

Research

## Visions for development and management of urban green and blue infrastructure: a citizen's perspective

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**ABSTRACT.** Ongoing urbanization leads to problems such as densification, loss of biodiversity, and social injustice in cities. For increasing urban populations, green–blue infrastructure (GBI) is an important element in compact cities contributing to human health, well-being, and the provision of important ecosystem services. We analyzed responses from two open-ended questions about visions, ideas, and topics for the development and management of GBI important for citizens of the city of Leipzig, Germany. The questions were part of an online survey accompanying the development of the local GBI planning strategy: Master Plan Green. The strategy is focusing on five guiding themes that are leading local and global debates about sustainable and resilient cities: biodiversity, climate adaptation, environmental justice, health, and sustainable mobility. We categorize citizens' ideas and suggestions, summarize frequent problems and conflicts, and link ideas and visions to the five guiding themes. As the last step, we discuss citizens' suggestions in order to minimize conflicts in GBI and to identify deficits in present local planning. Major problems and conflicts that were addressed by respondents relate to quality, usability, other users, activities, and safety and security of GBI. Numerous suggestions aimed to tackle these problems, for example, by designating separate use areas, adding naturalness, improving maintenance, and enhancing facilities. A range of ideas and suggestions were based on diverging expectations underpinning the challenge of matching heterogeneous demands of GBI users in an equitable fashion. Linking these suggestions to the five guiding themes reveals that most ideas are covered by one or several guiding themes and are considered in local planning strategies. However, findings also demonstrate that increasing the quantity of Leipzig's GBI is a central request from respondents. Sociocultural and economic aspects as well as conflicting demands among citizens should further be central to GBI planning to avoid injustice and achieve sustainability objectives. This analysis gives insights into opinions and visions of citizens regarding the development of the city's GBI network and thus substantiates major strategic and planning themes leading global and local urban strategies toward sustainable cities. Considering specific suggestions and GBI deficits that bother citizens on a local level, offers the opportunity to improve the social and ecological resilience of GBI.

**Key Words:** *compact green city; citizen participation; land use change; planning; urban green spaces*

### INTRODUCTION

The majority of global and European cities are facing similar problems: increasing urban populations leading to urban densification, soil sealing, biodiversity loss, and social injustice and segregation (de Oliveira et al. 2011, European Commission 2011). Climate change further contributes to increasing environmental challenges and extreme events such as heat waves, droughts, and heavy rainfalls especially affecting urban areas (European Environment Agency 2016a, Chapman et al. 2017). Going along with change in land use, essential ecosystem services directly or indirectly influencing human well-being, are under threat or negatively affected in urban areas (Millennium Ecosystem Assessment 2005, CBD 2010, Naturkapital Deutschland - TEEB DE 2016, McDonald et al. 2018).

To meet these challenges, many growing cities are focusing on densification rather than urban sprawl, simultaneously aiming at maintaining or increasing environmental quality and avoiding land sealing and loss of natural or agricultural land (European Environment Agency 2015, 2016b). City concepts like the compact green and sustainable city rely on mixed land use with nearby infrastructure for education, recreation, and transportation leading to land competition between gray infrastructure and green–blue infrastructure (GBI) (Burton 2000, European Environment Agency 2015). The compact green city thus requires a smart integration of multifunctionality, environment, and governance (BMUB 2007, Haaland and van den Bosch 2015,

Artmann et al. 2019). An efficient and strategically planned urban GBI providing multiple ecosystem services thereby plays a key role in the city concept (Artmann et al. 2019). In the current COVID-19 pandemic, we have come to realize the importance of accessible urban GBI, providing multiple benefits for human well-being and for the resilience of cities during a crisis (Ugolini et al. 2020, Venter et al. 2020).

