception of being on the other side of the city border.
- 1.10 There will be a corridor with green elements, where people will have the opportunity to sell products, assuming that the sale will increase over the years. Beyond this, the path could be connected in the future, with what is behind the “Peaks of the moon”.
- 1.11 Publicize the community through the community’s online presence (social media).
- 1.12 Various activities are expected to occur in the community (dance, sports, etc.). This will be bringing several experts to carry them out (professors, teachers, governments, civil society, etc.).
- 1.13 Integration internally to the neighborhood (through visually in the houses/facades) and externally with the city (through intervention of the river and corridor).
- 1.14 Currently there are spaces used but neglected: the baseball field is arranged to have guests from outside (tournaments, championships, etc.), the streets need interventions to reduce the speed of vehicles, and in the creeks, intervention are needed to “facilitate” the walking access to the community.
- 1.15 The corridor is considered as an opportunity for tourism, promoting hiking, the use of bicycles, connecting the community from outside.

Project 2 “Sense of belonging”

- 2.1 Through targeted activities (garbage collection, walking school bus, post-school at La Casa de la Iglesia), kids and adolescents learn how to become more responsible and to respect the place where they live.
- 2.2 Miss Heidi and the Church’s priest explained that young boys and girls need to be involved and valued. Hence, the starting point of the process sees the young generation of Paso del Norte as the main protagonist. In particular, the river can represent a resource for the Community of PDN but is polluted, thus its reclamation is extremely required.

- 2.3 The improvement of basic knowledge for everyone aims at supporting and consolidating the development of the values of sharing and mutual help in the face of a common feeling of individualism. The intention is to try to change the negative aspects of individualism and lack of sharing that are widespread in the community and to push away unhealthy temptations (drugs, alcoholism, no safety) which also reflects the bad organization of the community.
- 2.4 Environmental conditions can be improved by investing in the development of new green areas which can be transformed into Community Gardens.
- 2.5 To ensure a better organization on the social, political, and administrative level the project should be supported by the municipality and other social actors.
- 2.6 Citizens need to build a constructive dialogue with the municipality.
- 2.7 A PDN Board is fundamental to carry on the strategy in the long-term. It will be composed by the new generation and its role will be to realize the Community's will.
- 2.8 The role of women living in PDN has to be understood and enhanced at a social level.
- 2.9 Understanding the existing community's resources availability would have positive impacts for the general environment.
- 2.10 The process starts with kids and adolescents of the community who have the chance to improve their basic knowledge and abilities, this action affects adults who will be themselves involved in new activities.
- 2.11 A program of auto-construction through local material extraction is proposed to support economy and understand the land's value.
- 2.12 A specific Technical Group will deal with the urban quality of PDN.
- 2.13 Focusing on existing public spaces to organize a new area dedicated to a Local Market.
- 2.14 Focusing on the younger generations and getting rid of selfish behaviors.
- 2.15 The promotion of young people acts on the one hand on the effective improvement of the conditions of PDN, and on the other hand, inspire new feelings of responsibility and care that can evolve in the young and consequently transmitted to the older one through a bottom-up process. The discussion and exchanging of experiences help individuals to eliminate barriers and activate team-building processes.
- 2.16 The relationship between younger and adults is weak and needs attention. An important target is to change the diffused feeling among teenagers of not being important enough to be taken care of and valued.
- 2.17 Focusing on the change of perception from mere stay in a place to the feeling of belonging to that place and its importance.
- 2.18 Currently, streets represent a physical and social barrier by not being regularly maintained and leaving dirty. It is important focusing on this element in order to positively change flows in PDN.
- 2.19 The new proposed activities are oriented on taking on responsibility, taking care of the environment and each other. These activities will have a monetary retribution in order to catch interest and engagement. Establishing a circular process of exchange of both material and immaterial values aims at improving the economic aspect of residents' life.
- 2.20 Involving people in new gradual activities related to the social, political, economic, and environmental sphere is essential for establishing a new mentality that can reach the common good.
- 2.21 Recognition of all categories of people, their integration in the society, and respect to boundaries and needs.
- 2.22 The existing public spaces in PDN constitute a valid resource to activate social engagement.
- 2.23 Create a system of financial incentive when people do something for collectivity. The baseball field, the basketball court, and the playground have to be valued and exploited both in terms of human and physical capital: they constitute opportunities from an economic circular point of view, thus generating further benefits for the people in PDN.

