

Article

Assessment of the Climate Environmental Vulnerability Index for Urban Settlements on the Mediterranean Coast: A Case Study in Sicily

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Abstract: Climate change poses a severe environmental crisis where many European urban centers face increased risks, among others, of flooding and/or water scarcity due to intense rainfall and prolonged droughts. Urgent adaptation measures are required to enhance resilience in urban, peri-urban, and agricultural areas against extreme weather events. This article describes a method for categorizing urban areas based on climate-related risks as a targeting and prioritization system for allocating climate resilience measures in cities. The method allows for calculating a climate vulnerability index value, considering temperature, precipitation, wind patterns, population density, altitude, and urban area. Focused on the Mediterranean region, particularly Sicily, the index application generates quantifiable vulnerability values for urban settlements, enabling comparison and prioritization. The reproducible and scalable method provides a valuable tool for urban analysis beyond the Mediterranean and can facilitate decision-making processes to initiate future studies and projects.

Keywords: climate change; climate vulnerability index; urban settlements; Mediterranean area; resilience



Citation: Massimino, F.P.; Castanho, R.A.; Gómez, I.; Rincón, V.; Velázquez, J. Assessment of the Climate Environmental Vulnerability Index for Urban Settlements on the Mediterranean Coast: A Case Study in Sicily. *Urban Sci.* **2024**, *8*, 130. <https://doi.org/10.3390/urbansci8030130>

Academic Editor: Xiang Zhao

Received: 8 July 2024

Revised: 20 August 2024

Accepted: 27 August 2024

Published: 30 August 2024



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1. Introduction

The current era is defined by the term Anthropocene, which refers to the impact that human activities have had and continue to have on the Earth's balance. It can be argued that the Anthropocene era began in the late 18th century when measurements on polar glaciers revealed increasing concentrations of carbon dioxide and methane [1]. Human pressures on the environment have significantly increased, causing escalating greenhouse gas emissions; climate change is a global phenomenon that has a profound impact on urban settlements, territories, and oceans [2–6]. Mediterranean cities are vulnerable urban settlements facing multiple challenges and risks related to the effects of climate change [7]. Moreover, their fragility arises from human pressures and additional stresses due to geopolitical and economic dynamics [8]. We must aim for sustainable and resilient development capable of reducing vulnerability to various stressors acting on the territory. Climate risk assessment should be a tool to provide screening and potentially establish priority interests among all possible criticalities related to ongoing climatic impacts [9].

Some studies have dealt with climate change and have defined it as “the effects of extreme weather and climate events and climate change on natural and human systems” [10], generally referring to the effects on people, livelihoods, health, ecosystems, economic, social and cultural goods and resources, services, and infrastructure due to the interaction of climate change or hazardous climate events occurring within a specific time period, with the vulnerability of a society or system exposed to climate change [11]. However, this set of indicators is very broad, and there is a need to narrow the analysis field to a more limited system of indicators.

The impacts generated by climate change can have an impact on both natural resources and buildings and infrastructure, as well as the established population [12]. Climate change and urbanization are among the most pervasive and rapidly growing threats to biodiversity worldwide [13]. Climate change (CC) and urban heat island (UHI) are two recognized risk factors linked to human impacts that can strongly influence the performance of the built environment by introducing new vulnerability characteristics [14–18]. The publication of the paper “A method for the definition of local vulnerability domains to climate changed relate mapping. Two case studies in southern Italy”. Ref. [12] aims at the quantitative definition of domains of local vulnerability to climate change and their mapping. The authors’ method is based on the definition of vulnerability as a function of the type, magnitude, and rate of climate change to which a system is exposed, its sensitivity, and its ability to adapt.

Some of the various national and international studies and methodologies used to assess local climate vulnerability [19–21] have been a valuable reference for the methodological approach presented in this paper. In particular, we consider Formulas (2) and (3) and the AHP method used in the research carried out by Francini et al. [12] to draw a starting point for the formulas used in this article.

A methodology is implemented to create a rule that, through a scale of numerical values, allows us to classify coastal urban areas according to the risks of climate impact. Using multi-criteria techniques AHP [22–24] and information from official sources, we chose climate variables that consider the characteristics of urban settlements to create an equation that allows us to calculate the climate vulnerability index.

The newly created equation relates several variables essential for describing the climate vulnerability index. It will provide a numerical value that represents the vulnerability of an urban settlement on a numerical scale. The numerical quantification of the vulnerability index will allow the subsequent classification of the areas into three bands with low, high, and medium vulnerability indexes. This classification can facilitate the decision-making process for developing management, prevention, defense, adaptation, or mitigation plans based on the climatic risk of the examined urban area [25]. The climate vulnerability index is essential for the settlements examined [26–28]. Therefore, factors such as wind, absolute maximum temperatures, precipitation, and the residential density of the urban area have been considered. These factors have been adjusted by a percentage based on regional data concerning tourist flow in Sicily. Finally, the numerical results of the urban vulnerability index and the subsequent drafting of a ranking determine which urban settlement requires more urgent intervention. This climate vulnerability index enables territorial planning to mitigate the risks associated with climate change in the Sicily region.

This extreme climate change could result in decreased tourism in the warmer months. After calculating the value of the climate vulnerability index, it will be necessary to establish the mitigation and combating climate change measures in progress, and the interventions to be adopted will be commensurate with the climate vulnerability index found [29,30]. Therefore, it is necessary for cities to adapt to this new climatic scenario [31]. This adaptation is significant in settlements whose economic engine is tourism, as in the case of cities that are considered in the present study and present a high influx of tourists [32]. This work aims to create a reproducible methodology for calculating a climate vulnerability index related to urban settlements of a specific region, and this index can be quantified through a number. Subsequently, using the index results of various urban settlements, a timetable can be drawn

up to implement projects aimed at combating and mitigating the effects of climate change referring to the urban settlements along the Mediterranean coasts. Therefore, this will allow the urban settlements of a given Sicilian region to be able to carry out interventions with the priorities related to this index and according to the provisions of the classification band in which the cities fall [33]. In urban settlements with a tourist vocation, such as Sicily, all comforts must be created for citizens and tourists so that they can enjoy the landscape and stay in open places, especially during the summer months coinciding with the period of greatest heat and climatic discomfort [34].

2. Materials and Methods

2.1. Study Area

The study area is the region of Sicily, which, as shown in Figure 1, is located in southern Italy. Sicily, formerly known as Sicania and Trinacria due to its triangular shape, is the largest island in the Mediterranean, with an area of 25,460 km². Connected to Sicily are the following surrounding islands and archipelagos: the Aeolian Islands, Ustica, the Egadi Islands, Pantelleria, and the Pelagie Islands [35,36].



Figure 1. Location of Sicily and of the ten cities analyzed.

The region is predominantly hilly (61.4% of the territory), 24.5% is mountainous, and the remaining 14.1% is flat. Sicily has a Mediterranean climate characterized by dry summers with a high risk of drought and rainy winters with mild temperatures. The sea influences the climate, which is warm temperate, with daily and annual temperature variations modestly below 21 °C, leading to hot summers and mild winters. The coastal areas of Sicily experience a subtropical climate, meeting the parameters of this climatic type: the average annual temperature on the coasts exceeds 32 °C, and the average temperature of the coldest month is around 10 °C. In contrast, the temperature of the hottest month exceeds 30 °C. Sicily is called the Island of the Sun because the heliophany recorded in its coastal areas—the annual or monthly hours of sunshine—is the highest in Europe. The two meteorological stations that have this data in Sicily, those of Trapani and Gela, record an average of 7.3 h of sunshine per day annually (equivalent to a total of 2665 h of sunshine per year).

Sicily is a popular tourist destination for its artistic and cultural heritage, influenced by the Baroque and its climate; many tourists visit yearly.