It is commonly accepted that GBI such as urban parks, urban forests, vacant lots, urban gardens, street trees, and façade greening (green infrastructure) as well as rivers, streams, canals, and ponds, (blue infrastructure) provides essential ecosystem services and benefits to the urban population (Bolund and Hunhammar 1999, European Environment Agency 2014, Haase et al. 2014). Benefits derived from GBI range from microclimate regulation, pollution reduction, and rainwater drainage to recreational services and noise reduction, from which urban citizens directly benefit, i.e., they are demanded and used locally (Bolund and Hunhammar 1999, Breuste et al. 2013, Gómez-Baggethun and Barton 2013, Elmqvist et al. 2015). Further evidence exists about the positive impacts of biodiversity on human well-being, for example, increasing psychological health and stress relief (Fuller et al. 2007, Jorgensen and Gobster 2010, Dallimer et al. 2012, Marselle et al. 2020). The actual flow and provision of benefits and ecosystem services increase with the GBI's accessibility, availability, and with their quality, referring to available facilities, maintenance, and vegetation (Schipperijn

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et al. 2010, Hegetschweiler et al. 2017, Andersson et al. 2019). GBI with medium and high structural or landscape structure diversity including multiple biotopes, multi-layered vegetation structure, and different facilities, for example, hosting nature-related activities such as bird-watching and enjoying fresh air (Palliwoda et al. 2020, Vierikko et al. 2020).

Diverse cultural, personal, and socio-demographic backgrounds, beliefs, and worldviews are furthermore shaping the flow of benefits as well as preferred GBI demands, design, and management (Özgüner 2011, Hegetschweiler et al. 2017, Andersson et al. 2019). Different expectations from urban nature can thereby lead to conflicting demands among different user groups. Residents with a migration background in the Netherlands, for example, use urban parks more often for barbecues and family gatherings (Peters et al. 2010), which might be perceived as a nuisance by other user groups (Lyytimäki and Sipilä 2009). Diverging expectations make it challenging for planners to meet the demands of diverse stakeholders under the pressure of increasing urban populations. However, governance and planning strategies that include active participation of citizens and public consultations are leading to increased acceptance of decision-making as well as increased environmental, institutional, and social resilience of GBI (Buijs et al. 2016, Dennis and James 2016, Jacobs et al. 2016). The assessment and integration of multiple views and perceptions into GBI planning are thus urgently needed to minimize potential conflicts between different stakeholders (Hansen and Pauleit 2014). But how can GBI planning fulfill these multiple demands in a growing city competing with increasing spatial demands for housing, public service, transport, and education? How should GBI be designed, managed, and maintained to meet the quality standards researchers, planners, and citizens are calling for and to avoid user conflicts as far as possible? This study aims at assessing citizens' diverse ideas, suggestions, and visions for urban GBI development, underlying conflicts, problems, and the match and mismatch between citizens' demands and local planning objectives.

The situation for medium-sized and larger cities in Germany illustrates a typical pattern of urbanization processes and redevelopment of growing cities in the European Union (European Commission 2011). The city of Leipzig, for example, was affected by a long period of shrinkage and has experienced dynamic new growth of its population in the last decade (a more detailed information on the case study follows in the methods section). Therefore, to an increasing extent, open land is being (re)used, for example, for infrastructure, commercial and cultural, education, and housing purposes, and the city's GBI is characterized by increasing use density. To meet the multiple demands on GBI in Leipzig, the local planning strategy "Master Plan Green" (Masterplan Grün) (Stadt Leipzig 2020c) is being developed to which results of this paper are also contributing. The strategy will present spatial foci for implementing and maintaining ecosystem functions and services of GBI in the city-wide context including the creation of a multifunctional network connecting neighborhoods. To consider and integrate the citizens' perspective, the process is characterized by a participation process including workshops, panels, and an online survey to capture citizens' views on current use, problems, and conflicts between activities and users, and visions for the future development of