Project 3 “Community management”

- 3.1 The project aims that the community could take control of the garbage management in the neighborhood.
- 3.2 Low quality of hygienic infrastructures, can cause health problems.
- 3.3 Technology is considered as a means of training the community (know how to use computers and data).
- 3.4 The local government is perceived as the main partner to attract actors to participate in the work.
- 3.5 Indexes (NUE by INEGI) is used to understand levels of schooling and income, as well as the characteristics of the dwellings.
- 3.6 The project aims to contribute to reducing economic poverty, through training, so to supplement the personal income.
- 3.7 The local government is perceived as the main partner to attract actors to participate in the work.
- 3.8 Training can create economic independence in the neighborhood, so as to reduce the need of daily commute far away
- 3.9 The project aims to offer spaces and activities which can integrate the newest part of the neighborhood, which today is not participating to the local social life.
- 3.10 The project aims to realize a permanent solution (hub for workshops and teaching).
- 3.11 The project is composed by various stages (at least, design, financing and construction) during which community is working in empowering processes.
- 3.12 The designers imagined the development of an app for citizen participation.
- 3.13 The residents understand that all their ideas need the vision and support of several different professionals.
- 3.14 Interventions are planned where there are public spaces (for ownership and accessibility reasons). The baseball field is defined as main intervention area.
- 3.15 The designed spaces aim to allow the development of activities for personal growth (entrepreneurship is just one of the aspects of personal growth).

Project 4 “Ecological corridor”

- 4.1 Three main goals describe the project goal: (1) focus on education of the population to improve the relationship with the natural environment to avoid negative impacts and bring positive impacts; (2) make use of nature protection (take advantage of the ecological corridor); (3) stop the destruction of the hill.
- 4.2 It is supposed that the community is going to work for the care of the environment.
- 4.3 The ecological corridor is the main mean to reach the three goals and make community take care of the environment.
- 4.4 People will be trained on how to better manage the garbage.
- 4.5 The intervention makes visible the neighborhood to the city and offers political visibility.
- 4.6 The Ecologic Corridor will offer economic opportunities to the community
- 4.7 Promotion of adobe constructions will reduce the energy consumption and the dependence of the community.
- 4.8 To empower the community about the advantage of taking care of the natural environment and about the construction of the ecological corridor, organizations need to be created.
- 4.9 The corridor will also be a promoter of small businesses, an alternative to the corridor itself.
- 4.10 A building for the corridor management training and assistance will be built in the community.
- 4.11 A project’s goal is to strengthen the identity of the colony, stop perceiving new residents as strangers and a threat.
- 4.12 The project expects to make murals with community history along the corridor.
- 4.13 Study of the materials so that it does not appear threatening.

- 4.14 MIX: short-term training of children as guides + short, medium, and long-term community work.
- 4.15 It is supposed to have teaching activities and topics to support the generation of activities in the corridor.
- 4.16 The corridor will hallow connection with the formal city and connection with the landscape.
- 4.17 Since the community is relatively “young”, it will allow to collect and to transmit local history;
- 4.18 Murals to share history and to create identity will be painted in the “urban” areas of the corridor;
- 4.19 The corridor is planned as an urban element which can generate business opportunities.

Project 5 “Tourist route”

- 5.1 The main project goal is to raise awareness in the society, about caring for the ecosystem in the area, through outdoor activities.
- 5.2 The project aims to improve the social environment and the way in which people coexist within the community.
- 5.3 Technological means are used for the promotion and enhancement of landscape and natural heritage, as well as to encourage economic activities in the area.
- 5.4 Political responsibilities are considered mainly for the regulation of non-deeded land.
- 5.5 Indexes are used as reference to give the inhabitants a better quality of life with respect to their housing, education, health, and education.
- 5.6 The project aims to improve the income of the residents by encouraging their businesses through digital media, as well as strategies to increase consumption on strategic days.
- 5.7 With the aim of improving the quality of life and reducing violence, the intervention contemplates to complete the electricity and public lighting network.
- 5.8 Interventions will also be focused on teaching local sellers how to improve their sales and optimize their resources.
- 5.9 The improvement of the baseball field aims to bring the community together and enhance the sense of belonging.
- 5.10 The connection of the community with the rest of the city will help to reach the project’s goals.
- 5.11 The proposal contemplates the development of strategies and activities over time.
- 5.12 Capacity-building of the community, so that they are able to promote and implement strategies by themselves.
- 5.13 Strategies will focus on economic, social, political, tourism, and environmental improvement.
- 5.14 The completion of the urbanized the area (services) is one of the main interventions.
- 5.15 Respect, take advantage of, and improve existing areas to coexist with the spaces that are currently in place will help to reach the project’s goals.
- 5.16 The intervention will show the inhabitants different options to develop their businesses and create their companies in an effective and lasting way.