2.2. Methodology

This study used multi-criteria assessment techniques [12]. The report on the state of scientific knowledge on impacts, vulnerability, and adaptation to climate change in Italy [18] was also analyzed, which constitutes the knowledge base of the National Strategy for Adaptation to Climate Change [37,38]. The Analytic Hierarchy Process (AHP) method was used [39]. Thereby, weights were assigned to each parameter with the participation of a committee of experts. Two expert groups have been set up [24]. The first group consisted of 6 professionals in the field of construction (including architects and biologists), while the second group consisted of 6 experts who specialized in environmental studies (including graduates in environmental economics and civil engineers). The methodology for calculating the climate vulnerability index is divided into three steps (Figure 2):

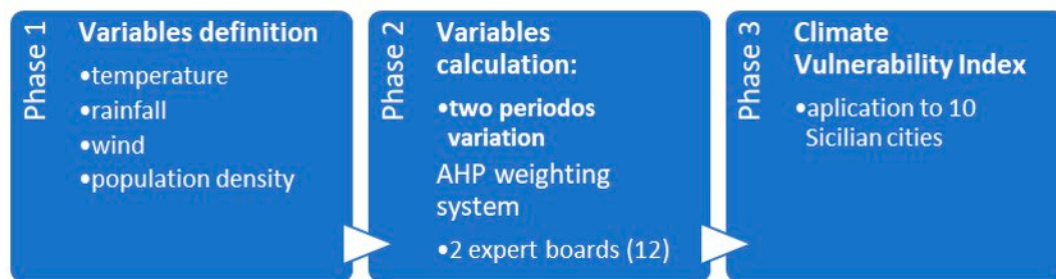


Figure 2. Phases of the methodology.

2.2.1. Phase 1—Identification of Parameters

After analyzing climatic data from the Sicily region (sourced from the SIAS REGIONE SICILIA based in Palermo, Italy) database and based on considerations from local professionals, four parameters were determined to characterize the climate vulnerability index of urban settlements in the Sicily region. The considered parameters are as follows:

- Temperature max absolute (T) [10];
- Rainfall precipitation (P) [10,12];
- Wind speed (WI) [12];
- Urban settlement density (DENS): it is one of the most influential factors for the climate vulnerability index [12].

The climate vulnerability Index for settlements in the Sicily region is indicated with Equation (1):

$$CVI = \alpha \times T + \beta \times P + \gamma \times DENS + \delta \times WI \quad (1)$$

in which α , β , γ , and δ are coefficients representing the relative importance of each parameter in contributing to the climate vulnerability index [12].

Ten urban settlements representative of the climate in the Sicily region were identified: Agrigento, Acireale, Catania, Enna, Messina, Palermo, Ragusa, Siracusa, Trapani, and Zafferana (Figure 1). These ten cities were selected considering their diverse characteristics of altitude above sea level, exposure, and population density. Furthermore, the chosen cities are distributed to face each of the seas bathing the island: the Tyrrhenian Sea to the north, the Sicilian Sea to the west and south, and the Ionian Sea to the east.

Two time frames are considered: the first period from 1965 to 1994, and subsequently the years 2022 and 2023, in order to give bigger significance to the more recent years. Meteorological data are obtained from the SIAS REGIONE SICILIA, while sociodemographic data are sourced from ISTAT [40]. The parameters under consideration—T, P, Dens, and Wi—are determined as follows:

T_i , temperature maximum absolute of city i , is the average of the maximum absolute temperatures of the two distinct time periods defined above [12], as shown in Equation (2).

$$T_i = \frac{T_{\max \text{ abs(} \text{period 1)}} + T_{\max \text{ abs(} \text{period 2)}}}{2} \quad (2)$$

Figure 3 shows the values for temperature maximum (Tmax) absolute for the 10 considered cities in the two different periods.

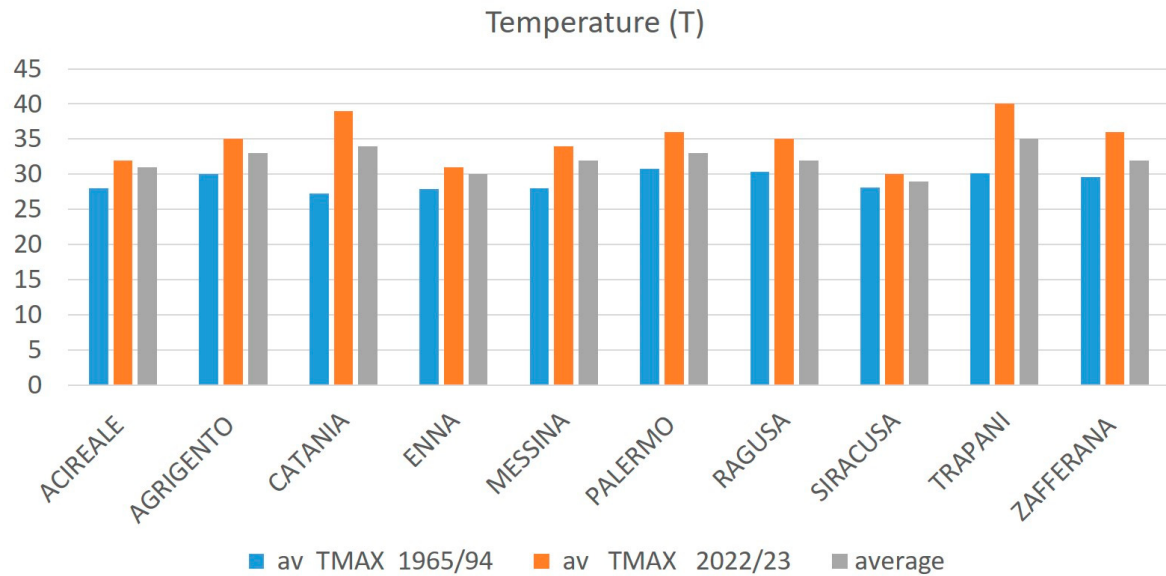


Figure 3. Values of temperature average of Tmax absolute of period 1 (1965–1994) and period 2 (2022/2023), and finally the ‘average’ between both values per city and period, with value used as temperature parameter (T).

A similar approach is followed for rainfall (Pi), calculated as the linear average of the average rainfall of the period 1 and period 2, respectively (Figure 4).

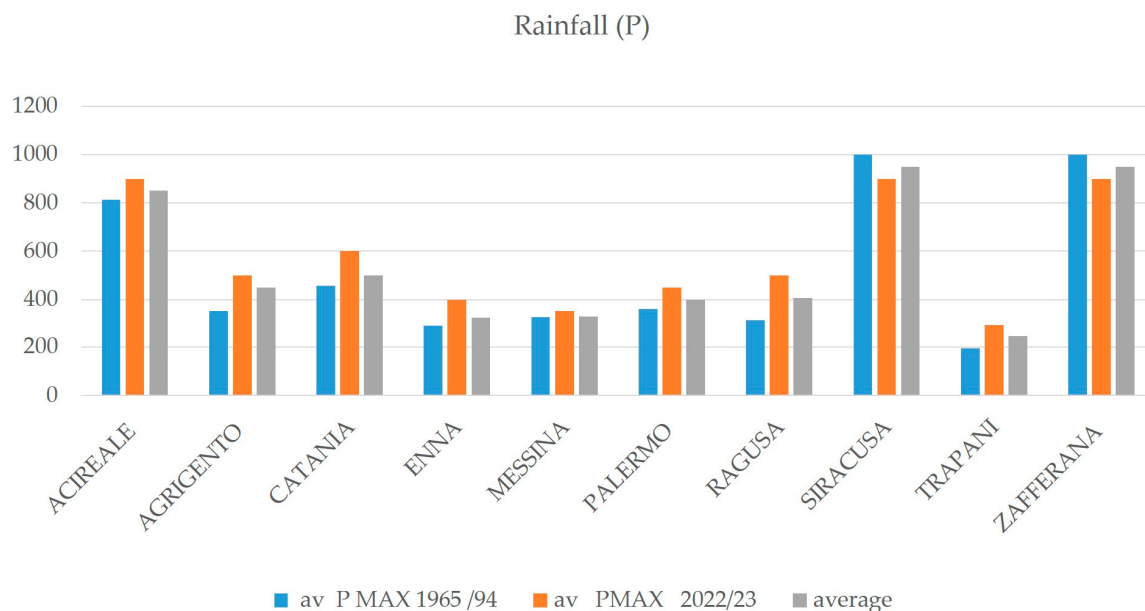


Figure 4. Rainfall values of period 1 (1965–1994) and period 2 (2022/2023), and average between both values per city and period, with value used as rainfall parameter (P).

