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NEW CHALLENGES FOR XXI CENTURY CITIES

Global warming, ageing of population, reduction of energy consumption, immigration flows, optimization of land use, technological innovation

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The cover image shows railway street in Hanoi, Vietnam (Source: TeMA Journal Editorial Staff).

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Towards participatory urban planning: insights from citizens. Results of a survey on the local effects of climate change in Parma

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Abstract
Citizens' involvement in urban transition processes has been gaining recognition within the scientific literature and urban transformation initiatives. Co-design and co-planning, in both top-down and bottom-up urban transformation processes, allow stakeholders to collaborate in defining the future of cities in a climate change adaptation framework that encompasses interventions such as soil desealing. In this framework, surveys have emerged as valuable instruments to solicit citizens' insights into participatory processes, as an aid to orient urban planning and transformation scenarios towards their needs and vulnerabilities. After tracing the outline of a local bottom-up project (named "Green in Parma"), this contribution will present and discuss the outcomes of a survey that investigated the perception of the citizens of Parma regarding climate change and its local effects. Univariate and bivariate analyses, including Chi-square tests and factor analyses, were conducted on data collected from a sample of 1,352 participants. The findings provided insights linked to the city and to the neighbourhoods, allowing to localise the quantitative data and to qualitatively associate them with the neighbourhoods socio-environmental characteristics, fostering the envisioning of climate change adaptation strategies. The analyses reveal the potential of surveys and citizens' involvement in shaping urban planning scenarios, acknowledging the citizens' role as bearers of knowledge and active stakeholders.

Keywords
Urban planning; Citizens' perception; Desealing; Climate change adaptation; Survey.

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1. Introduction

Within the context of cities adaptation to climate change, the role of desealing (i.e., the removal of the impervious soil layers) and greening interventions, under the wider umbrella of Nature-based solutions (NBSs), has been increasingly promoted by researchers and urban stakeholders as an effective mean to mitigate the effects of the increasing soil consumption (Frantzeskaki et al., 2019; Salata & Yiannakou, 2016; De Noia et al., 2022; Ceci et al., 2023).

In this framework, the role of public participation and the knowledge borne by citizens and communities have been studied and recognized by researchers since the last century (Paez, 2003; Few et al., 2007). Smith (1983) defined public participation as the inclusive process that grants those affected by a decision the opportunity to provide input into that decision. Public participation acquires relevance in urban transformation processes as it helps to understand the aspirations of the stakeholders and is considered one of the main aspects to guarantee the effectiveness and quality of urban planning (Semeraro et al., 2020). However, there are issues and/or challenges which need to be assessed. *Who and in what measure is participating? What processes can be defined as participatory processes?* Both in research and practice, it appears relevant to consider the purpose and meaning of participation, avoiding its instrumentalization and valuing the emotions of those involved, avoiding, for instance, illusions of power in the decision-making process that imply feelings of dissatisfaction (Arnstein, 1969). This appears especially significant in a highly uncertain framework such as climate change (Few et al., 2007).

In this context, the effectiveness of bottom-up initiatives in highlighting the needs of the citizens is emerging (Pissourios, 2014), as well as the value borne by their integration with top-down practices (Girard et al., 2015). After tracing an overview of bottom-up participatory processes, as well as presenting the relevance of surveys in this framework (Section 2), Section 3 will briefly trace the outline of a bottom-up project, "Green in Parma", which is being carried out in Parma, an Italian city located in the western Emilia-Romagna Region. Section 3 will then focus on presenting a survey that, within "Green in Parma", aimed at investigating the citizens' perception of climate change and its local effects to understand the reasons behind a "failed" attempt of a participatory co-design desealing intervention. This section will also present the methodology that was employed[1], describing the analyses (e.g., Chi-square tests and factor analyses) that were conducted on data from a 1,352 participants sample. The research findings provided insights linked to the city and the neighbourhoods, allowing for the localisation of the quantitative data, which were then linked to socio-environmental characteristics. Sections 4, 5, and the Conclusions will include the results of these analyses and a discussion about their implication in urban planning practices, while investigating at the same time the role of surveys in urban planning and bottom-up processes, underlining their strengths and weaknesses in the context of urban adaptation to climate change: the analyses reveal the potential of surveys and citizens' involvement in understanding the needs of the communities, acknowledging the citizens' role as bearers of knowledge and active stakeholders.

2. Literature review

The relevance of bottom-up participatory processes in urban planning has been addressed in the scientific literature from a variety of perspectives, aiming to tackle several socio-economic and environmental issues related to climate change. Some authors investigated these processes through applicative case studies (i.a., Geropanta et al., 2022; Nicolini & Pinto, 2013; Vogt, 2002), while others provided taxonomies and reviews of the existing approaches (i.a., Seve, Redondo, et al., 2023; Meroni & Selloni, 2022).

[1] The results of the survey were analysed by the Research Group of Urban and Regional Planning of the University of Parma (Italy) in collaboration with Eindhoven University of Technology (the Netherlands).

On a general level, bottom-up participatory processes have been broadly recognised as efficient tools/strategies for increasing urban resilience to climate change (i.a., Strange et al., 2022; Vaňo et al., 2021), while other authors underlined their significance in the framework of urban development or regeneration (i.a., Canesi et al., 2022; Mayrhofer, 2018), highlighting their political and socio-economic role (i.a., García de Jalón et al., 2020; Kuokkanen & Palonen, 2018; Eizenberg, 2019).
Other researchers focused on investigating the tools that can serve as an aid to promote and foster bottom-up participatory processes, such as art (Seve et al., 2023). Among the available tools, the role of digital technologies emerged (Sharifi et al., 2017; Stelzle et al., 2017) to overcome the spatial and temporal limits. Overall, the contribution of the knowledge, expertise, and perception of citizens and stakeholders in the improvement of the urban transformation processes appears crucial.

2.1 Bottom-up participatory processes for urban planning to face the effects of climate change

Two points of view have been identified in the research that deals with fostering the participation, empowerment, and bottom-up contribution of the citizens and stakeholders to face the effects of climate change. The first group of authors recognises a bottom-up need for urban space transformation and investigates ways to respond to those needs. Among others, Santoro et al. (2020) acknowledged a bottom-up demand for the enhancement of the environment. Zagare (2018) focused on self-organising processes, linking climate adaptation and urban development, and investigating local participatory methodologies. In this framework, co-design and co-planning emerge as physical and/or digital participation strategies/tools (Sharifi et al., 2017; Stelzle et al., 2017), that allow stakeholders to collaborate in defining the future of cities, both in the top-down and bottom-up urban transformation processes. The second group of researchers investigates strategies to foster the emergence of bottom-up processes themselves. For instance, Charli-Joseph et al. (2018) proposed a methodological approach for promoting "transformation laboratories", aiming to create a safe space that can stimulate dialogue and interaction among the participants. Focusing on the tools, Ranjbar Nooshery et al. (2017) studied public participation Geographical Information Systems (PPGIS) as a mean to address urban environmental problems, as well as data mining tools to gather insight from the citizens. Vaňo et al. (2021) proposed a model that, through the involvement of mediatory agencies, creates links between lower and higher planning levels in response to procedural barriers. According to their model, bottom-up actions might stimulate the planning of green infrastructure in their case, at a higher level.
In the framework of promoting soil desealing in urban areas, "Depave" (United States), "Depave Paradise" (Canada), and "Steenbreek" (Netherlands) emerge as bottom-up initiatives that aim to create a collaborative network of stakeholders to put in action desealing interventions in urban areas, involving communities and institutions (Garda, 2019; Puerari et al., 2013; Stobbelaar et al., 2021).

2.2 The role played by surveys

Among the various involvement tools and strategies that are available to foster the dialogue between the citizens and the stakeholders, digital instruments have emerged as valuable instruments to solicit citizens' insights into participatory processes (Schröter et al., 2023). Balram & Dragićević (2005) have underlined that there is a dominant use of surveys to characterize people's environmental attitude, and are recognised as valuable instruments to act locally and gather fine social and attitude data. Boglietti & Tiboni (2022) employed surveys to enrich the technical analysis of neighbourhood mobility with citizens' perception of critical issues, planning regeneration proposals accordingly. Tiellemans et al. (2022), in the framework of discrete choice modelling, presented a stated choice experiment to study residents' preferences for sustainable energy measures on dwellings. Specifically, residents were asked to choose between hypothetical choice situations (alternatives), which are defined in terms of attributes that are then used to determine the preferences.

Similarly, Verboven (2021) presented a stated choice experiment to investigate the preferences of urban residents regarding Green-Based Solutions for heat adaptation. Cervera et al. (2021) employed surveys about the community's perception before and after implementing bottom-up urban acupuncture interventions that were combined with a top-down intervention. Franco & Cappa (2021) mentioned surveys as a valuable quantitative instrument for the application of citizen science in urban areas, emphasising their ability to highlight urban peculiarities.

3. Materials and methodology

Soil consumption rates of the city of Parma have been increasing, while the urban area has to deal more and more with climate change-related alterations such as heat waves and floodings. The growing awareness of the citizens about these issues fostered initiatives such as the bottom-up project "Green in Parma", which, promoted and led by the Centro Etica Ambientale (CEA) of Parma[2], is among the first community projects in Parma that advocates for urban resilience supporting soil desealing and the enhancement of green areas. One of the project initiatives consists of the survey "Parma si interroga sugli effetti locali del cambiamento climatico" (Parma wonders about the local effects of climate change)[3], which will be presented in this contribution. The survey is part of the bottom-up process that aims to put into action a desealing intervention in Parma through the project partners and local communities' involvement and was intended as a tool that - in a participatory perspective - allows to give a voice and gather (localised) information from the citizens and stakeholders, such as their perception and opinions.