References

1. McNeill, J.R. *The Great Acceleration an Environmental History of the Anthropocene since 1945*; Harvard University Press: Cambridge, MA, USA, 2016.
2. Batty, M. *Inventing Future Cities*; MIT Press: Cambridge, MA, USA, 2018.
3. Glaeser, E. *Triumph of the City: How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier*; Reprint Edizione; Penguin Books: New York, NY, USA, 2012.
4. Home, R.; Bauer, N. Researchers Working with City Administrations: Reflecting on Transdisciplinary Collaboration under Conditions of Shared Goals but Different Constraints. *Urban Ecosyst.* **2022**, *25*, 223–228. [[CrossRef](#)]
5. Foshag, K.; Aeschbach, N.; Höfle, B.; Winkler, R.; Siegmund, A.; Aeschbach, W. Viability of Public Spaces in Cities under Increasing Heat: A Transdisciplinary Approach. *Sustain. Cities Soc.* **2020**, *59*, 102215. [[CrossRef](#)]
6. Patel, Z.; Schneider, F.; Paulavets, K. Linking Local Projects With Global Processes: Learning From Transdisciplinary Collaborations in African Cities. *Front. Sustain. Cities* **2022**, *4*, 1–14. [[CrossRef](#)]
7. Mori, K.; Fujii, T.; Yamashita, T.; Mimura, Y.; Uchiyama, Y.; Hayashi, K. Visualization of a City Sustainability Index (CSI): Towards Transdisciplinary Approaches Involving Multiple Stakeholders. *Sustainability* **2015**, *7*, 12402–12424. [[CrossRef](#)]