Dens is calculated as the average population density of the 10 cities increased by 25% to reflect seasonal floating population due to tourism influx, as population data available refer only to stable resident citizens [12] (Figure 5).

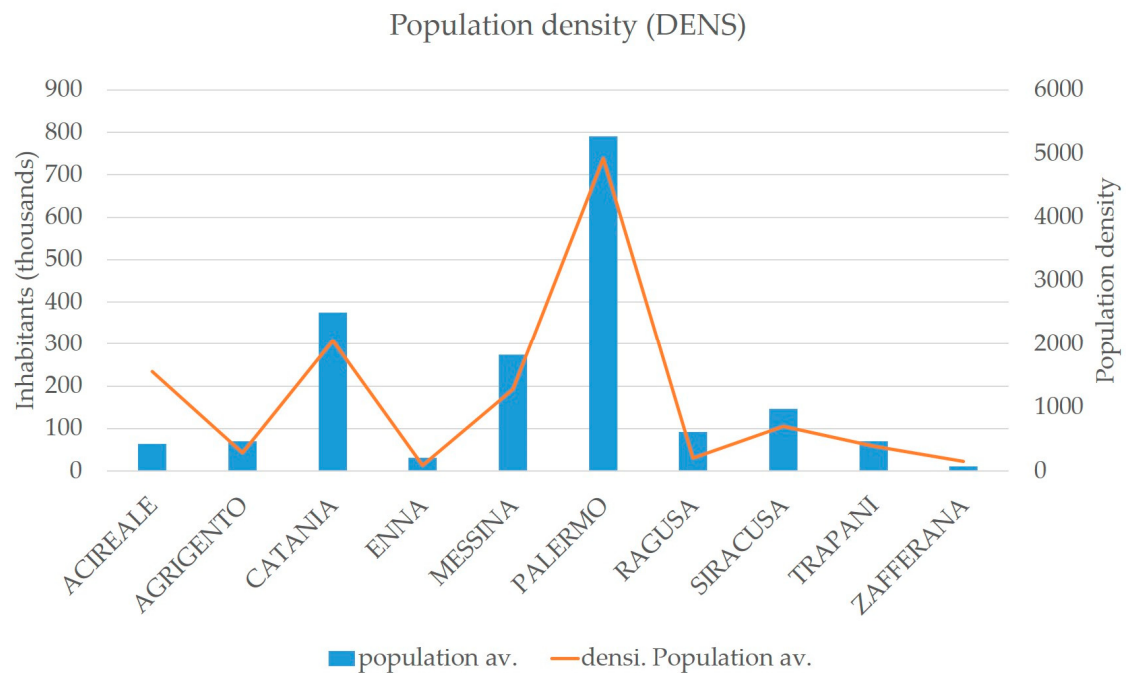


Figure 5. Population and population density (Dens) values for the ten cities.

Wi indicates the annual average wind speed, calculated as average of the respective averages of the two time periods examined [12] (Figure 6), as for *P*.

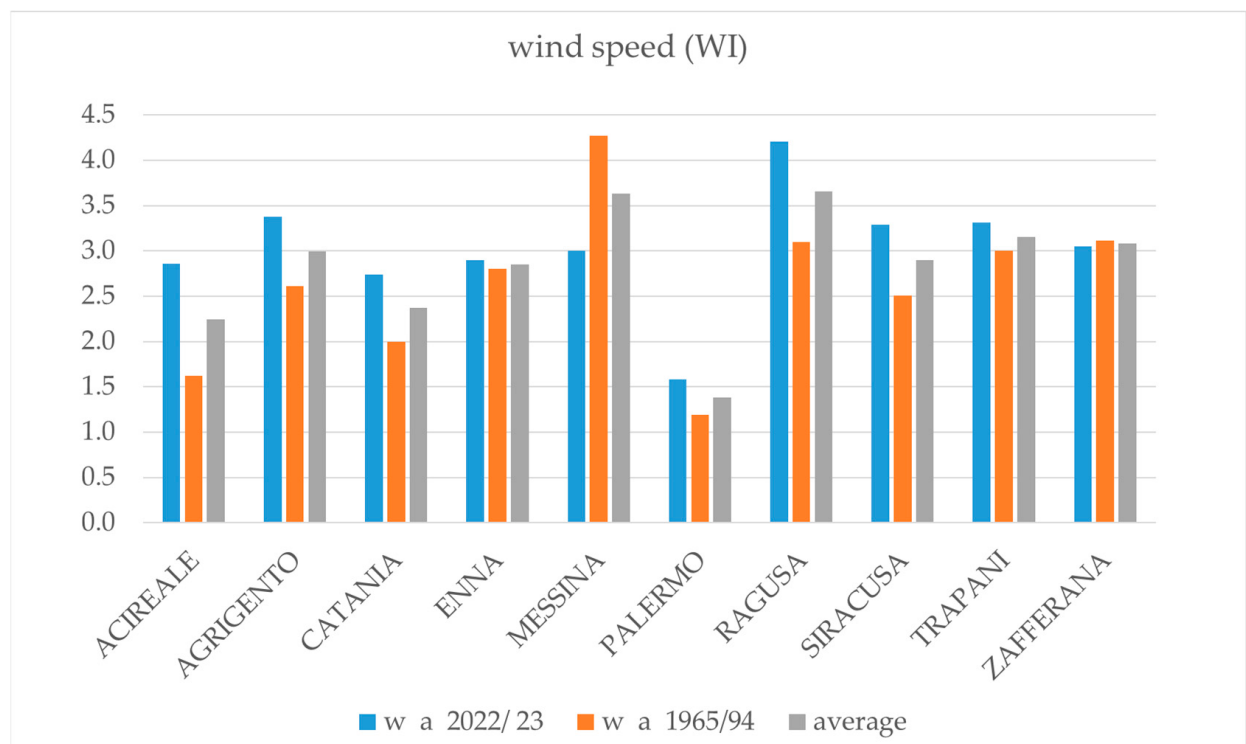


Figure 6. Average wind speed values of period 1 (1965–1994) and period 2 (2022/2023), and average between both values per city and period, with value used as wind parameter (*W*).

2.2.2. Phase 2—Calculation of Parameter Values

Once values of the temperature, precipitation, wind, and population density are calculated (Table A1), using the Analytic Hierarchy Process (AHP) method, weights based

on an expert committee were assigned to each parameter [41–44]. Two groups of experts were selected: the first comprised six professionals in the construction field (architects and biologists), and the second comprised six experts who specialized in environmental studies (graduates in environmental economics and civil engineers). These experts were surveyed to evaluate each criterion characterizing the suitability, impact, and risk models pairwise.

The Table A2 Comparison SAAT Matrix obtained is not perfectly consistent. In order to estimate the vector W , those values are normalized regarding the totals, as shown in Table A3, with the last column showing the value of the vector W .

The resulting weights are $W1 (\alpha) = 0.427$, $W2 (\beta) = 0.042$, $W3 (\gamma) = 0.358$, $W4 (\delta) = 0.175$ (see Table 1), resulting in Equation (3):

$$CVI = \alpha \times T + \beta \times P + \gamma \times DENS + \delta \times WI \quad (3)$$

Table 1. Climate vulnerability index calculation for Acireale. The tables for the other 9 cities can be consulted at Appendix A (Tables A6–A14).

Vulnerability Index Calculation			Acireale
	W vector		
	$\alpha = 0.43$	$T = 0.88$	$\alpha \times T = 0.38$
	$\beta = 0.04$	$P = 0.86$	$\beta \times P = 0.04$
	$\gamma = 0.36$	$DENS = 0.3$	$\gamma \times DENS = 0.11$
	$\delta = 0.18$	$WI = 0.56$	$\delta \times WI = 0.10$
CVI			0.62

The values of the considered variables T , P , $DENS$, and WI are reported in Tables A4 and A5 as standardized values.