3.1 The "Green in Parma" project

The first series of dissemination and divulgation initiatives of the "Green in Parma" project took place in 2021 and fostered the establishment of the project partners and a stakeholders' network. On this basis, a bottom-up desealing project was proposed in 2022 in the San Leonardo neighbourhood. As a first step, informative and co-design meetings were organised to involve the local community (Centro Etica Ambientale, 2021; Caselli et al., 2023). However, the issues that were encountered during the process, i.e., the difficulties in involving the citizens' community in a fruitful dialogue, as well as the uncertainties about the availability of the project area, led to taking a step backward and investigating the reasons why the project was unsuccessful. This was particularly motivated by the fact that, despite the hardships faced in setting up the desealing intervention, a noticeable willingness to collaborate was observed among the citizens and the stakeholders, thus serving as a prompt for the following phase of the project (Ceci et al., 2023). An online survey was setup during the last months of 2022, with the main aim of gathering insight about the citizens' perception about climate change and its related local effects in the urban area. The communities' perception is intended as one of the mosaic pieces of the urban context knowledge framework, thus helping to orient the urban planning and transformation scenarios towards the socio-environmental needs and vulnerabilities (Ceci et al., 2023).
Furthermore, another purpose of the survey is to foster the citizens' knowledge and empowerment about their role and the role of greening in the local climate change adaptation strategies.

3.2 Questionnaire design and data collection

The online questionnaire was designed during various meetings, throughout which the structure and the contents of the questionnaire were carefully and iteratively defined by the project partners, in a reciprocal exchange of ideas.

[2] The CEA is a third-sector local organisation that is part of the Italian Network of Centres for Environmental Ethics (CepEA).
[3] The survey was promoted by the project partners, e.g., the CEA of Parma, the Emilia-Romagna Agenzia Regionale Prevenzione Ambiente Energia (ARPAE), and the Research Group in Urban and Regional Planning of the University of Parma.

The questionnaire was designed to be easily understandable by all the population classes and encompassed 13 questions (Fig.1), divided into three main sections: i) demographic questions about the participants; ii) climate change risk and effects at the regional, urban and local (neighbourhood) level; iii) citizens' preferences concerning climate change adaptation intervention.

	Question		Choice answers	Variable denomination and characteristics	
Q1	Age		<15; 15-20; 21-30; 31-50; 51-70; >70	Age	DEMOGRAPHIC/STRING/INDEPENDENT
Q2	Sex		Single choice: F; M; Other	Sex	
Q3	Neighbourhood where you live/that you most frequently visit		Parma Centro; Oltretorrente; Molinetto; Pablo; Golese ; San Pancrazio; San Leonardo; Cortile San Martino; Lubiana; San Lazzaro; Cittadella; Montanara; Vigatto	Neighbourhood	
Q4	Activities		Unpaid domestic worker; Student; Freelancer; Employee in the public sector; Employee in the private sector; Entrepreneur (industry-agriculture); Entrepreneur (services-trade); Retired; Other	Activities	
Q5	Social activities [...]	SINGLE CHOICE	Regular; Saltuary/occasional; None	Social activities	
Q6	With reference to western Emilia, from the Apennines to the Po River, how relevant do you consider the role of climate change on the increasing trend of dry spring-winter and large summer droughts, heavy rains, hailstorms and tornadoes?		Very relevant; Somewhat relevant; Irrelevant	Relevance of climate change	CLIMATE CHANGE RISK AND EFFECTS/STRING/DEPENDENT
Q7	With reference to western Emilia, from the Apennines to the Po, how relevant do you consider the role of climate change on the trend of increasing temperatures and frequency of heat waves?		Very relevant; Somewhat relevant; Irrelevant		
Q8	With reference to the city of Parma, what do you think could be the main effects (impacts) of dry springs and winters and major summer droughts, heat waves, heavy rains, hailstorms and tornadoes?	MULTIPLE-CHOICE	Degradation of green areas and street greenery; Reduced usability/liveability of the outdoor environment for people and animals; Negative effects on the safety and well-being of workers in the outdoor environment; Adverse effects on health and well-being within homes and workplaces; Adverse health effects from poor air quality [...]; Increased deaths among the elderly and frail people; Damage to public/private outdoor properties; Restrictions on drinking water supply; Flooding; Non-significant impacts; I do not know	Effects of climate change_City of Parma_1 A/A_2 ... A/A_11	
Q9	In the neighbourhood that you have selected in question D3, as a result of the heat waves and prolonged summer droughts of the past two decades, have there been any cases of people becoming/feeling seriously ill?		Several; Some; None; I do not know	Observed effects of climate change_Neighbourhood	
Q10	In the neighbourhood that you have selected in question Q3, as a result of the heat waves and prolonged summer drought periods of the past two decades, have there been any instances of major green losses?	SINGLE CHOICE	Several; Some; None; I do not know		
Q11	In the neighbourhood that you have selected in question D3, as a result of heavy rainfall/hail/high winds/thunderstorms in the past two decades, have there been any instances of flooding or damage to public/private properties?		Several; Some; None; I do not know		
Q12	Considering the neighbourhood and the parts of the city of Parma that you frequent, and referring to the state of the built-up areas (cemented/paved/asphalted), what interventions do you think are most urgent in order to reduce climate risk?	MULTIPLE-CHOICE	Replacement of dark flooring/asphalts with light-coloured flooring/asphalts [...]*; Implementation of greenery on buildings [...]; Removal of excess concrete/asphalt [...]; Refurbishing manholes and street drains [...]; Wastewater network refurbishment [...] ; Aqueduct network refurbishment [...]; Build rainwater storage tanks [...]; I am not sufficiently informed to answer. *each answer included the purpose of the intervention	Perceived urgency of interventions_Built-up areas_1 A/A_2 ... A/A_8	ADAPTATION INTERVENTIONS/STRING/DEPENDENT
Q13	Considering the neighbourhood and the parts of the city of Parma that you frequent, and referring to the state of the unbuilt and green areas (but also of the strips, often built up, on the side of roads/sidewalks/sidewalks), what interventions do you think are most urgent in order to reduce climate risk?		Implementation of trees/shrubs on green areas to be redeveloped and on unbuilt areas, including partly cemented areas [...]*; Implementation of new greenery connected to existing greenery [...]; Redevelopment/rehabilitation of aquatic ecosystems [...]; Construction of [infiltration] trenches/pits [...]; Implementation of trees/hedges in roadside/sidewalk strips [...]; I am not sufficiently informed to answer. *each answer included the purpose of the intervention	Perceived urgency of interventions_1 A/A_2 ... A/A_6	

Fig.1 The questions and the choice answers of the questionnaire. A/A stands for as above

Fig.2 shows the conceptual model of the questionnaire, which first purpose was to investigate the hypothesis of a relationship between population classes and their answers. While questions (variables) were chosen in concert with the stakeholders and were therefore mainly connected with their expertise on climate change, bivariate analyses were conducted based on the existing literature, which suggests a relationship between the demographic variables and people's perception of climate change (Poortinga et al., 2019; Weber, 2016).

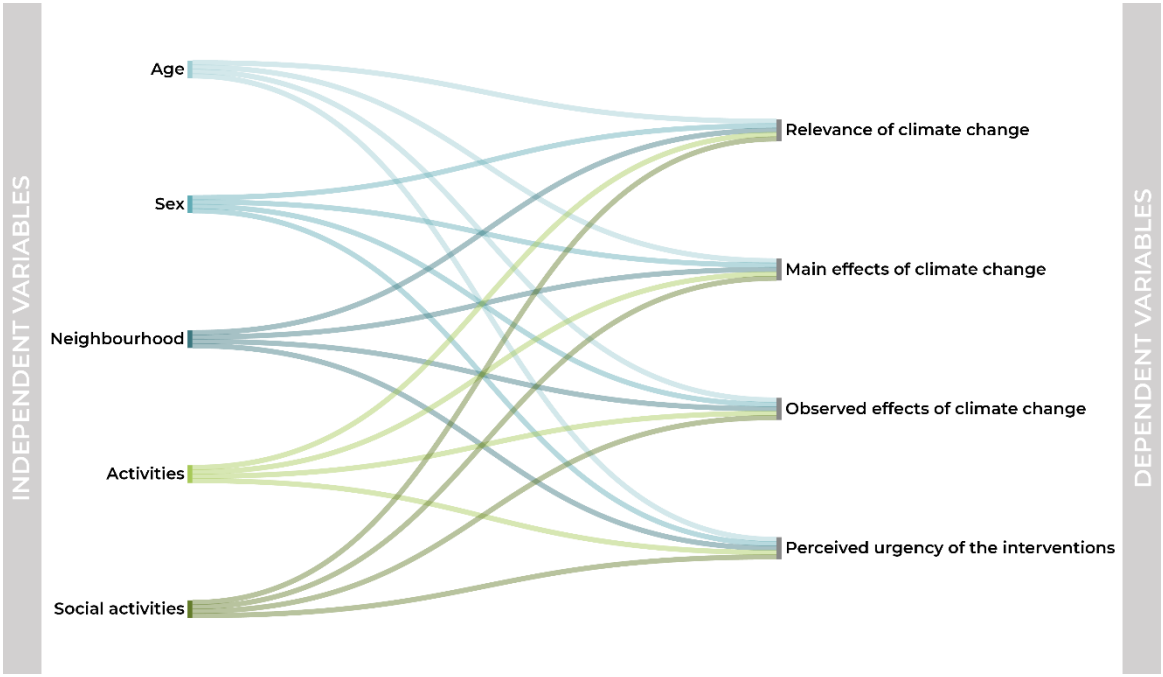

Fig.2 Conceptual model behind the questionnaire setup

Among the different options available to setup a questionnaire, the online questionnaire was chosen for its ability to reach a broad audience and for its technical and economic accessibility, as well as its potential to collect opinions and information also from the citizens that are generally less involved in the community or public life.