8. Frantzeskaki, N.; Vandergert, P.; Connop, S.; Schipper, K.; Zwierzchowska, I.; Collier, M.; Lodder, M. Examining the Policy Needs for Implementing Nature-Based Solutions in Cities: Findings from City-Wide Transdisciplinary Experiences in Glasgow (UK), Genk (Belgium) and Poznań (Poland). *Land Use Policy* **2020**, *96*, 104688. [[CrossRef](#)]
9. Thiam, S.; Aziz, F.; Kushitor, S.B.; Amaka-Otchere, A.B.K.; Onyima, B.N.; Odume, O.N. Analyzing the Contributions of Transdisciplinary Research to the Global Sustainability Agenda in African Cities. *Sustain. Sci.* **2021**, *16*, 1923–1944. [[CrossRef](#)]
10. Gutkind, E.A. *The Expanding Environment: The End of Cities-the Rise of Communities*; Freedom Press: London, UK, 1953.
11. Jackson, T. *Prosperity without Growth: Economics for a Finite Planet*; Earthscan: London, UK; New York, NY, USA, 2009.
12. Giorgi, E.; Cattaneo, T.; Flores Herrera, A.M.; del Aceves Tarango, V.S. *Design for Vulnerable Communities*; The Urban Book Series; Springer: Cham, Switzerland, 2022.
13. Paul, S.K. Vulnerability Concepts and Its Application in Various Fields: A Review on Geographical Perspective. *J. Life Earth Sci.* **2013**, *8*, 63–81. [[CrossRef](#)]
14. Eakin, H.; Luers, A.L. Assessing the Vulnerability of Social-Environmental Systems. *Annu. Rev. Environ. Resour.* **2006**, *31*, 365–394. [[CrossRef](#)]
15. Wolf, S.; Hinkel, J.; Hallier, M.; Bisaro, A.; Lincke, D.; Ionescu, C.; Klein, R.J.T. Clarifying Vulnerability Definitions and Assessments Using Formalisation. *Int. J. Clim. Chang. Strateg. Manag.* **2013**, *5*, 54–70. [[CrossRef](#)]
16. Huq, E.; Shoeb, A.Z.M.; Hossain, M.A.; Fahad, S.; Kamruzzaman, M.M.; Javed, A.; Saleem, N.; Adnan, K.M.M.; Sarker, S.A.; Ali, M.Y.; et al. Measuring Vulnerability to Environmental Hazards: Qualitative to Quantitative. In *Environment, Climate, Plant and Vegetation Growth*; Fahad, S., Hasanuzzaman, M., Alam, M., Ullah, H., Saed, M., Ali Khan, I., Adnan, M., Eds.; Springer International Publishing: Cham, Switzerland, 2020; pp. 421–452. [[CrossRef](#)]
17. Adger, W.N. Vulnerability. *Glob. Environ. Chang.* **2006**, *16*, 268–281. [[CrossRef](#)]
18. Cattaneo, T.; Giorgi, E.; Herrera, A.M.F.; del Socorro Aceves Tarango, V. Introduction on Design for Vulnerable Communities. In *Design for Vulnerable Communities*; Giorgi, E., Cattaneo, T., Flores Herrera, A.M., del Aceves Tarango, V.S., Eds.; The Urban Book Series; Springer International Publishing: Cham, Switzerland, 2022; pp. 1–17. [[CrossRef](#)]
19. Salas, J.; Yepes, V. Urban Vulnerability Assessment: Advances from the Strategic Planning Outlook. *J. Clean. Prod.* **2018**, *179*, 544–558. [[CrossRef](#)]
20. Anurudran, A.; Yared, L.; Comrie, C.; Harrison, K.; Burke, T. Domestic Violence amid COVID-19. *Int. J. Gynecol. Obstet.* **2020**, *150*, 255–256. [[CrossRef](#)]
21. Giorgi, E.; Martín López, L.; Garnica-Monroy, R.; Krstikj, A.; Cobreros, C.; Montoya, M.A. Co-Housing Response to Social Isolation of COVID-19 Outbreak, with a Focus on Gender Implications. *Sustainability* **2021**, *13*, 7203. [[CrossRef](#)]