3. Results

With the equation established, the vulnerability index is calculated for the examined urban settlements of ten selected cities, as shown in Table 2. Different climate vulnerability index (CVI) values are yielded. The results are also shown in Figure 7. Values vary between 0.42 and 0.98. Subsequently, the cities are classified as low, medium, or high vulnerability, as follows: 0.42–0.60 low; 0.61–0.65 medium; 0.66–0.98 high.

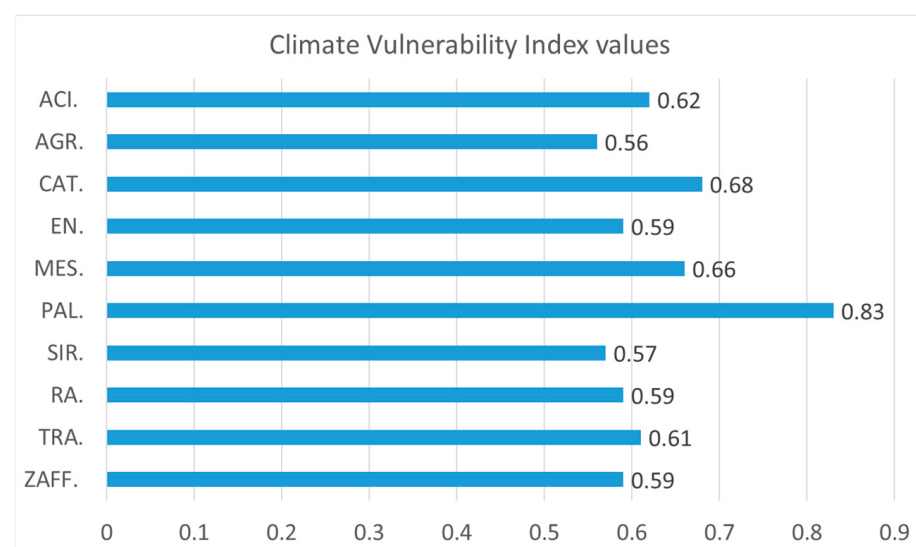


Figure 7. Climatic vulnerability index values along the 10 selected cities for the case study.

Table 2. Results of calculation of the CVI. Values of the variables for each city show the value before the application of the weight.

Vble.	W	Acir.	Agri.	Cata.	Enna	Mess.	Pal.	Sira.	Ragu.	Trap.	Zaff.
T	0.427	0.88	0.92	0.95	0.84	0.91	0.95	0.83	0.93	1.00	0.94
P	0.042	0.86	0.43	0.53	0.34	0.34	0.40	0.95	0.41	0.24	0.95
DENS	0.358	0.30	0.06	0.41	0.26	0.26	0.98	0.14	0.04	0.08	0.03
WI	0.175	0.56	0.75	0.59	0.71	0.91	0.34	0.72	0.91	0.79	0.70
CVI		0.62	0.56	0.68	0.59	0.66	0.83	0.57	0.59	0.61	0.59
Band		M	L	H	L	H	H	L	L	M	L

4. Discussion

The cities that, according to the calculations of the climate vulnerability index, have a vulnerability index above 0.60 are cities with severe climate-related issues, identified as having extremely high temperatures. For these cities with a climatic index above 0.60, urgent interventions must be planned to mitigate the effects of the climate during the summer months, with priority given to those with a CVI above 0.65; these are typically among the most critical, as we can see with the Palermo city's higher population densities, magnifying the impact and then the needs for adaptation.

The analysis reflects that there is a progressive increase in temperatures in Sicilian cities, most probably due to climate change. This phenomenon is also associated with a reduction in average rainfall (with an increase in intense rainfall of modest duration, which manifests itself as water bombs) and an increase in extreme wind episodes. Precipitation has recently decreased considerably, and Sicily is increasingly becoming a tropical island.

Sicilian cities are, therefore, facing a climate emergency due to these extreme weather conditions. High temperatures mainly affect the well-being and health of the population; the high maximum temperatures in cities determine the phenomenon known as heat islands.

The data from calculating the climate vulnerability index can serve as the basis for future designs for infrastructure and planning of urban settlements, potentially supporting regulations accounting for this vulnerability index [26,45,46]. Currently, in Italy, there is no legislation on adaptation to climate change [47,48], and, therefore, there are no specific objectives set or obligations for regions to adopt a planning tool to address this issue [49,50]. Although the National Strategy for Adaptation to Climate Change was approved in 2015, the National Plan for Adaptation to Climate Change (PNACC) was definitively approved in December 2023 to implement the National Strategy for Adaptation to Climate Change (SNAC).

If the pace of increasing greenhouse emissions is not significantly reduced, and knowing that the effects of many of those current emissions would last hundreds and even thousands of years, we can inevitably expect an increase in the climate vulnerability index, and it will be increasingly challenging to create climate adaptation plans for Mediterranean cities. At the Cityfutures 2009 Conference, organized in Milan (Italy) by the Italian Society of Architectural Technology (SITdA) and MADE Expo, topics related to the planning of urban spaces and their ability to adapt were discussed. One of the key takeaways is the role of cities as catalysts for the transformation taking place and that “the priority of cities that are adapting to change has become that of attention to the global climate condition in favor of reducing carbon emissions” [51–54]. Contextually, this can lead to increased potential climate impacts, resulting in increased vulnerability of people and cities [55–57]. For example, we will see diseases due to the increase in bacteria resulting from adapting these bacteria to climate change in urban settlements. This study provides critical information on how to influence other urban planning processes. The climate vulnerability index can be used, among other things, for infrastructure planning and territorial guidance [58,59].

In light of the climate data in the ten cities analyzed, since they all have a climate vulnerability index greater than 0.5, interventions must be carried out to counteract the effects

of high temperatures. Therefore, numerous green areas of considerable extension should be provided within Sicilian cities and around their perimeter. Strategies are needed to increase the current green space in cities, as the cities examined have a high index of construction density (available data) and little index of green areas [60,61]. Existing buildings should be transformed into elements that integrate with the natural context [62,63].

Based on many interventions carried out in other European cities to counteract the extreme effects of high temperatures, it would be necessary to provide for the flat roofs of buildings to be covered with plants that can absorb carbon dioxide emissions and reduce the temperature of urban centers [16,64–67]. The interventions carried out in the cities of Milan, ABBPR, and the multifunctional complex of Corso Buenos Aires [57,68] can be one good example. So-called “green roofs” should be designed and implemented, contributing to better rainwater management and reducing the effect of urban heat islands, as plants play a cooling role during the hot summer months due to evapotranspiration and light shadowing [69]. Green roofs are also effective against pollution [16,70–72]. Due to their insulating effect that provides additional protection against solar radiation, green roofs can also reduce the energy needed to regulate building temperatures.

In contrast, conventional roofs lose heat in winter but heat up in summer [73,74]. Emilio Ambasz, the father of green architecture, has experimented with the technical limits of combining architecture and vegetation in many projects. In the case of the Prefectural International Hall, Fukuoka, Japan, 1990, the architect dedicated the entire stepped roof entirely open to the public to the vegetal surface [75–77]. Therefore, it will be necessary to plan adequately for choosing plantings that adapt to the Mediterranean climate and have a greater capacity to absorb carbon dioxide. Vertical gardens can be envisaged to be inserted into the balconies of existing buildings [78–80]. So, to implement disaster mitigation or prevention measures, prevention plans against possible extreme temperatures must be developed in cities with a high climate vulnerability index.

5. Conclusions

Through this study, we can calculate a numerical value for the climate vulnerability index, which provides inputs for more specific assessments. Therefore, this allows us to objectively determine the climate vulnerability of cities within a given region and establish a ranking (value scale). Therefore, knowledge of the climate vulnerability index gives managers and politicians a solid basis for making decisions that balance economic and environmental objectives [81–83].