The questionnaire was setup through the EUSurvey platform (www.ec.europa.eu/eusurvey) and was published online, in Italian, during December 2022.

The questionnaire was promoted through the mailing lists of the University of Parma and of the CEA, and through local newspapers. 1,352 responses were collected between 27 December 2022 and 28 February 2023. The first descriptive analyses were carried out and shared with the citizens at a press conference on 4 March 2023, and later publicly presented at conferences and in publications.

In-depth statistical analyses of the responses were carried out employing Chi-square tests to test the statistical significance of the results, and factor analyses were employed to find patterns in the answers. The software used e are Microsoft Excel and IBM SPSS, while the opensource QGis software (www.qgis.org) was used to uncover the relationship of the questionnaire data with the urban socio-environmental characteristics.

3.3 Methodology for the analysis of the questionnaire data

This section presents the methodology employed to carry out univariate descriptive and bivariate analyses of the questionnaire results.

The first step consisted of the variable definition for the univariate descriptive analysis, i.e. the exploration of each variable in the dataset, separately. In the case of multiple-choice questions, a variable was created for each. A category was attributed to each variable, chosen among i) demographic, ii) climate change risk and effects, and iii) adaptation interventions, which correspond to the three main sections of the questionnaire. Fig.1 encloses the variables and their characteristics, namely their category, their value type ("string" for all

cases), and variable type (independent/dependent). Simple histograms were then plotted, with the variables choice answers on the x-axis and the count of respondents on the y-axis. Some choice answers needed to be grouped to be suitable for further analyses, i.e. they were merged to obtain groups with similar and significative number of respondents.

A crucial step in the univariate analyses consisted in assessing the sample representativeness of the urban population (Gobo, 2004). The urban population of Parma characteristics (in percentage) were compared with those of the sample, using the available open data.

To understand the relationship between the citizens' classes (demographic variables) and their perception of climate change and its local effects (bivariate analyses), Chi-square tests (Voinov et al., 2013) and factor analyses (Adelman, 1990) were run. Performing a Chi-square test means investigating two variables of nominal or ordinal measurement level, testing a null (H_0 - there is no difference between the groups) and an alternative hypothesis (H_1 – there is a difference between the groups) through, for instance, a cross table that shows the observed frequencies in a sample. Chi-square (χ^2) measures the difference of these values (frequencies) with the expected values, as explained by the following formula:

$$\chi^2 = \sum_{i=1}^{k} \frac{(o_i - e_i)^2}{e_i}$$

where o_i is the observed frequency in cell i; e_i is the expected frequency in cell i.

In other words, it was tested whether a difference found in the sample could be generalised to the population, with a significance of 5%. If a significance level lower than 5% was found, the null hypothesis (H_0) could be rejected, finding, therefore, a statistically significant difference between the groups.

Factor analyses were also carried out, defining and interpreting the rotated component matrix which was obtained, thus identifying patterns in the answers of the respondents.

To proceed with the bivariate analyses, the first step, similarly to the univariate analyses, was the definition of the variables. The same variables of the univariate analyses were kept, except for what concerned questions Q8, Q12, and Q13, for which new variables were defined, corresponding to one or more choices of the multiple-choice question (Tab.1).

Question code	Corresponding variable(s)	Variable group
Q8	Physical_Effects of climate change_City of Parma Drinking water_*A/A* Flooding_*A/A* Health_*A/A* None_*A/A*	Climate change risk and effects
Q12	NBSs_Perceived urgency of interventions_Built-up areas Grey measures__*A/A* Desealing__*A/A* None__*A/A*	Adaptation interventions
Q13	Perceived urgency of interventions_Green areas	

Tab.1 Overview of the questions and corresponding variables and categories. A/A stands for as above

The bivariate analyses were conducted between all the independent and dependent variables, but for the purpose of this contribution, the Results and Discussion sections will focus only on the Chi-square tests and factor analyses between the Neighbourhood and the dependent variables.

The statistically significant Chi-square tests were qualitatively compared to the socio-environmental characteristics of the neighbourhoods[4], aiming to discuss the influence of properties such as the neighbourhoods soil consumption rates on the respondents' answers.

4. Results

This section will present the analyses results, namely: the demographic characteristics of the sample (Subsection 4.1); the univariate analyses concerning the climate change risk and effects variables (Subsection 4.2) and the adaptation interventions variables (Subsection 4.3); the results of the Chi-square tests (Subsection 4.4); and the results of the factor analyses (Subsection 4.5).

4.1 Sample characteristics

The univariate analyses of the dataset showed that the age groups consist of 215 people aged 0-20; 298 people aged 21-30; 350 people falling into the 31-50 group; and 489 people in the 51-70 or >70 one. For what concerns the participants' sex, 819 individuals identified as females, while 533 identified as male or other. As shown in Figure 3, most participants selected "Parma Centro" (344), "Cittadella" (181), and "Oltretorrente" (166) as their neighbourhood. The least represented neighbourhood is Cortile San Martino.

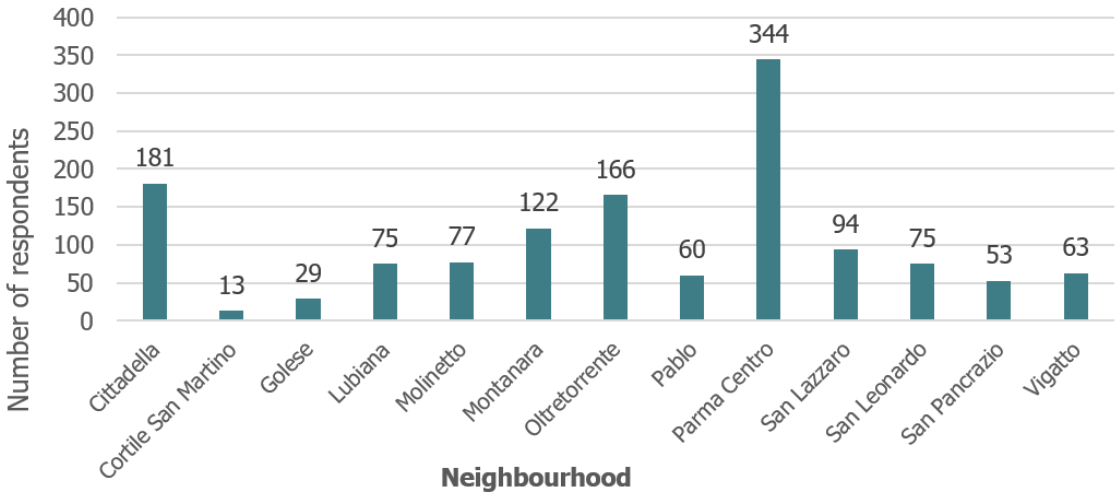

Fig.3 Distribution of the sample among the neighbourhoods

For what concerns the activities of the participants, most respondents were students (481) and employees in the public sector (391), followed by employees in the private sector (192), and by freelancers or entrepreneurs (120).

Finally, most people (631) selected that they are not active in social or volunteering activities, 302 are regularly involved in such regard, while 419 only occasionally.

The available open data allowed for the comparison of the demographic (independent) variables with the population of Parma, even though no open data concerning the activities or the social engagement of the citizens of Parma was found online. The results of this analysis (Fig.4) show that, in general terms, the urban population is well represented.

[4] The social and environmental data consisted of: the neighbourhood green areas retrieved from the four-level urban land use (Regione Emilia-Romagna, 2018); the demographic density (Comune di Parma, 2021), the mean age of the population (Comune di Parma, 2021); the soil consumption rates obtained with an elaboration based on the 2021 land consumption map of the Italian Institute for Environmental Protection and Research (Istituto Superiore per la Protezione e la Ricerca Ambientale, 2021); the Urban Heat Island (UHI) analysis (Rota, 2017) and the hydraulic hazard of the city (Comune di Parma, 2016).