22. Aven, T. On Some Recent Definitions and Analysis Frameworks for Risk, Vulnerability, and Resilience. *Risk Anal.* **2011**, *31*, 515–522. [[CrossRef](#)]
23. Polsky, C.; Eakin, H. Global Change Vulnerability Assessments: Definitions, Challenges, and Opportunities. In *The Oxford Handbook of Climate Change and Society*; Oxford University Press: Oxford, UK, 2012. [[CrossRef](#)]
24. Warburton, D. (Ed.) *Community and Sustainable Development: Participation in the Future*; Routledge: London, UK, 2013. [[CrossRef](#)]
25. Ugwu, A.N.; Aruma, E.O. Community participation as a tool for the promotion of sustainable community development. *Int. J. Community Coop. Stud.* **2019**, *7*, 1–10.
26. Santhanam, M.L. Community Participation for Sustainable Development. *Indian J. Public Adm.* **1993**, *39*, 413–423. [[CrossRef](#)]
27. Gutiérrez, K.D. 2011 AERA Presidential Address: Designing Resilient Ecologies: Social Design Experiments and a New Social Imagination. *Educ. Res.* **2016**, *45*, 187–196. [[CrossRef](#)]
28. Hagen, J.J. Queering Women, Peace and Security. *Int. Aff.* **2016**, *92*, 313–332. [[CrossRef](#)]
29. Oreni, D.; Brumana, R.; Torre, S.D.; Banfi, F. Survey, HBIM and Conservation Plan of a Monumental Building Damaged by Earthquake. *Int. Arch. Photogramm. Remote Sens. Spat. Inf. Sci.* **2017**, *42*, 337–342. [[CrossRef](#)]
30. Newman, G.; Shi, T.; Yao, Z.; Li, D.; Sansom, G.; Kirsch, K.; Casillas, G.; Horney, J. Citizen Science-Informed Community Master Planning: Land Use and Built Environment Changes to Increase Flood Resilience and Decrease Contaminant Exposure. *Int. J. Environ. Res. Public Health* **2020**, *17*, 486. [[CrossRef](#)] [[PubMed](#)]
31. van Lier, J.R.; Harasti, D.; Laird, R.; Noble, M.M.; Fulton, C.J. Importance of Soft Canopy Structure for Labrid Fish Communities in Estuarine Mesohabitats. *Mar. Biol.* **2017**, *164*, 5. [[CrossRef](#)]
32. Driver, A.; Mehdizadeh, C.; Bara-Garcia, S.; Bodenreider, C.; Lewis, J.; Wilson, S. Utilization of the Maryland Environmental Justice Screening Tool: A Bladensburg, Maryland Case Study. *Int. J. Environ. Res. Public Health* **2019**, *16*, 348. [[CrossRef](#)]
33. Fischer, H.W. Policy Innovations for Pro-Poor Climate Support: Social Protection, Small-Scale Infrastructure, and Active Citizenship under India's MGNREGA. *Clim. Dev.* **2020**, *12*, 689–702. [[CrossRef](#)]
34. Núñez Collado, J.R.; Wang, H.-H. Slum Upgrading and Climate Change Adaptation and Mitigation: Lessons from Latin America. *Cities* **2020**, *104*, 102791. [[CrossRef](#)]
35. Lebel, L.; Salamanca, A.; Kallayanamitra, C. The Governance of Adaptation Financing: Pursuing Legitimacy at Multiple Levels. *Int. J. Glob. Warm.* **2017**, *11*, 226–245. [[CrossRef](#)]
36. File, D.J.M.; Derbile, E.K. Sunshine, Temperature and Wind: Community Risk Assessment of Climate Change, Indigenous Knowledge and Climate Change Adaptation Planning in Ghana. *Int. J. Clim. Chang. Strateg. Manag.* **2020**, *12*, 22–38. [[CrossRef](#)]