In fact, they could create a timetable using the data obtained from calculating the climate vulnerability index of Sicilian cities [61,84], thus establishing which cities’ interventions need to be carried out more urgently and, therefore, with greater priority [85,86].

Improving the perception of the risk associated with overheating allows us to plan all the measures necessary to stop climate change, halt the loss of natural ecosystems, and protect cities. It also contains the spread of emerging diseases due to new distributions of parasites due to the complex ecological relationships that link pathologies with climate change.

Therefore, if we were to make a timetable of interventions in Sicily to mitigate and counteract the risks deriving from climate change, the following sequence should be envisaged [26,82].

The city of Palermo was first, followed by Catania, Messina, Acireale, and Trapani. The climate vulnerability index can be used for emergency planning and as additional information for governments to manage [87,88].

6. Study Limitations and Prospective Research Lines

Among the limitations of this research was the difficulty of finding data for further climate-related quantities for periods longer than ten years.

Another limitation is the lack of urban planning regulations in Sicily that consider the vulnerability indices of urban settlements in cities.

Studying additional data that may influence the climate vulnerability index could provide a more comprehensive understanding of the situation in the Sicilian region. Other variables could be considered, such as the interaction between the vulnerability index and environmental pollution in urban areas. However, obtaining the necessary data and information is currently a challenge. Therefore, this study aims to serve as a starting point for further research on the climate vulnerability index and to offer a more complete picture.

Author Contributions: Conceptualization F.P.M., J.V. and I.G.; methodology, F.P.M., J.V., I.G. and V.R.; validation, R.A.C. and J.V.; formal analysis, F.P.M., J.V. and R.A.C.; investigation, F.P.M., J.V. and I.G.; data curation, V.R. and I.G.; writing—original draft preparation, F.P.M., I.G. and J.V.; writing—review and editing, F.P.M., J.V., I.G. and V.R.; visualization, R.A.C. and I.G.; supervision, J.V., I.G. and R.A.C. project administration, J.V. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The data of the current research is available from the corresponding author upon request.

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

Appendix A

This appendix includes the main tables of data used for this study.

Table A1. Climatic data used for the study.

	ACI.	AGR.	CAT.	ENN.	MES.	PAL.	RAG.	SIR.	TRA.	ZAFF.
T1 TMAX 1965/94	28.00	30.00	27.30	27.90	28.00	30.80	30.40	28.10	30.10	29.60
T2 TMAX 2022/23	32.00	35.00	39.00	31.00	34.00	36.00	35.00	30.00	40.00	36.00
AVERAGE (T1,T2)	31.00	32.50	33.15	29.45	32.00	33.4	32.72	29.05	35.05	32.80
P1 MAX 1965/94	813.00	352.00	458.00	289.00	323.00	361.00	312.00	1001.00	195.00	1001.00
P2 MAX 2022/23	900.00	500.00	600.00	400.00	350.00	450.00	500.00	900.00	290.00	900.00
P (P1,P2)	856.50	426.00	529.00	344.50	336.50	405.50	406.00	950.50	242.50	950.50
WI 1965/94	1.62	2.61	2	2.8	4.27	1.19	3.1	2.51	3	3.11
WI 2022/23	2.86	3.38	2.74	2.9	3	1.58	4.21	3.29	3.31	3.05
WI	2.24	2.995	2.37	2.85	3.635	1.385	3.655	2.9	3.155	3.08

Table A2. Comparison Saaty matrix. Phase 2 experts.

	Temperatures	Rainfall	Population Dens Inc.	Wind	Total
Temperatures	1.00	7.00	5.00	1.00	
Rainfall	0.14	1.00	0.14	0.33	
Population Dens Inc.	0.20	7.00	1.00	9.00	
Wind	1.00	3.00	0.11	1.00	
Total	2.34	18.00	6.25	11.33	37.93

Table A3. Table in which the value of the vector W is determined.

	T	P	DENS	WI	Total	W Vector
Temperatures	0.43	0.39	0.80	0.09	1.70	0.427
Rainfall	0.06	0.06	0.02	0.03	0.17	0.042
Population Dens Inc.	0.09	0.39	0.16	0.79	1.43	0.358
Wind	0.43	0.17	0.02	0.09	0.70	0.175
Total					4.00	

Table A4. The values of the considered variables T absolute, P, Dens, WI.

	ACI.	AGR.	CAT.	EN.	MES.	PAL.	SR.	RAG.	TRA.	ZAF.
T	31.00	32.50	33.15	29.45	32.00	33.40	29.05	32.72	35.05	32.80
P	856.50	426.00	529.00	344.50	336.50	405.50	950.50	406.00	242.50	950.50
DENS	1564.0	285.00	2049.00	1282.0	1287.00	4923.00	701.00	206.00	386.00	152.00
WI	2.24	2.99	2.37	2.85	3.63	1.38	2.90	3.65	3.15	3.08

Table A5. Calculation table of standardized quantities referring to the 10 cities.

	ACI.	AGR.	CAT.	EN.	MES.	PAL.	SR.	RAG.	TRA.	ZAF.
T	0.88	0.92	0.95	0.84	0.91	0.95	0.83	0.93	1.00	0.94
P	0.86	0.43	0.53	0.34	0.34	0.40	0.95	0.41	0.24	0.95
DENS	0.3	0.06	0.41	0.26	0.26	0.98	0.14	0.04	0.08	0.03
WI	0.56	0.75	0.59	0.71	0.91	0.34	0.72	0.91	0.79	0.77

Table A6. Vulnerability index calculation tables. Agrigento.

Vulnerability Index Calculation		Agrigento	
	W vector		
	$\alpha = 0.43$	$T = 0.92$	$\alpha \times T = 0.39$
	$\beta = 0.04$	$P = 0.43$	$\beta \times P = 0.02$
	$\gamma = 0.36$	$DEN = 0.06$	$\gamma \times DEN = 0.02$
	$\delta = 0.18$	$WI = 0.75$	$\delta \times WI = 0.13$
CVI			0.56

Table A7. Vulnerability index calculation tables. Catania.

Vulnerability Index Calculation		Catania	
	W vector		
	$\alpha = 0.43$	$T = 0.95$	$\alpha \times T = 0.41$
	$\beta = 0.04$	$P = 0.53$	$\beta \times P = 0.02$
	$\gamma = 0.36$	$DENS = 0.41$	$\gamma \times DEN = 0.15$
	$\delta = 0.18$	$WI = 0.59$	$\delta \times WI = 0.10$
CVI			0.68

Table A8. Vulnerability index calculation tables. Enna.

Vulnerability Index Calculation		Enna	
	W vector		
T	$\alpha = 0.427$	$T = 0.84$	$\alpha \times T = 0.36$
P	$\beta = 0.042$	$P = 0.34$	$\beta \times P = 0.01$
DENS	$\gamma = 0.358$	$DENS = 0.26$	$\gamma \times DEN = 0.09$
WI	$\delta = 0.175$	$WI = 0.71$	$\delta \times WI = 0.12$
CVI			0.59

Table A9. Vulnerability index calculation tables. Messina.

Vulnerability Index Calculation		Messina	
	W vector		
	$\alpha = 0.427$	$T = 0.91$	$\alpha \times T = 0.39$
	$\beta = 0.042$	$P = 0.34$	$\beta \times P = 0.01$
	$\gamma = 0.358$	$DENS = 0.26$	$\gamma \times DEN = 0.09$
	$\delta = 0.175$	$WI = 0.91$	$\delta \times WI = 0.16$
CVI			0.66

Table A10. Vulnerability index calculation tables. Palermo.

Vulnerability Index Calculation		Palermo	
CVI	W vector		
	$\alpha = 0.427$	$T = 0.95$	$\alpha \times T = 0.41$
	$\beta = 0.042$	$P = 0.40$	$\beta \times P = 0.02$
	$\gamma = 0.358$	$DENS = 0.98$	$\gamma \times DENS = 0.35$
	$\delta = 0.175$	$WI = 0.34$	$\delta \times WI = 0.06$
		0.83	

Table A11. Vulnerability index calculation tables. Siracusa.