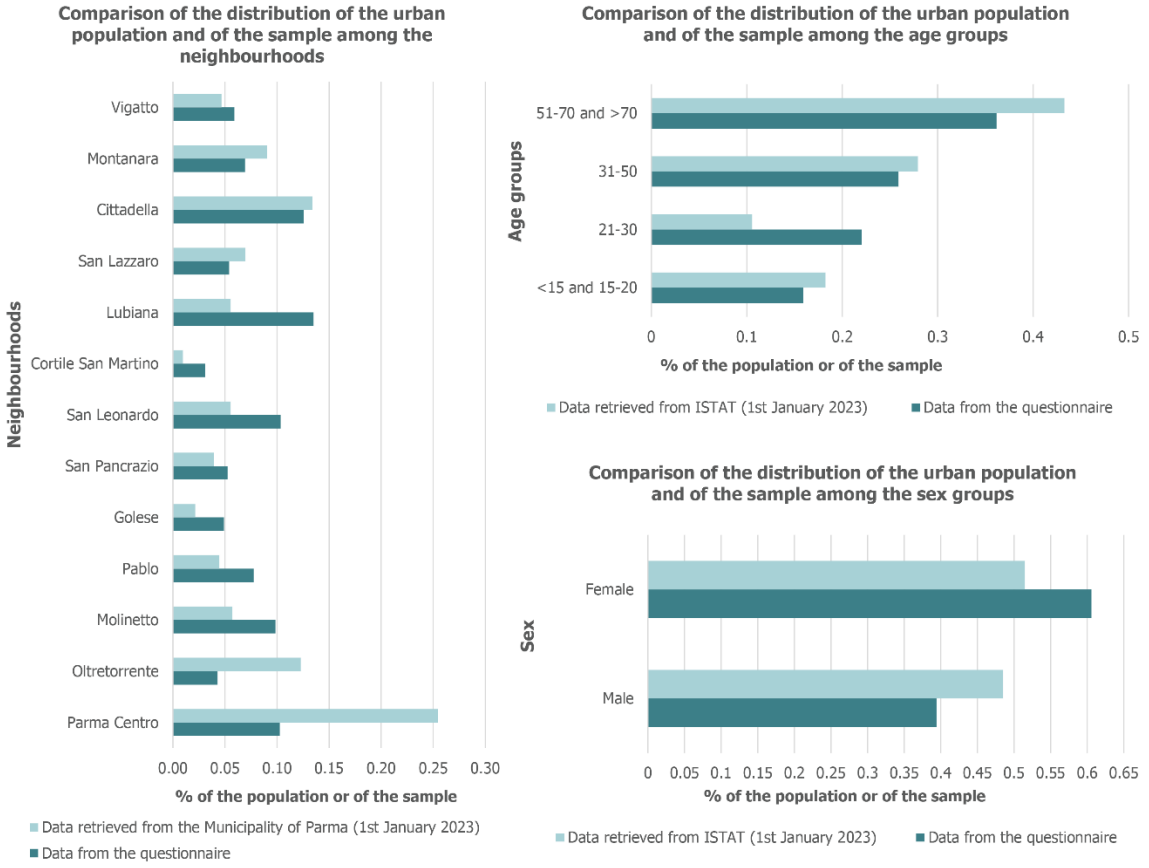

Fig.4 Comparison of the sample characteristics with those of the urban area

4.2 Climate change risks and effects variables

For what concerns the participants' perceived relevance of climate change on the regional territory (Relevance of climate change), the majority has a very clear idea (85.9%), while the remaining 14.1% are more doubtful. As shown by Tab.1, Question 8 was divided into five variables which were analysed separately. Results indicate that, for the city of Parma, 81.8% of the participants observed climate change impact on physical goods and/or properties, and 59.7% on drinking water. 62.2% of the respondents observed effects such as floodings, and 90% on health. Overall, 98.3% of the participants selected at least one answer other than "Non-significant impacts/I do not know" (None_Effects of climate change_City of Parma).

For what concerns the observed effects of climate change in their neighbourhood (Observed effects of climate change_Neighbourhood), most participants (66.7%) are doubtful if heat waves and prolonged droughts resulted in people feeling ill. This variable was therefore not further considered.

The analysis of the variable Observed effects of climate change_Neighbourhood, which investigates the respondents' observation of climate change effects in their neighbourhood, showed that 16.1% of the participants observed a high number of impacts, 30.3% a medium one, and more than half (53.1%) low or none.

4.3 Adaptation interventions variables

As shown by Tab.1, Question 12 was divided into four variables. 87.3% of the respondents believe that, concerning built-up areas, there is a need for NBSs in their neighbourhood, and 79.1% believe that it is necessary to employ grey measures (such as building rainwater storage tanks or refurbishing the aqueduct network). Among the participants, 60.6% would promote desealing. Overall, 92.5% of the respondents

selected at least one intervention. For what concerns the last variable (Perceived urgency of interventions_Green areas), 92.1% of the participants would intervene on green areas.

4.4 Results of the Chi-square tests

Chi-square tests were carried out between the independent and dependent variables listed in Table 2, according to the conceptual model represented in Fig.2 and Tab.2 provides an overview of the fulfilment of the conditions of the Chi-square tests (condition 1: less than 20% of expected counts is smaller than 5, and condition 2: there cannot be zero expected counts). All the tests except one fulfilled the aforementioned conditions. Tab.2 reports whether there is a difference between the groups which is statistically significant at a 5% significance level. Four tests resulted statistically significant.

Dependent variable	Independent variable	Are the conditions for the Chi-square test met?	Is the difference between the two groups statistically significant at a 5% significance level?
Relevance of climate change	Neighbourhood	✓	✗
Physical_Effects of climate change_City of Parma		✓	✗
Drinking water_*A/A*		✓	✗
Flooding_*A/A*		✓	✗
Health_*A/A*		✓	✗
None_*A/A*		✗	✗
Observed effects of climate change_Neighbourhood		✓	✓
NBSs_Perceived urgency of interventions_Built-up areas		✓	✗
Grey measures_*A/A*		✓	✓
Desealing_*A/A*		✓	✓
None_*A/A*		✓	✓
Perceived urgency of interventions_Green areas		✓	✗

Tab.2 Overview of the conducted Chi-square tests and their fulfilment of the chosen conditions. A/A stands for as above

Fig.s 5 and 6 encompass an overview of all the Chi-square tests results. The statistically significant tests will be described and compared with the socio-environmental data of each neighbourhood (Fig.7) in the following paragraphs, aiming to understand if and how living in and/or frequenting a neighbourhood influences the participants' answers.

The results of the Chi-square test between Observed effects of climate change_Neighbourhood and Neighbourhood show that the participants who observed most effects of climate change in their neighbourhood (Fig.5i) were from Cortile San Martino (38.5%) and San Pancrazio (34.0%). A medium level of climate change effects (Fig.5h) was mostly observed by respondents from Molinetto (41.6%) and Vigatto (41.3%), while the lowest level of effects (Fig.5g) was observed by participants from Pablo (68.3%) and San Leonardo (61.3%). The least sensitive neighbourhoods appear to be mostly the central and eastern neighbourhoods, which are also the ones with higher densities (Fig.7d). The central neighbourhoods are also those associated with higher soil consumption (Fig.7f). Medium and high numbers of effects are observed in the more peripheral neighbourhoods which show a higher percentage of agricultural and woods and seminatural area, decreased demographic densities and soil consumption (Fig.7a; 7b; 7c). The increased attention of the administration to the maintenance of central areas might be a reason for the decreased inhabitants' perception of the climate change effects.

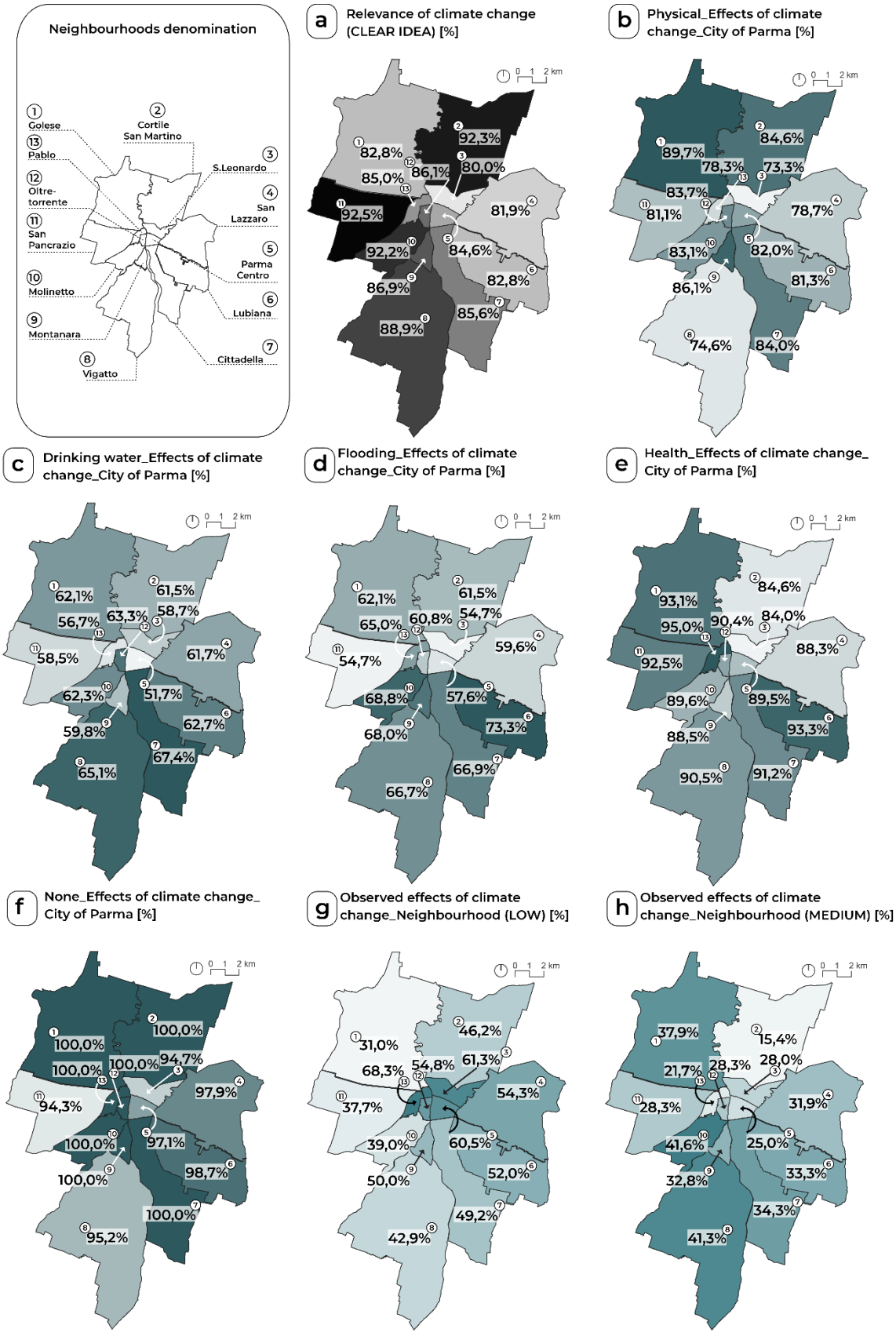

Fig.5 Results of the Chi-square tests between the Neighbourhood and the dependent variables - Part 1