37. Merino, G. Poverty and Design, an Economics and Policy Perspective. In *Design for Vulnerable Communities*; Giorgi, E., Cattaneo, T., Flores Herrera, A.M., del Aceves Tarango, V.S., Eds.; The Urban Book Series; Springer International Publishing: Cham, Switzerland, 2022; pp. 45–64. [[CrossRef](#)]
38. Harari, Y.N. *Sapiens: A Brief History of Humankind*; Harper: New York, NY, USA, 2015.
39. Marcu, A.; Vangenechten, D.; Org, I. Managing a Sustainable Transition to a Low-Carbon Society: The Socio-Economic Impacts of Mitigation Policies. *Geneva Int. Cent. Trade Sustain. Dev.* **2018**, *12*, 1.
40. Lucatello, S. Climate Resilient Development Pathways in the US-Mexico Border Region: The Case of the El Paso Del Norte Metropolitan Area. In *Design for Vulnerable Communities*; Giorgi, E., Cattaneo, T., Flores Herrera, A.M., del Aceves Tarango, V.S., Eds.; The Urban Book Series; Springer International Publishing: Cham, Switzerland, 2022; pp. 361–375. [[CrossRef](#)]
41. Markkanen, S.; Anger-Kraavi, A. Social Impacts of Climate Change Mitigation Policies and Their Implications for Inequality. *Clim. Policy* **2019**, *19*, 827–844. [[CrossRef](#)]
42. Petrini, M.A.; Rocha, J.V.; Brown, J.C. Mismatches between Mill-Cultivated Sugarcane and Smallholding Farming in Brazil: Environmental and Socioeconomic Impacts. *J. Rural Stud.* **2017**, *50*, 218–227. [[CrossRef](#)]
43. Hallegatte, S.; Rozenberg, J. Climate Change through a Poverty Lens. *Nat. Clim. Chang.* **2017**, *7*, 250–256. [[CrossRef](#)]
44. Climate Change and Health. Available online: <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health> (accessed on 1 May 2022).
45. Frumkin, H.; Hess, J.; Luber, G.; Malilay, J.; McGeehin, M. Climate Change: The Public Health Response. *Am. J. Public Health* **2008**, *98*, 435–445. [[CrossRef](#)] [[PubMed](#)]
46. McMichael, C.; Barnett, J.; McMichael, A.J. An Ill Wind? *Climate Change, Migration, and Health. Environ. Health Perspect.* **2012**, *120*, 646–654. [[CrossRef](#)] [[PubMed](#)]
47. von Uexkull, N.; Buhaug, H. Security Implications of Climate Change: A Decade of Scientific Progress. *J. Peace Res.* **2021**, *58*, 3–17. [[CrossRef](#)]
48. Grewal, D.; Hulland, J.; Kopalle, P.K.; Karahanna, E. The Future of Technology and Marketing: A Multidisciplinary Perspective. *J. Acad. Mark. Sci.* **2020**, *48*, 1–8. [[CrossRef](#)]
49. Agarwal, R.; Dugas, M.; Gao, G.; Kannan, P.K. Emerging Technologies and Analytics for a New Era of Value-Centered Marketing in Healthcare. *J. Acad. Mark. Sci.* **2020**, *48*, 9–23. [[CrossRef](#)]
50. Molina, C. Towards Conscious Design and Urban Planning: Inspiration from Consciousness in Business. In *Design for Vulnerable Communities*; Giorgi, E., Cattaneo, T., Flores Herrera, A.M., del Aceves Tarango, V.S., Eds.; The Urban Book Series; Springer International Publishing: Cham, Switzerland, 2022; pp. 103–115. [[CrossRef](#)]
51. Zhu, X.; Leuba dit Galland, P. Thinking in Systems: Sustainability Cognition for Design Communities. In *Design for Vulnerable Communities*; Giorgi, E., Cattaneo, T., Flores Herrera, A.M., del Aceves Tarango, V.S., Eds.; The Urban Book Series; Springer International Publishing: Cham, Switzerland, 2022; pp. 91–102. [[CrossRef](#)]
52. Malcolm, A. Thinking Socially: Anthropological Approaches to Contemporary Research. In *Design for Vulnerable Communities*; Giorgi, E., Cattaneo, T., Flores Herrera, A.M., del Aceves Tarango, V.S., Eds.; The Urban Book Series; Springer International Publishing: Cham, Switzerland, 2022; pp. 83–90. [[CrossRef](#)]
53. Ignaccolo, C.; Zhai, Y. Urban Form and Social Vulnerability in Shanghai: A Comparative Study of Hongkou District Before and After the 1990s Urban Renewal. In *Design for Vulnerable Communities*; Giorgi, E., Cattaneo, T., Flores Herrera, A.M., del Aceves Tarango, V.S., Eds.; The Urban Book Series; Springer International Publishing: Cham, Switzerland, 2022; pp. 225–243. [[CrossRef](#)]
54. Verdini, G.; Dean, C. Climate Urbanism in the Post-Pandemic World: Mapping Vulnerabilities and Exploring Community Activism in East London. In *Design for Vulnerable Communities*; Giorgi, E., Cattaneo, T., Flores Herrera, A.M., del Aceves Tarango, V.S., Eds.; The Urban Book Series; Springer International Publishing: Cham, Switzerland, 2022; pp. 245–262. [[CrossRef](#)]
55. Ni, M. Digital Participation for Inclusive Growth: A Case Study of Singapore’s Collaborative Digital Governance Model. In *Design for Vulnerable Communities*; Giorgi, E., Cattaneo, T., Flores Herrera, A.M., del Aceves Tarango, V.S., Eds.; The Urban Book Series; Springer International Publishing: Cham, Switzerland, 2022; pp. 323–337. [[CrossRef](#)]
56. Diaz-Barriga, V.B.; Barnhart, A. Sustainable Energy Through Design: An Approach to Alleviate Energy Poverty in Vulnerable Communities on the US–Mexico Border Region. In *Design for Vulnerable Communities*; Giorgi, E., Cattaneo, T., Flores Herrera, A.M., del Aceves Tarango, V.S., Eds.; The Urban Book Series; Springer International Publishing: Cham, Switzerland, 2022; pp. 423–448. [[CrossRef](#)]
57. Krstikj, A.; Lukoseviciute, G.; Boyes, C.; Contreras Ruiz Esparza, M.G. Nutritious Landscapes: The Food Environments in the Metropolitan Peripheries of Mexico. In *Design for Vulnerable Communities*; Giorgi, E., Cattaneo, T., Flores Herrera, A.M., del Aceves Tarango, V.S., Eds.; The Urban Book Series; Springer International Publishing: Cham, Switzerland, 2022; pp. 377–394. [[CrossRef](#)]
58. Maya, M.; Cobreros, C.; Ontiveros, E.; Biondi, S. Community collaboration for product design (co-co design): An academic alternative for social innovation. In *DS 95: Proceedings of the 21st International Conference on Engineering and Product Design Education (E&PDE 2019), University of Strathclyde, Glasgow, UK, 12–13 September 2019*; University of Strathclyde: Glasgow, UK, 2019. [[CrossRef](#)]
59. Treviño Sherk, J.; Cobreros Rodriguez, C. Rural democratic design: Participatory design and service learning strategies in sustainable development to promote civic mindedness in community development. In *DS 95: Proceedings of the 21st International Conference on Engineering and Product Design Education (E&PDE 2019), University of Strathclyde, Glasgow, UK, 12–13 September 2019*; University of Strathclyde: Glasgow, UK, 2019. [[CrossRef](#)]