Vulnerability Index Calculation		Siracusa	
CVI	W vector		
	$\alpha = 0.427$	$T = 0.83$	$\alpha \times T = 0.35$
	$\beta = 0.042$	$P = 0.95$	$\beta \times P = 0.04$
	$\gamma = 0.358$	$DENS = 0.14$	$\gamma \times DENS = 0.05$
	$\delta = 0.175$	$WI = 0.72$	$\delta \times WI = 0.13$
		0.57	

Table A12. Vulnerability index calculation tables. Ragusa.

Vulnerability Index Calculation		Ragusa	
CVI	W vector		
	$\alpha = 0.427$	$T = 0.93$	$\alpha \times T = 0.40$
	$\beta = 0.042$	$P = 0.41$	$\beta \times P = 0.02$
	$\gamma = 0.358$	$DENS = 0.04$	$\gamma \times DENS = 0.01$
	$\delta = 0.175$	$WI = 0.91$	$\delta \times WI = 0.16$
		0.59	

Table A13. Vulnerability index calculation tables. Trapani.

Vulnerability Index Calculation		Trapani	
CVI	W vector		
	$\alpha = 0.427$	$T = 1.00$	$\alpha \times T = 0.43$
	$\beta = 0.042$	$P = 0.24$	$\beta \times P = 0.01$
	$\gamma = 0.358$	$DENS = 0.08$	$\gamma \times DENS = 0.03$
	$\delta = 0.175$	$WI = 0.79$	$\delta \times WI = 0.14$
		0.61	

Table A14. Vulnerability index calculation tables. Zafferana.

Vulnerability Index Calculation		Zafferana	
CVI	W vector		
	$\alpha = 0.427$	$T = 0.94$	$\alpha \times T = 0.40$
	$\beta = 0.042$	$P = 0.95$	$\beta \times P = 0.04$
	$\gamma = 0.358$	$DENS = 0.03$	$\gamma \times DENS = 0.01$
	$\delta = 0.175$	$WI = 0.77$	$\delta \times WI = 0.13$
		0.59	

References

1. Steffen, W.; Crutzen, P.J.; McNeill, J.R. The Anthropocene: Are humans now overwhelming the great forces of nature. *Ambio-J. Hum. Environ. Res. Manag.* **2007**, *36*, 614–621. [[CrossRef](#)]
2. Stone, B. *The City and the Coming Climate: Climate Change in the Places We Live*; Cambridge University Press: Cambridge, UK, 2012.
3. Adamo, S.B.; de Sherbinin, A. The impact of climate change on the spatial distribution of populations and migration. *Popul. Distrib. Urban. Intern. Migr. Dev. An. Int. Perspect.* **2011**, 161.
4. Osipov, V.I.; Rumyantseva, N.A.; Eremina, O.N. Living with risk of natural disasters. *Russ. J. Earth Sci.* **2019**, *19*, 4. [[CrossRef](#)]

5. Acharjee, S. Urban land use and geohazards in Itanagar, Arunachal Pradesh, India: The need for geotechnical intervention and geoethical policies in urban disaster resilience programmes in a changing climate. *Geol. Soc. Lond. Spec. Publ.* **2015**, *419*, 63–68. [CrossRef]
6. Stern, D.I.; Kaufmann, R.K. Anthropogenic and natural causes of climate change. *Clim. Chang.* **2014**, *122*, 257–269. [CrossRef]
7. Muñoz, F. Lock living: Urban sprawl in Mediterranean cities. *Cities* **2003**, *20*, 381–385. [CrossRef]
8. Werrell, C.E.; Femia, F. Climate change, the erosion of state sovereignty, and world order. *Brown J. World Aff.* **2016**, *22*, 221–235.
9. Prasad, N.; Ranghieri, F.; Shah, F.; Trohanis, Z.; Kessler, E.; Sinha, R. *Climate Resilient Cities: A Primer on Reducing Vulnerabilities to Disasters*; World Bank Publications: Chicago, IL, USA, 2009.
10. Giordano, F.; Sebbio, C.; Antolini, G.; Botarelli, L.; Flapp, F.; Bonati, V.; Onorato, L.; Loglisci, N.; Priod, G.; Pelosini, R.; et al. Criteri per la definizione di indicatori prioritari di impatto dei cambiamenti climatici: Verso un set a livello nazionale. *Ing. Dell'ambiente* **2018**, *5*, 213–227.
11. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. An EU Strategy on Adaptation to Climate Change. Available online: <https://eur-lex.europa.eu/legal-content/IT/ALL/?uri=CELEX:52013SC0137> (accessed on 30 October 2020).
12. Francini, M.; Chieffallo, L.; Palermo, A.; Viapiana, M.F. A method for the definition of local vulnerability domains to climate change and relate mapping. Two case studies in southern Italy. *Sustainability* **2020**, *12*, 9454. [CrossRef]
13. Sumasgutner, P.; Cunningham, S.J.; Hegemann, A.; Amar, A.; Watson, H.; Nilsson, J.F.; Isaksson, C. Interactive effects of rising temperatures and urbanisation on birds across different climate zones: A mechanistic perspective. *Glob. Change Biol.* **2023**, *29*, 2399–2420. [CrossRef]
14. Castellari, S.; Venturini, S.; BallarinDenti, A.; Bigano, A.; Bindi, M.; Bosello, F.; Carrera, L.; Chiriaco, M.V.; Danovaro, R.; Desiato, F.; et al. *Rapporto sullo Stato delle Conoscenze Scientifiche su Impatti, Vulnerabilità ed Adattamento ai Cambiamenti Climatici in Italia*; Ministero dell'Ambiente e della Tutela del Territorio e del Mare: Roma, Italia, 2014.
15. Alexander, L.V.; Zhang, X.; Peterson, T.C.; Caesar, J.; Gleason, B.; Tank, A.M.G.K.; Haylock, M.; Collins, D.; Trewin, B.; Rahimzadeh, F.; et al. Global observed changes in daily climate extremes of temperature and precipitation. *J. Geophys. Res. Space Phys.* **2006**, *111*, 1–22. [CrossRef]
16. Santamouris, M. Cooling the cities—A review of reflective and green roof mitigation technologies to fight heat island and improve comfort in urban environments. *Sol. Energy* **2014**, *103*, 682–703. [CrossRef]
17. Lorenzo, M.; Pagani, R. *Cityfutures: Architettura Design Tecnologia per il Futuro della città: Atti della Conferenza Internazionale CityFutures 2009 Organizzata dalla Società Italiana di tecnologia Dell'architettura (SITdA) e da MADE Expo: Milano, 4-5 Febbraio 2009*; Hoepli: Milan, Italy, 2010.
18. Ertürk, A.; Ekdal, A.; Gürel, M.; Karakaya, N.; Guzel, C.; Gönenç, E. Evaluating the impact of climate change on groundwater resources in a small Mediterranean watershed. *Sci. Total Environ.* **2014**, *499*, 437–447. [CrossRef] [PubMed]
19. Fussler, H.M.; Jol, A.; Hildén, M. *Climate Change, Impacts and Vulnerability in Europe 2012; An Indicator-based Report 12/2012*; European Environment Agency: Copenhagen, Denmark, 2012.
20. Lankao, P.R.; Qin, H. Conceptualizing urban vulnerability to global climate and environmental change. *Curr. Opin. Environ. Sustain.* **2011**, *3*, 142–149. [CrossRef]
21. Tapia, C.; Abajo, B.; Feliu, E.; Mendizabal, M.; Martinez, J.A.; Fernández, J.G.; Laburu, T.; Lejarazu, A. Profiling urban vulnerabilities to climate change: An indicator-based vulnerability assessment for European cities. *Ecol. Indic.* **2017**, *78*, 142–155. [CrossRef]
22. Bagheri, M.; Zaiton Ibrahim, Z.; Mansor, S.; Abd Manaf, L.; Akhir, M.F.; Talaat, W.I.A.W.; Beiranvand Pour, A. Application of multi-criteria decision-making model and expert choice software for coastal city vulnerability evaluation. *Urban Sci.* **2021**, *5*, 84. [CrossRef]
23. Velázquez, J.; Infante, J.; Gómez, I.; Hernando, A.; Gülçin, D.; Herráez, F.; Rincón, V.; Castanho, R.A. Walkability under Climate Pressure: Application to Three UNESCO World Heritage Cities in Central Spain. *Land* **2023**, *12*, 944. [CrossRef]
24. Rincón, V.; Velázquez, J.; Gutiérrez, J.; Sánchez, B.; Hernando, A.; García-Abril, A.; Santamaría, T.; Sánchez-Mata, D. Evaluating European conservation areas and proposal of new zones of conservation under the habitats directive. application to Spanish territories. *Sustainability* **2019**, *11*, 398. [CrossRef]
25. Torresan, S.; Critto, A.; Rizzi, J.; Marcomini, A. Assessment of coastal vulnerability to climate change hazards at the regional scale: The case study of the North Adriatic Sea. *Nat. Hazards Earth Syst. Sci.* **2012**, *12*, 2347–2368. [CrossRef]
26. Nguyen, T.T.; Bonetti, J.; Rogers, K.; Woodroffe, C.D. Indicator-based assessment of climate-change impacts on coasts: A review of concepts, methodological approaches and vulnerability indices. *Ocean Coast. Manag.* **2016**, *123*, 18–43. [CrossRef]
27. Mackay, A.W. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. *J. Environ. Qual.* **2008**, *37*, 2407. [CrossRef]
28. Jacobs, R.; Smith, P.C.; Goddard, M. *Measuring Performance: An Examination of Composite Performance Indicators: A Report for the Department of Health*. Centre for Health Economics; University of New York: New York, NY, USA, 2004.
29. Hallegatte, S.; CorfeeMorlot, J. Understanding climate change impacts, vulnerability and adaptation at city scale: An introduction. *Clim. Chang.* **2010**, *104*, 1–12. [CrossRef]
30. Field, C.B.; Barros, V.; Stocker, T.F.; Dahe, Q. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change*; Cambridge University Press: Cambridge, UK, 2012.