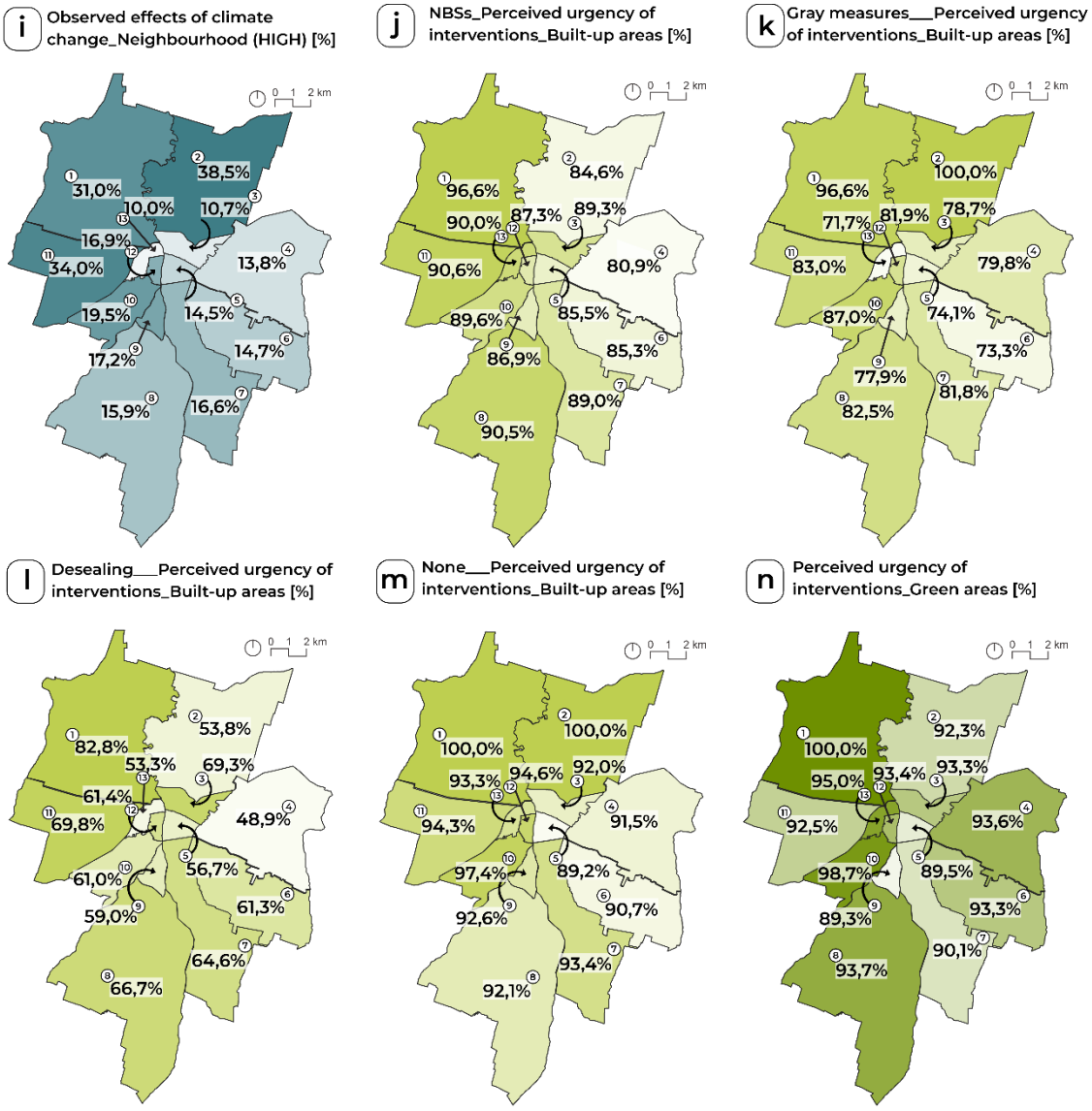

Fig.6 Results of the Chi-square tests between the Neighbourhood and the dependent variables - Part 2

Grey measures to face the climate change effects in built-up areas (Fig. 6k) appear to be needed the most by the Cortile San Martino (100%) and Golese (96.6%) inhabitants, and least desired by Pablo (28.3%) and Lubiana (26.7%).

Figure 8 shows the distribution among the neighbourhoods of people who selected zero, one, two, three, or four choices related to the urgency of grey measures on built-up spaces to face the climate change effects.

The urgency of desealing interventions (Fig.6l) is mostly perceived by Golese (82.8%) and San Pancrazio (69.8%) neighbourhoods, which show low percentages of urban greenery (Fig.7a), but not particular high demographic densities and soil consumption percentages (Fig.7d and 7f). They are however characterised by a high UHI effect (Fig.7g). More than half of the respondents from San Lazzaro (51.1%) and 46.7% from Pablo appear not to feel a particular need for desealing. San Lazzaro shows low urban greenery percentages, associated with a low UHI effect and soil consumption. On the other hand, Pablo is characterized by high soil consumption and urban greenery, and not by a very high UHI effect. The percentage of participants in each neighbourhood which perceive an urgency for desealing is lower compared to the other proposed interventions.

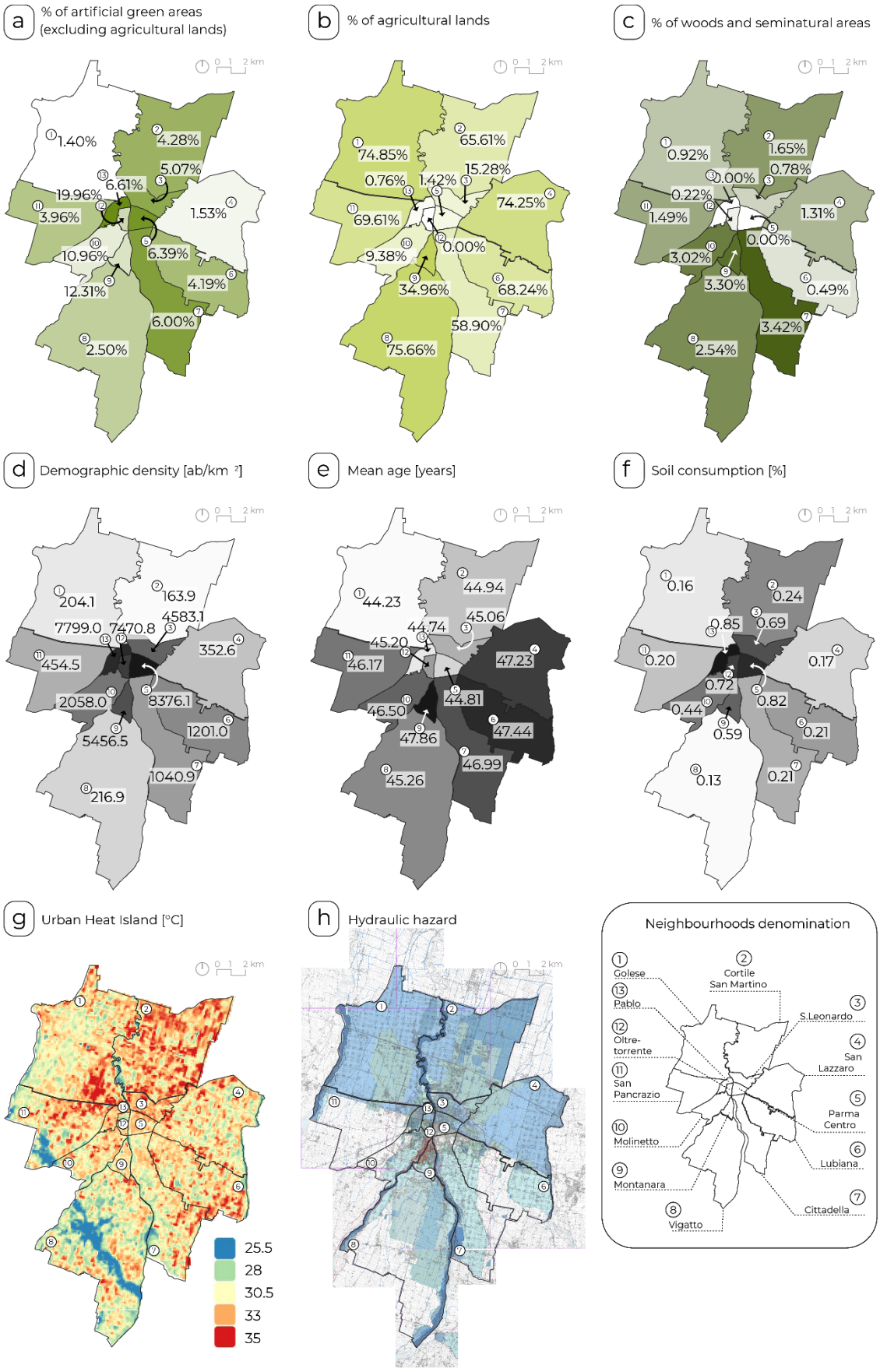

Fig.7 Socio-environmental characteristics of the neighbourhoods (the legend of Figure 7h is available on ssl.comune.parma.it with the query Delibera di Giunta n. 172 26/04/2017