60. Papanek, V. *Design for the Real World: Human Ecology and Social Change*; Bantam Books: New York, NY, USA, 1973.
61. Besselaar, P.V.D.; Heimeriks, G. Disciplinary, Multidisciplinary, Interdisciplinary: Concepts and Indicators. In Proceedings of the 8th conference on Scientometrics and Informetrics—ISSI2001, Sydney, Australia, 16–20 July 2001; Davis, M., Wilson, C.S., Eds.; UNSW: Sydney, Australia, 2001; pp. 705–716.
62. Thompson Klein, J. *Interdisciplinarity. History, Theory and Practice*; Wayne State University Press: Detroit, MI, USA, 1991.
63. Choi, B.C.K.; Pak, A.W.P. Multidisciplinarity, Interdisciplinarity and Transdisciplinarity in Health Research, Services, Education and Policy: 1. Definitions, Objectives, and Evidence of Effectiveness. *Clin. Investig. Med.* **2006**, *29*, 351–364.
64. Cattaneo, T.; Giorgi, E.; Ni, M. Landscape, Architecture and Environmental Regeneration: A Research by Design Approach for Inclusive Tourism in a Rural Village in China. *Sustainability* **2019**, *11*, 128. [[CrossRef](#)]
65. Van Ouwerkerk, M.; Rosemann, J. *Research by Design: International Conference Faculty of Architecture Delft University of Technology in Co-Operation with the EAAE/AEEA 1–3 November 2000: Proceedings A*; Delft University Press: Delft, The Netherlands, 2001.
66. Hauberg, J. *Research by Design—A Research Strategy*; AE Revista Lusófona de Arquitectura e Educaçao: Lisboa, Portugal, 2011; pp. 46–56.
67. Roggema, R. Research by Design: Proposition for a Methodological Approach. *Urban Sci.* **2017**, *1*, 2. [[CrossRef](#)]
68. Nassauer, J.I.; Opdam, P. Design in Science: Extending the Landscape Ecology Paradigm. *Landsc. Ecol.* **2008**, *23*, 633–644. [[CrossRef](#)]
69. Schoonderbeek, M. A Theory of “Design by Research”; Mapping Experimentation in Architecture and Architectural Design. *Ardeth Mag. Power Proj.* **2017**, *1*, 63–79. [[CrossRef](#)]
70. Design for Vulnerables. Designforvulnerables. Available online: <https://www.designforvulnerables.com/> (accessed on 25 April 2022).
71. Chihuahua: Economía, Empleo, Equidad, Calidad de Vida, Educación, Salud Y Seguridad Pública. Data México. Available online: <https://datamexico.org/es/profile/geo/chihuahua-ch> (accessed on 28 June 2022).
72. Paso Del Norte | Design for Vulnerables. Designforvulnerables. Available online: <https://www.designforvulnerables.com/paso-del-norte> (accessed on 28 June 2022).
73. Verbeke, J. This Is Research by Design. In *Design Research in Architecture*; Fraser, M., Ed.; Ashgate: Farnham, UK, 2013; pp. 137–159.
74. Aish, R. Human Computer Interaction Systems and Educational Strategies to Support Design Participation. In *aae2016 International Peer-Reviewed Conference on “Research Based Education”*; UCL Publisher: London, UK, 2016; p. 468.
75. Vines, J.; McNaney, R.; Clarke, R.; Lindsay, S.; McCarthy, J.; Howard, S.; Romero, M.; Wallace, J. Designing For- and with-Vulnerable People. In *CHI ’13 Extended Abstracts on Human Factors in Computing Systems on—CHI EA ’13*; ACM Press: Paris, France, 2013; p. 3231. [[CrossRef](#)]