31. Karki, S.; Burton, P.R.; Mackey, B. Climate change adaptation by subsistence and smallholder farmers: Insights from three agro-ecological regions of Nepal. *Cogent Soc. Sci.* **2020**, *6*, 1720555. [\[CrossRef\]](#)
32. Harvey, A.; Hinkel, J.; Horrocks, L.; Klein, R.; Lasage, R.; Hodgson, N.; Sajwaj, T.; Benzie, M. *Preliminary Assessment and Roadmap for the Elaboration of Climate Change Vulnerability Indicators at Regional Level*; AEA: London, UK, 2009.
33. Sanzaro, D.; Trovato, M.R.; Chiara, C. An Interpretive Ruination Model of the Built Heritage in Inner Areas: The Case Study of the Neighbourhood Granfonte in Leonforte. *Heritage* **2023**, *6*, 6965–6992. [\[CrossRef\]](#)
34. Santonocito, S.D. Sustainable tourism and carrying capacity in the Mediterranean area focus on Sicily. In Proceedings of the 3rd IRT International Scientific Conference, Helwan, Egypt, 24–26 October 2009; Volume 1.
35. Brullo, S.; Scelsi, F.; Siracusa, G.; Spampinato, G. Caratteristiche bioclimatiche della Sicilia. *Plant Biosyst.* **1996**, *130*, 177–185. [\[CrossRef\]](#)
36. Grillone, G.; Agnese, C.; D’Asaro, F. Stima della radiazione solare giornaliera in Sicilia mediante i dati di temperatura massima e minima. *Riv. Ital. Di Agrometeorol.* **2009**, *2*.
37. Strategia Nazionale di Adattamento ai Cambiamenti Climatici. Available online: <https://www.minambiente.it/notizie/strategia-nazionale-di-adattamento-ai-cambiamenti-climatici-> (accessed on 5 March 2024).
38. Available online: http://www.sias.regione.sicilia.it/frameset_download.htm (accessed on 3 March 2024).
39. Marins, C.S.; de Souza, D.O.; da Barros, M.S. O uso do método de análise hierárquica (AHP) na tomada de decisões gerenciais—um estudo de caso. *Xli Sbp* **2009**, *1*, 49.
40. Sipahi, S.; Timor, M. The analytic hierarchy process and analytic network process: An overview of applications. *Manag. Decis.* **2010**, *48*, 775–808. [\[CrossRef\]](#)
41. Khan, S.A.; Chaabane, A.; Dweiri, F.T. Multi-criteria decision-making methods application in supply chain management: A systematic literature. *Multi-Criteria Methods Tech. Appl. Supply Chain. Manag.* **2018**, *1*, 10–5772.
42. Thakkar, J.J. Analytic hierarchy process (AHP). *Multi-Criteria Decis. Mak.* **2021**, 33–62.
43. Abreu, L.M.D.; Granemann, S.R.; Gartner, I.; Bernardes, R.S. Escolha de um programa de controle da qualidade da água para consumo humano: Aplicação do método AHP. *Rev. Bras. De Eng. Agrícola E Ambient.* **2000**, *4*, 257–262. [\[CrossRef\]](#)
44. Trevizano, W.A.; Freitas, A.L.P. Emprego do Método da Análise Hierárquica (AHP) na seleção de Processadores. *XXV Encontro Nac. De Eng. De Produção—Porto Alegre RS Bras.* **2005**, 29.
45. Ambasz, E. I: The university of design and development. II: Manhattan: Capital of the twentieth century. III: The designs of freedom. *Perspecta* **1971**, *13*, 359–365. [\[CrossRef\]](#)
46. Voskamp, I.M.; Van de Ven, F.H. Planning support system for climate adaptation: Composing effective sets of blue-green measures to reduce urban vulnerability to extreme weather events. *Build. Environ.* **2015**, *83*, 159–167. [\[CrossRef\]](#)
47. Swart, R.J.; Biesbroek, G.R.; Binnerup, S.; Carter, T.; Cowan, C.; Henrichs, T.; Loquen, S.; Mela, H.; Morecroft, M.; Reese, M.; et al. *Europe Adapts to Climate Change. Comparing National Adaptation Strategies in Europe*; No. 1; PEER: Helsinki, Finland, 2009.
48. Hurtado, S.D.G.; Olazabal, M.; Salvia, M.; Pietrapertosa, F.; Olazabal, E.; Geneletti, D.; D’Alonzo, V.; Feliú, E.; Leo, S.D.; Reckien, D. Implications of Governance Structures on Urban Climate Action: Evidence from Italy and Spain. 2014. Available online: https://www.researchgate.net/publication/260831942_Implications_of_governance_structures_in_urban_climate_action_evidence_from_Italy_and_Spain (accessed on 5 March 2024).
49. Acuti, D.; Bellucci, M. Resilient cities and regions: Planning, initiatives, and perspectives. In *Climate Action*; Springer: Berlin/Heidelberg, Germany, 2020; pp. 763–774.
50. Keessen, A.M.; van Rijswijk, H.F. Adaptation to climate change in European water law and policy. *Utrecht Law. Rev.* **2012**, *8*, 38–50. [\[CrossRef\]](#)
51. Eames, M.; Dixon, T.; May, T.; Hunt, M. City futures: Exploring urban retrofit and sustainable transitions. *Build. Res. Inf.* **2013**, *41*, 504–516. [\[CrossRef\]](#)
52. Moir, E.; Moonen, T.; Clark, G. What are future cities? Origins, meanings and uses. *Foresight Future Cities* **2014**, *1*, 10–11.
53. Dawson, R. Re-engineering cities: A framework for adaptation to global change. *Philos. Trans. R. Soc. A Math. Phys. Eng. Sci.* **2007**, *365*, 3085–3098. [\[CrossRef\]](#)
54. Fry, T. *City Futures in the Age of a Changing Climate*; Routledge: London, UK, 2014.
55. Al-Humaiqani, M.M.; Al-Ghamdi, S.G. Exploring the Significance of Resilience Qualities in the Context of the Middle East Built Environment. In *Asia Conference on Environment and Sustainable Development*; Springer Nature: Singapore, 2022.
56. Al-Humaiqani, M.M.; Al-Ghamdi, S.G. Enhancing Built Environment Resilience: Exploring Themes and Dimensions. In *Sustainable Cities in a Changing Climate: Enhancing Urban Resilience*; John and Wiley and Sons: Hoboken, NJ, USA, 2023; pp. 121–137.
57. Al-Humaiqani, M.M.; Al-Ghamdi, S.G. Quantifying Urban Resilience: Methods and Approaches for Comprehensive Assessment. In *Sustainable Cities in a Changing Climate: Enhancing Urban Resilience*; John and Wiley and Sons: Hoboken, NJ, USA, 2023; pp. 155–182.
58. Bellinson, R.; Chu, E. Learning pathways and the governance of innovations in urban climate change resilience and adaptation. *J. Environ. Policy Plan.* **2019**, *21*, 76–89. [\[CrossRef\]](#)
59. Torresan, S.; Critto, A.; Valle, M.D.; Harvey, N.; Marcomini, A. Assessing coastal vulnerability to climate change: Comparing segmentation at global and regional scales. *Sustain. Sci.* **2008**, *3*, 45–65. [\[CrossRef\]](#)
60. La Greca, P.; Barbarossa, L.; Ignaccolo, M.; Inturri, G.; Martinico, F. The density dilemma. A proposal for introducing smart growth principles in a sprawling settlement within Catania Metropolitan Area. *Cities* **2011**, *28*, 527–535. [\[CrossRef\]](#)