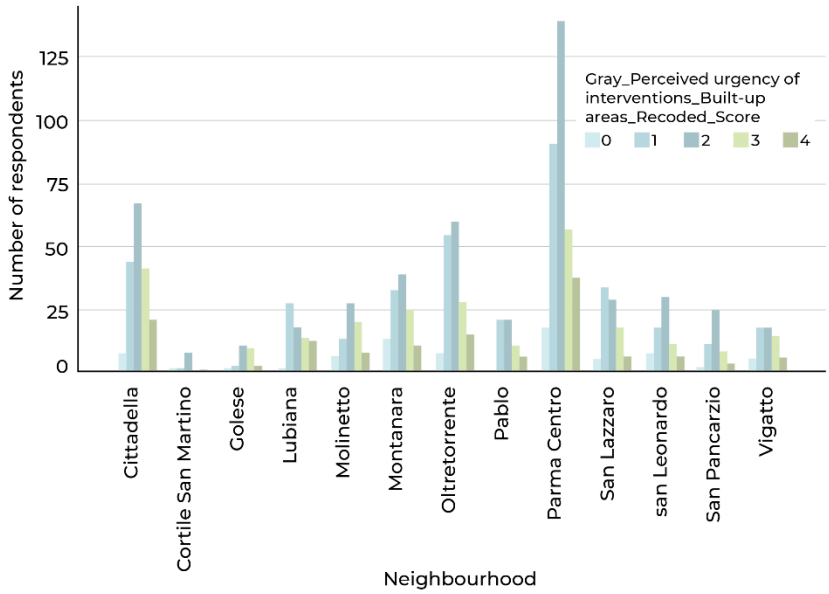

Fig.8 Distribution among the neighbourhoods of people who selected one, two, three, or four grey measures

This might be motivated by a lower knowledge about the concept of soil desealing and its benefits, being it a relatively new concept in the common citizens' knowledge: desealing was introduced in the regional legislative framework in 2017 with the Regional Law 24/2017 of the Emilia-Romagna Region.
All the neighbourhoods seem quite sensitive about the urgency of the interventions on grey areas (Fig.6j; 6k; 6l; 6m). The results of this Chi-square test show that all the respondents from two neighbourhoods (Cortile San Martino and Golese) appeared to think that at least one kind of intervention is necessary to face the climate change effects. This percentage decreases up to 89.2% for Parma Centro, where 10.8% of the participants do not feel the need for interventions in built-up areas.
In general, more than 80% of each neighbourhood respondents perceive an urgency for NBSs. The highest percentage was found in Golese, which is also the neighbourhood with the lowest urban greenery (Fig.7a). The central and eastern neighbourhoods show a lower perceived urgency of the interventions compared to the others, despite their high soil consumption and demographic density (Fig.7d and Fig.7f).

4.5 Results of the factor analyses

After carrying out Chi-square tests, factor analyses were conducted on three questions as well. Tab.3 puts into relation the analysed questions of the questionnaire with the identified factors, which emerged with the multiple-choices that were recurringly chosen together by the participants.

Question code	Factor number	Factor description	
Q8	1	Concerns about	Health and well-being
	2		Quality outdoor environment
	3		Water
	4		Degradation of public and private outdoor properties
Q12	1	Perceived urgency for	Water and rainwater-related interventions
	2		Rainwater drainage-related interventions

Question code	Factor number	Factor description
Q13	3	Improving thermal comfort
	1	Green-related interventions (green areas)
	2	Water and rainwater-related interventions (green areas)

Tab.3 Factors analyses results

5. Discussion

The results of the survey analysis allowed us to gather a general overview of the citizens' perception of climate change and its local effects. However, it appears relevant to make some further considerations.

For what concerns the survey design, it should be noted that it was initially intended as an explorative experiment, to be analysed with qualitative means. Only in the second phase, the opportunity to analyse it with quantitative methods appeared and some adjustments to the variables needed to be made.

Concerning the distribution of the survey, the resulting sample composition is a relevant matter to discuss. The analysed sample consisted mostly of students and public sector employees, almost certainly due to the University of Parma mailing list powerfulness compared to the other distribution means. The consequences on the results might be relevant, as, for instance, students might have moved to Parma only for study purposes and not have a deep knowledge of the urban area. In hindsight, it could have been appropriate to trace the access means to the survey to be able to assess if and what were the differences of the analyses results among them. Furthermore, even though some simple comparisons with the demographic characteristics of the population were carried out and showed overall positive results (Fig.4), working on increased representativeness of the urban population could be beneficial – focusing for instance on the involvement of the least considered neighbourhoods in the future steps of the bottom-up project. Furthermore, considering the voluntary nature of the survey, those who decided to participate are probably individuals who are more sensitive to climate change topics. Finally, for what concerns the survey analysis, as the soil consumption and demographic density maps (Fig.7d and 7f) highlight, it appears that central neighbourhoods show a higher soil consumption and are generally denser. It should be noted that the peripheral neighbourhoods of Parma present a heterogeneity in their urbanisation degree due to which the interpretation of the results might have been sometimes inaccurate. In this contribution, the administrative district perimeters of the Municipality of Parma were used as analysis areas, thus including also agricultural land. Future analyses and/or surveys might need to focus on the urbanised areas.

Furthermore, the qualitative discussion about the link of the Chi-square tests results with the neighbourhoods socio-environmental data could be deepened, for instance about the joined influence of the different neighbourhoods features. As observed for the perceived urgency of desealing interventions, a high soil consumption percentage in the neighbourhood associated with a high percentage of urban green areas might mitigate the perceived desealing urgency for the citizens.

Finally, the explorative and general nature of this survey might constitute a prelaminar step to more in-depth analyses of the neighbourhoods, which might involve the setup of experiments that explore the citizens' preferences for the interventions.

6. Conclusion

Considering these results, as well as the limits of online surveys in public participation processes, further steps of the project "Green in Parma" need to involve the neighbourhoods communities with in-person meetings and workshops. Urban transformation processes cannot do without the direct contact with the population, which allows to deepen the gathered insight, understand if it needs to be further investigated and/or corrected

and to capture feelings and emotions that cannot be translated into words. Therefore, the analyses results can be intended as a piece of the knowledge framework necessary to orient the future scenarios and empower the population. As highlighted by Beltramino et al. (2022), the lack of information about a system's components might hamper the effective implementation of resilient strategies, emphasising the importance of gaining information about system vulnerabilities to implement localised actions. The survey appeared to be successful in collecting information and involving the urban community, reflecting the "Green in Parma" project itself. The project showed good results in establishing communication, thus appearing to well represent - similarly to the first group of authors identified in Subsection 2.1 - a bottom-up demand for resilience actions. Technical ways to foster their concretisation may consist of pilot "demonstrative" desealing actions in the neighbourhoods most sensitive to climate change, its effects, and counteractions. Furthermore, it appears appropriate to propose participatory processes aimed at sharing and co-learning in the less sensitive ones, in a mutual knowledge exchange with the communities.

This contribution encompasses the first step results of a research methodology that aims to identify the most suitable urban areas and neighbourhoods for the implementation of soil desealing interventions, recognising the importance of promoting ecosystem services in urban planning through urban regeneration (Moraci et al., 2024). Further steps involve the setup of a stated choice experiment to investigate citizens' preferences and the proposal of co-design and co-planning workshops. The theoretical framework of this research unavoidably links the effectiveness of soil desealing interventions in limiting soil consumption (and its related issues) with urban planning measures that limit urban areas expansion while preserving natural and agricultural lands.

In this framework, the survey results relate to the decision-making process in different ways. First, they emphasise a bottom-up need of interventions with regard to climate change and its local effects, thus (hopefully) soliciting an intervention of the administration. The results may be practically translated in the knowledge framework documents of the Italian cities' urban and implementation plans. For instance, the new Parma general urban plan (PR050 - www.parma2050.eu) features extensive research about the socio-economic and environmental characteristics of the urban area. Furthermore, the survey results may guide the definition of regulations on both private space (e.g., the control over building permits or the activation of land take compensation measures or incentives for desealing actions) and public space (Lai & Zoppi, 2024): the perceived urgency of the interventions, the perception of the effects of climate change and the factors that guided the participants respondents can help determine the location, priorities, characteristics and communication strategy (and lexical choices) for the actions of the administration, also in relationship to the characteristics of the neighbourhoods.