76. “Intuition Must Be Grounded to the Site And Context”: In Conversation with Oscar Ko of Interval Architects. Available online: <https://www.archdaily.com/914833/intuition-must-be-grounded-to-the-site-and-context-in-conversation-with-oscar-ko-of-interval-architects> (accessed on 27 June 2022).
77. Cole, R.J. Transitioning from Green to Regenerative Design. *Build. Res. Inf.* **2012**, *40*, 39–53. [[CrossRef](#)]
78. Zhang, X.; Skitmore, M.; De Jong, M.; Huisinigh, D.; Gray, M. Regenerative Sustainability for the Built Environment—from Vision to Reality: An Introductory Chapter. *J. Clean. Prod.* **2015**, *109*, 1–10. [[CrossRef](#)]
79. Sianipar, C.P.M.; Dowaki, K.; Yudoko, G. Technological Solution for Vulnerable Communities: How Does Its Approach Matter? *IOP Conf. Ser. Mater. Sci. Eng.* **2014**, *58*, 012022. [[CrossRef](#)]
80. Leśniak, A.; Górka, M.; Skrzypczak, I. Barriers to BIM Implementation in Architecture, Construction, and Engineering Projects—The Polish Study. *Energies* **2021**, *14*, 2090. [[CrossRef](#)]
81. Chan, D.W.M.; Olawumi, T.O.; Ho, A.M.L. Perceived Benefits of and Barriers to Building Information Modelling (BIM) Implementation in Construction: The Case of Hong Kong. *J. Build. Eng.* **2019**, *25*, 100764. [[CrossRef](#)]
82. Oke, A.E.; Arowoija, V.A. Critical Barriers to Augmented Reality Technology Adoption in Developing Countries: A Case Study of Nigeria. *J. Eng. Des. Technol.* **2021**, *20*, 1320–1333. [[CrossRef](#)]
83. Oxman, N. Age of Entanglement. *J. Des. Sci.* **2016**. [[CrossRef](#)]
84. Friedman, K. Theory Construction in Design Research: Criteria: Approaches, and Methods. *Des. Stud.* **2003**, *24*, 507–522. [[CrossRef](#)]
85. Megahed, Y. On Research by Design. *ARQ Archit. Res. Q.* **2017**, *21*, 338–343. [[CrossRef](#)]
86. Salas, J.; Yepes, V. MS-ReRO and D-ROSE Methods: Assessing Relational Uncertainty and Evaluating Scenarios’ Risks and Opportunities on Multi-Scale Infrastructure Systems. *J. Clean. Prod.* **2019**, *216*, 607–623. [[CrossRef](#)]
87. Hall, J.; Keller, R.; Hackbarth, A.; Mijere, C.; McInerney, D. Robust Climate Policies Under Uncertainty: A Comparison of Robust Decision Making and Info-Gap Methods. *Risk Anal.* **2012**, *32*, 1657–1672. [[CrossRef](#)] [[PubMed](#)]
88. COP23: Conferencia de la ONU Sobre El Cambio Climático de 2017. Available online: <https://www.un.org/sustainabledevelopment/es/cop23-conferencia-de-la-onu-sobre-el-cambio-climatico-de-2017/> (accessed on 15 August 2022).

89. Giorgi, E. How Technology Devices Can Help or Harm Vulnerable Communities in Technocene. Issues for Designers, Architects, and Policy Makers. In *Design for Vulnerable Communities*; Giorgi, E., Cattaneo, T., Flores Herrera, A.M., del Aceves Tarango, V.S., Eds.; The Urban Book Series; Springer International Publishing: Cham, Switzerland, 2022; pp. 21–43. [[CrossRef](#)]
90. de Cote, E.P.M.L.M.; Flores Herrera, A.M.; Giorgi, E.; Cattaneo, T. Augmented Reality (AR) and Virtual Reality (VR) as Tools to Empower Vulnerable Communities: Opportunities and Challenges for Designers. In *Design for Vulnerable Communities*; Giorgi, E., Cattaneo, T., Flores Herrera, A.M., del Aceves Tarango, V.S., Eds.; The Urban Book Series; Springer International Publishing: Cham, Switzerland, 2022; pp. 307–321. [[CrossRef](#)]