61. Gupta, K.; Kumar, P.; Pathan, S.K.; Sharma, K.P. Urban Neighborhood Green Index—A measure of green spaces in urban areas. *Landsc. Urban. Plan.* **2012**, *105*, 325–335. [\[CrossRef\]](#)
62. Grazuleviciute-Vileniske, I.; Daugelaite, A.; Viliunas, G. Classification of biophilic buildings as sustainable environments. *Buildings* **2022**, *12*, 1542. [\[CrossRef\]](#)
63. Weisser, W.W.; Hensel, M.; Barath, S.; Culshaw, V.; Grobman, Y.J.; Hauck, T.E.; Joschinski, J.; Ludwig, F.; Mimet, A.; Perini, K.; et al. Creating ecologically sound buildings by integrating ecology, architecture and computational design. *People Nat.* **2023**, *5*, 4–20. [\[CrossRef\]](#)
64. Lehmann, S. Low carbon districts: Mitigating the urban heat island with green roof infrastructure. *City Cult. Soc.* **2014**, *5*, 1–8. [\[CrossRef\]](#)
65. Özyavuz, M.; Karakaya, B.; Ertin, D.G. The effects of green roofs on urban ecosystems. In Proceedings of the Conference: Green Age Symp, Istanbul, Türkiye, 15–17 April 2015.
66. Barriuso, F.; Urbano, B. Green roofs and walls design intended to mitigate climate change in urban areas across all continents. *Sustainability* **2021**, *13*, 2245. [\[CrossRef\]](#)
67. Pisello, A.L. State of the art on the development of cool coatings for buildings and cities. *Sol. Energy* **2017**, *144*, 660–680. [\[CrossRef\]](#)
68. Abdelfattah, L.; Deponte, D.; Fossa, G. The 15-minute city as a hybrid model for Milan. *TEMA* **2022**, 71–86.
69. Theodosiou, T. Green roofs in buildings: Thermal and environmental behaviour. *Adv. Build. Energy Res.* **2009**, *3*, 271–288. [\[CrossRef\]](#)
70. Rowe, D.B. Green roofs as a means of pollution abatement. *Environ. Pollut.* **2011**, *159*, 2100–2110. [\[CrossRef\]](#)
71. Li, Y.; Babcock, R.W. Green roofs against pollution and climate change: A review. *Agron. Sustain. Dev.* **2014**, *34*, 695–705. [\[CrossRef\]](#)
72. Dimitrijević, D.; Živković, P.; Branković, J.; Dobrnjac, M.; Stevanović, Ž. Air pollution removal and control by green living roof systems. *Acta Tech. Corviniensis-Bull. Eng.* **2018**, *11*, 47–50.
73. Rafael, S.; Correia, L.; Ascenso, A.; Augusto, B.; Lopes, D.; Miranda, A. Are green roofs the path to clean air and low carbon cities? *Sci. Total Environ.* **2021**, *798*, 149313. [\[CrossRef\]](#) [\[PubMed\]](#)
74. Mehta, G.; MacDonald, D. *New Japan Architecture: Recent Works by the World's Leading Architects*; Tuttle Publishing: Rutland, VT, USA, 2012.
75. Matsumura, S. *Open Architecture for the People: Housing Development in Post-War Japan*; Routledge: London, UK, 2019.
76. Majerska-Patubicka, B.; Latusek, E. Intelligence-Based Design Illustrated with Examples of ACROS Fukuoka, KKL Luzern and MICA Changsha Buildings—A Multicriterial Case Study. *Buildings* **2021**, *11*, 135. [\[CrossRef\]](#)
77. Besir, A.B.; Cuce, E. Green roofs and facades: A comprehensive review. *Renew. Sustain. Energy Rev.* **2018**, *82*, 915–939. [\[CrossRef\]](#)
78. Hopkins, G.; Goodwin, C. *Living Architecture: Green Roofs and Walls*; Csiro Publishing: Clayton, Australia, 2011.
79. Qian, S.H.A.O. Hanging Gardens in Modern High-Rise Apartment Buildings. *J. Landsc. Res.* **2018**, *10*, 1.
80. Fassbender, E.; Ludwig, F.; Hild, A.; Auer, T.; Hemmerle, C. Designing transformation: Negotiating solar and green strategies for the sustainable densification of urban neighbourhoods. *Sustainability* **2022**, *14*, 3438. [\[CrossRef\]](#)
81. Flanagan, B.E.; Gregory, E.W.; Hallisey, E.J.; Heitgerd, J.L.; Lewis, B. A social vulnerability index for disaster management. *J. Homel. Secur. Emerg. Manag.* **2011**, *8*, 0000102202154773551792. [\[CrossRef\]](#)
82. Kasperson, J.X.; Kasperson, R.E.; Turner, B.L.; Hsieh, W.; Schiller, A. Vulnerability to global environmental change. In *Social Contours of Risk*; Routledge: London, UK, 2022; pp. 245–285.
83. Huiteima, D.; Adger, W.N.; Berkhout, F.; Massey, E.; Mazmanian, D.; Munaretto, S.; Plummer, R.; Termeer, C.C.J.A.M. The governance of adaptation: Choices, reasons, and effects. Introduction to the Special Feature. *Ecol. Soc.* **2016**, *21*, 37. [\[CrossRef\]](#)
84. Zuccaro, G.; Leone, M.F. Climate services to support disaster risk reduction and climate change adaptation in urban areas: The CLARITY project and the Napoli case study. *Front. Environ. Sci.* **2021**, *9*, 693319. [\[CrossRef\]](#)
85. Schneider, S.; Sarukhan, J.; Adejuwon, J.; Azar, C.; Baethgen, W.; Hope, C.; Moss, R.; Leary, N.; Richels, R.; Van Ypersele, J.P.; et al. Overview of impacts, adaptation, and vulnerability to climate change. *Clim. Chang.* **2001**, 75–103.
86. Carmin, J.A.; Dodman, D.; Chu, E. *Urban Climate Adaptation and Leadership: From Conceptual Understanding to Practical Action*; OECD Publishing: Paris, France, 2013.
87. Brunner, R.; Lynch, A. *Adaptive Governance and Climate Change*; Springer Science & Business Media: Berlin/Heidelberg, Germany, 2013.
88. Field, C.B.; Vicente, R.B. *Climate Change 2014—Impacts, Adaptation and Vulnerability: Regional Aspects*; Field, C.B., Barros, V.R., Eds.; Cambridge University Press: Cambridge, UK, 2014.

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