For instance, the results concerning the observed effects of climate change may highlight the most vulnerable neighbourhoods, similarly to the perceived urgency of desealing (term which might need to be promoted among the citizens) and grey measures. The latter may also expose the neighbourhoods that would mostly welcome climate change adaptation actions and policies, thus influencing the priorities given by the administration to public interventions foreseen by, for instance, the Programmi triennali di intervento (three-year intervention programs). In the framework of the participatory processes set up by the municipalities, e.g. those of the new PR050 in the neighbourhoods, the survey results may represent an initial "gauging" of the areas.

Concrete case studies of survey implementation in urban planning practice are the cities of Bologna and Brescia. The first gathered insight from the citizens within the project Bologna Città 30, using the survey results to orient the project communication and to identify dangerous roads and public space lacking quality (Comune di Bologna, 2023). Similarly, the city of Brescia, within the implementation of its Climate Transition Strategy, asked the citizens to share, through a survey, potential areas to regenerate, and has now activated within the "SpaziAttivi" project a co-design, co-realisation, and management process for two of them (Comune di Brescia, 2024).

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Attributions

The authors jointly designed and contributed to the paper. Conceptualization: I.D.N., A.K., P.W., B.C.; methodology: A.K., P.W., I.D.N.; investigation: I.D.N.; data curation: I.D.N.; validation: A.K., P.W., B.C., S.R.; writing-original draft: I.D.N; writing – review and editing: I.D.N., A.K., P.W., B.C., S.R.; supervision: A.K., P.W., B.C., S.R.; corresponding author: I.D.N.

References

Adelman, I. (1990). Factor Analysis. In J. Eatwell, M. Milgate & P. Newman (Eds.), *Time Series and Statistics*, 90-94. Palgrave Macmillan UK. https://doi.org/10.1007/978-1-349-20865-4_9

Arnstein, S. R. (1969). A Ladder Of Citizen Participation. *Journal of the American Institute of Planners*, *35* (4), 216-224. https://doi.org/10.1080/01944366908977225

Balram, S. & Dragićević, S. (2005). Attitudes toward urban green spaces: Integrating questionnaire survey and collaborative GIS techniques to improve attitude measurements. *Landscape and Urban Planning*, *71* (2), 147-162. https://doi.org/10.1016/j.landurbplan.2004.02.007

Beltramino, S., Scalas, M., Rodriguez, D. J. C., Brunetta, G., Pellerey, F., Demichela, M., Voghera, A., Longhi, A., Mutani, G., Caldarice, O., Miraglia, G., Lenticchia, E. & Riccia, L. L. (2022). Assessing territorial vulnerability. *TeMA - Journal of Land Use, Mobility and Environment*, *15* (3), 355–375. https://doi.org/10.6093/1970-9870/9069

Boglietti, S. & Tiboni, M. (2022). Public spaces critical issues analysis for soft mobility. *TeMA - Journal of Land Use, Mobility and Environment*, 131–145. https://doi.org/10.6093/1970-9870/8643

Canesi, R., D'Alpaos, C. & Marella, G. (2022). A Case of Local Community Engagement for Urban Regeneration: The South Boston Area. In F. Abastante, M. Bottero, C. D'Alpaos, L. Ingaramo, A. Oppio, P. Rosato & F. Salvo (Eds.), *Urban Regeneration Through Valuation Systems for Innovation*, 217–228. Springer International Publishing. https://doi.org/10.1007/978-3-031-12814-1_13

Ceci, M., Caselli, B. & Zazzi, M. (2023). Soil de-sealing for cities' adaptation to climate change. *TeMA - Journal of Land Use, Mobility and Environment*, *16* (1), 121–145. https://doi.org/10.6093/1970-9870/9395

Ceci, M., De Noia, I., Tedeschi, G., Caselli, B. & Zazzi, M. (2023). Soil de-sealing and participatory urban resilience actions: The "Green in Parma" case study. *UPLanD - Journal of Urban Planning, Landscape & Environmental Design*, *7* (2), Article 2. https://doi.org/10.6093/2531-9906/10116

Centro Etica Ambientale (2021). *Presentazione del Progetto di Comunità Green in Parma—Orto Botanico dell'Università di Parma 29 ottobre 2021.* CEA-Parma edizioni digitali 2021.

Cervera, M., Bell, S., Muñoz, F., Mishra, H. S., Fleming, L. E., Grellier, J., Carrasco-Turigas, G., Nieuwenhuijsen, M. J., Vert, C. & Gascon, M. (2021). A Transdisciplinary Approach to Recovering Natural and Cultural Landscape and Place Identification: A Case Study of Can Moritz Spring (Rubí, Spain). *Int. J. Environ. Res. Public Health*, *18* (4), 1709.

Charli-Joseph, L., Siqueiros-García, J., Eakin, H., Manuel-Navarrete, D. & Shelton, R. (2018). Promoting agency for social-ecological transformation: A transformation-lab in the Xochimilco social-ecological system. *Ecology and Society*, *23*. https://doi.org/10.5751/ES-10214-230246

Comune di Bologna (2023). *Bologna Città 30, in 20mila hanno partecipato al questionario*. *www.comune.bologna.it/notizie/bologna-citta-30-in-20mila-hanno-partecipato-al-questionario*

Comune di Brescia (2024). *Spazi Attivi*. *www.comune.brescia.it/aree-tematiche/urban-center/progetto-un-filo-naturale/spazi-attivi*

Comune di Parma (2016). *Piano del Rischio Idraulico Comunale* [Review of *Piano del Rischio Idraulico Comunale*, by Studio Zanzucchi Srl].

Comune di Parma (2021). *La realtà socio-demografica dei quartieri di Parma al 31.12.2020*. www.comune.parma.it/comune/Statistica/quartieri-1_m1067.aspx

De Noia, I., Favargiotti, S. & Marzadri, A. (2022). *Renaturalising lands as an adaptation strategy. Towards an integrated water-based design approach. TeMA - Journal of Land Use, Mobility and Environment. 15 (2)*. doi.org/10.6093/1970-9870/9074

Eizenberg, E. (2019). Patterns of self-organization in the context of urban planning: Reconsidering venues of participation. *Planning Theory*, *18* (1), 40-57.

Few, R., Brown, K. & Tompkins, E. L. (2007). Public participation and climate change adaptation: Avoiding the illusion of inclusion. *Climate Policy*, *7* (1), 46-59. https://doi.org/10.1080/14693062.2007.9685637

Franco, S. & Cappa, F. (2021). Citizen science: Involving citizens in research projects and urban planning. *TeMA - Journal of Land Use, Mobility and Environment*, *14* (1), 114-118. https://doi.org/10.6092/1970-9870/7892

Frantzeskaki, N., McPhearson, T., Collier, M. J., Kendal, D., Bulkeley, H., Dumitru, A., Walsh, C., Noble, K., van Wyk, E., Ordóñez, C., Oke, C. & Pintér, L. (2019). Nature-Based Solutions for Urban Climate Change Adaptation: Linking Science, Policy, and Practice Communities for Evidence-Based Decision-Making. *BioScience*, *69* (6), 455-466. https://doi.org/10.1093/biosci/biz042

García de Jalón, S., Chiabai, A., Tague, A., Artaza, N., Ayala, A., Quiroga, S., Kruize, H., Suárez, C., Bell, R. & Taylor, T. (2020). Providing Access to Urban Green Spaces: A Participatory Benefit-Cost Analysis in Spain. *International Journal of Environmental Research and Public Health*, *17*, 2818. https://doi.org/10.3390/ijerph17082818

Garda, E. (2019). Let's get dirty! Le azioni di depaving dei suoli urbani per la multifunzionalità degli spazi sottoutilizzati. *Altre Modernità*, 164-178. https://doi.org/10.13130/2035-7680/12150

Geropanta, V., Karagianni, A., Parthenios, P., Ampatzoglou, T., Fatouros, L., Simantiraki, V., Brokos-Melissaratos, O. & Eleftheriadis, D. (2022). *Digitalization of Participatory Greening - The case of UnionYouth in Chania*. 469-478. doi.org/10.52842/conf.ecaade.2022.1.469

Girard, C., Pulido-Velazquez, M., Rinaudo, J.-D., Pagé, C. & Caballero, Y. (2015). Integrating top–down and bottom–up approaches to design global change adaptation at the river basin scale. *Global Environmental Change*, *34*, 132-146. https://doi.org/10.1016/j.gloenvcha.2015.07.002

Gobo, G. (2004). Sampling, Representativeness and Generalizability. In C. Seale, G. Gobo, J. Gubrium & D. Silverman, *Qualitative Research Practice*, 405-426. SAGE Publications Ltd. https://doi.org/10.4135/9781848608191.d34

Istituto Superiore per la Protezione e la Ricerca Ambientale (2021). *Carta nazionale di copertura del suolo 2021* [dataset]. www.isprambiente.gov.it/it/attivita/suolo-e-territorio/suolo/copertura-del-suolo/carta-nazionale-di-copertura-del-suolo

Kuokkanen, K. & Palonen, Em. (2018). Post-Political Development and Emancipation: Urban Participatory Projects in Helsinki. In *Public Space Unbound*. Routledge.

Lai, S. & Zoppi, C. (2023). Factors affecting the supply of urban regulating ecosystem services. Empirical estimates from Cagliari, Italy. *TeMA - Journal of Land Use, Mobility and Environment*, 7-32. https://doi.org/10.6093/1970-9870/10194

Mayrhofer, R. (2018). Co-Creating community gardens on untapped terrain – lessons from a transdisciplinary planning and participation process in the context of municipal housing in Vienna. *Local Environment*, *23* (12), 1207-1224. https://doi.org/10.1080/13549839.2018.1541345

Meroni, A. & Selloni, D. (2022). *The Rise of Co-design Processes for Urban Commons*, 11–22. https://doi.org/10.1007/978-3-031-06035-9_2

Moraci, F., Bevilacqua, C. & Pizzimenti, P. (2024). Planning the transition of cities. Innovative research approaches and trajectories. *TeMA - Journal of Land Use, Mobility and Environment*, *17* (1), 109-127. https://doi.org/10.6093/1970-9870/10430

Nicolini, E. & Pinto, M. R. (2013). Strategic Vision of a Euro-Mediterranean Port City: A Case Study of Palermo. *Sustainability*, *5* (9), Article 9. https://doi.org/10.3390/su5093941

Paez, D. (2003). Spatial and Temporal Representation of Environmental Policy Outcomes Using Geo-Computation: A Case Study in Victoria, …. *San Diego, USA*.

Pissourios, I. (2014). Top-Down and Bottom-up Urban and Regional Planning: Towards a Framework for the Use of Planning Standards. *European Spatial Research and Policy*, *21* (1), 83-99.

Poortinga, W., Whitmarsh, L., Steg, L., Böhm, G. & Fisher, S. (2019). Climate change perceptions and their individual-level determinants: A cross-European analysis. *Global Environmental Change*, *55*, 25-35. https://doi.org/10.1016/j.gloenvcha.2019.01.007

Puerari, E., Concilio, G., Longo, A. & Rizzo, F. (2013). *Innovating public services in urban environments: A SOC inspired strategy proposal*.

Ranjbar Nooshery, N., Taleai, M., Kazemi, R. & Ebadi, K. (2017). Developing a web-based ppgis, as an environmental reporting service. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *XLII-2-W7*, 115–121. doi.org/10.5194/isprs-archives-XLII-2-W7-115-2017

Regione Emilia-Romagna, S. S., Comunicazione, Sistemi Informativi geografici, Partecipazione. (2018). *Database uso del suolo di dettaglio 2014* (S. Corticelli, M. L. Garberi, M. Bocci, M. C. Mariani & S. Masi, Eds.).

Rota, P. (2017). *Una fragilità adattabile. Mappe climatiche e indirizzi urbanistici per la resilienza dei quartieri residenziali della città media emiliana. An adaptable fragility. Urban climatic maps and guidelines to the resiliency of the residential neighbourghoods of the middle Emilian city.* [Tesi di dottorato, Università di Parma].

Salata, K. D. & Yiannakou, A. (2016). Green Infrastructure and climate change adaptation. *TeMA - Journal of Land Use, Mobility and Environment*, *9* (1), 7–24. https://doi.org/10.6092/1970-9870/3723

Santoro, S., Balena, P. & Camarda, D. (2020). Knowledge Models for Spatial Planning: Ecosystem Services Awareness in the New Plan of Bari (Italy). *Sustainability*, *(4)*. https://doi.org/10.3390/su12041516

Schröter, B., Gottwald, S., Castro-Arce, K., Hartkopf, E., Aguilar-González, B. & Albert, C. (2023). Virtual participatory mapping of nature-based solutions in the Grande de Tárcoles River basin, Costa Rica: Connecting diverse knowledge systems in a context of physical immobility. *Science of The Total Environment*, *872*, 162195. https://doi.org/10.1016/j.scitotenv.2023.162195

Semeraro, T., Nicola, Z., Lara, A., Sergi Cucinelli, F. & Aretano, R. (2020). A Bottom-Up and Top-Down Participatory Approach to Planning and Designing Local Urban Development: Evidence from an Urban University Center. *Land*, *9* (4), Article 4. https://doi.org/10.3390/land9040098

Seve, B., Domínguez, E. R. & Martínez, Z. M. (2023). Urban notes. Conscious and participatory drawing. *EGA Expresión Gráfica Arquitectónica*, *28* (48), Article 48. https://doi.org/10.4995/ega.2023.16878

Seve, B., Redondo, E. & Sega, R. (2023). Facetas de la co-creación urbana. *ACE: Arquitectura, Ciudad y Entorno*. https://doi.org/10.5821/ace.17.51.11694

Sharifi, A., Chelleri, L., Fox-Lent, C., Grafakos, S., Pathak, M., Olazabal, M., Moloney, S., Yumagulova, L. & Yamagata, Y. (2017). Conceptualizing Dimensions and Characteristics of Urban Resilience: Insights from a Co-Design Process. *Sustainability*, *9* (6), 1-20. https://doi.org/10.3390/su9061032

Smith, L. G. (2014). Impact Assessment and Sustainable Resource Management. Routledge. https://doi.org/10.4324/9781315846187

Stelzle, B., Jannack, A. & Rainer Noennig, J. (2017). Co-Design and Co-Decision: Decision Making on Collaborative Design Platforms. *Procedia Computer Science*, *112*, 2435-2444. https://doi.org/10.1016/j.procs.2017.08.095

Stobbelaar, D. J., van der Knaap, W. & Spijker, J. (2021). Greening the City: How to Get Rid of Garden Pavement! The 'Steenbreek' Program as a Dutch Example. *Sustainability*, *13* (6), Article 6. https://doi.org/10.3390/su13063117

Strange, K., Satorras, M. & March, H. (2022). Bridging Urban Climate Justice and Participatory Governance to Explore the Transformative Capacity of Climate Resilience. In I. Ruiz-Mallén, H. March & M. Satorras (Eds.), *Urban Resilience to the Climate Emergency: Unravelling the transformative potential of institutional and grassroots initiatives*, 21–42. Springer International Publishing. https://doi.org/10.1007/978-3-031-07301-4_2

Tiellemans, N. H. M., Kemperman, A. D. A. M., Maussen, S. J. E. & Arentze, T. A. (2022). The influence of group decision making on residents' preferences for sustainable energy measures of dwellings. *Building Research & Information*, *50* (4), 410-423. https://doi.org/10.1080/09613218.2021.1992261

Vaňo, S., Stahl Olafsson, A. & Mederly, P. (2021). Advancing urban green infrastructure through participatory integrated planning: A case from Slovakia. *Urban Forestry & Urban Greening*, *58*, 126957. https://doi.org/10.1016/j.ufug.2020.126957

Verboven, R. (2021). *The preferences and willingness to pay of urban residents in the Netherlands regarding Green-Based Solutions for heat adaptation* [Eindhoven University of Technology].

Vogt, S. (2002). Citizens' participation in urban planning in Tôkyô. *Geographische Rundschau*, *54* (6), 50-53.

Voinov, V., Balakrishnan, N. & Nikulin, M. S. (2013). *Chi-squared goodness of fit tests with applications*. Elsevier/AP.

Weber, E. U. (2016). What shapes perceptions of climate change? New research since 2010. *WIREs Climate Change*, *7* (1), 125-134. https://doi.org/10.1002/wcc.377

Zagare, V. (2018). Towards a Method of Participatory Planning in an Emerging Metropolitan Delta in the Context of Climate Change: The Case of Lower Paraná Delta, Argentina. *A+BE | Architecture and the Built Environment*, *25*, Article 25. https://doi.org/10.7480/abe.2018.25.2660

Image Sources

Fig.1, 2, 3, 4: Elaboration by the authors;

Fig.5, 6: Elaboration by the authors. The perimeter of the neighbourhoods was retrieved from the Municipality of Parma open data website;

Fig.7: Elaboration by the authors, partially based on data retrieved from:
- Delibera di Giunta n. 172 26/04/2017 "Approvazione della proposta di Piano di Rischio Idraulico (PRI) del Comune di Parma" available on the website ssl.comune.parma.it for the hydraulic hazard map;
- Rota, P. (2017). Una fragilità adattabile. Mappe climatiche e indirizzi urbanistici per la resilienza dei quartieri residenziali della città media emiliana. An adaptable fragility. Urban climatic maps and guidelines to the resiliency of the residential neighbourghoods of the middle Emilian city. [Tesi di dottorato, Università di Parma]. www.repository.unipr.it/handle/1889/3455 for the land surface temperature map (Aster/CNR-IBIMET Florence data, June 2015).
The perimeter of the neighbourhoods was retrieved from the Municipality of Parma open data website;

Fig. 8: Elaboration by the authors.

Authors' profiles

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Building Engineer and Architect, she graduated in 2021 from the University of Trento with a thesis focused on Nature-based solutions for territorial (re)development. Since 2022, Ilaria has been pursuing a Ph.D. in Civil Engineering and Architecture at the University of Parma, exploring the role of soil desealing as an urban adaptation strategy. During her visiting semester at Eindhoven University of Technology, her research investigated the contribution of citizens involvement in this framework.

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He studied Transportation at the National Academy of Planning, Transportation and Logistics in Tilburg and Human Geography at Utrecht State University. Since 1986, he is a lecturer/researcher at the Urban Planning and Transportation group of Eindhoven University of Technology, the Netherlands. He provides education in Transportation Engineering and Geographic Information Systems. His main research areas concern the design and use of car, cycling, and pedestrian facilities with a focus on the relationship between these facilities and people's travel decisions.