Leipzig's GBI (Stadt Leipzig 2018). The Master Plan Green will be led by five guiding themes structuring the discussion about GBI development: biodiversity, climate adaptation, environmental justice, healthy living & environmental conditions (health), and sustainable mobility (Stadt Leipzig 2020c). These guiding themes are not only relevant in the city of Leipzig but also lead the current debate about the future development of cities all over the world (European Commission 2011, Elmqvist et al. 2013, Wolch et al. 2014). The UN sustainable development goal (SDG) "Sustainable communities and cities" (Goal 11), for example, formulates the target to provide a "safe, affordable, accessible, and sustainable transport system (...)" (Target 11.2) as well as "universal access to safe, inclusive, and accessible green and public spaces (...)" (Target 11.7) reflecting the guiding themes sustainable mobility and environmental justice. Climate adaptation, biodiversity, and health are further represented in the SDG catalog (Goal 13: Climate action, Goal 15: Life on land, and Goal 3: Good health and well-being) (United Nations 2015). To achieve these objectives for sustainable and resilient cities and to meet current challenges like increased energy use for transportation, unjust living conditions, social segregation, and threatened biodiversity that arise from increasing land use change, the compact green city with high-qualitative GBI is thereby part of the solution (European Commission 2011, Güneralp et al. 2013, Müller et al. 2013).

In this light, we analyze the citizens' perspectives and ideas for the future development of GBI that were assessed in an online survey under the framework of the guiding global themes. In this study, we (1) summarize ideas and suggestions on how to improve GBI and topics for its future development that are important to citizens, (2) identify emerging major problems and conflicts in Leipzig's GBI, and (3) link citizens' ideas, suggestions and topics with the five guiding themes (biodiversity, climate adaptation, environmental justice, health, and sustainable mobility), in order to define these guiding themes from a citizen's view.

We then discuss ideas and suggestions as possible solutions for current problems and conflicts and illustrate the citizens' views on the five guiding themes in relation to local policies and planning strategies. The aim of the study is to emphasize citizens' perspectives to decrease potential conflicts, integrate multiple values into the new Master Plan Green planning strategy, and to reveal deficits between planning and the citizens' visions of future developments of urban GBI.

## METHODS

### Case study

Leipzig covers about 30,000 ha and counts more than 600,000 inhabitants (Stadt Leipzig 2020b). The city was characterized by a long period of shrinking, especially after the German reunification in 1990, due to de-industrialization, demographic decline, suburbanization, and emigration (Haase 2008, Mathey and Rink 2020). These processes shaped the cityscape by generating more than 2000 vacant sites (brownfields) of former industrial, residential, or commercial use, covering an area of more than 700 hectares (Muschak et al. 2009). Nevertheless, massive suburbanization took place accompanied by the designation of new commercial and residential areas on former agricultural land in the surrounding area of the city leading to

urban sprawl (Mathey and Rink 2020). In the 2000s, the city first experienced moderate growth in the form of re-urbanization, and since the early 2010s, there has been dynamic growth. For several years, Leipzig was the fastest growing major city in Germany with annual growth rates of 2-3% (approx. 8500 citizens per year). This has led to growing pressure on the remaining open spaces, especially in the inner city (Stadt Leipzig 2019b). Population growth is mainly driven by young people less than 30-years old, who prefer to move to neighborhoods close to the city center, which are often characterized by residential buildings of the Wilhelminian period around 1900 (Gründerzeit) and low available GBI per capita. Some of the numerous unused spaces (brownfields) that were generated during the shrinking process had been developed for recreational use by interim-use strategies (Rall and Haase 2011) or developed into valuable habitats due to natural succession. Nowadays, especially in popular neighborhoods, they have become opportunities for residential and commercial development and are highly valued for investment (European Environment Agency 2015, Stadt Leipzig 2019a) as well as being used as informal green space for recreational activities (Pueffel et al. 2018, Palliwoda et al. 2020).

Today, more than 11% of the total city area is covered with green open areas including allotment gardens and public parks (Stadt Leipzig 2019b). Another 7% is covered with forest area, which is mainly characterized by the riparian forest running arch-shaped from the southwest to the northwest of the city, providing multiple regulating and habitat ecosystem services as well as recreational space for city dwellers. In addition, the city provides multiple lakes (“Neuseenland”) in the urban fringe that were established in areas formerly used for coal mining (Stadt Leipzig 2017b).

### Survey Data

As part of the participation process of the Master Plan Green an online survey was set up (Appendix A1). The online survey was developed by the city’s Office of Green Space and Water and a local urban planning firm (StadtLabor<sup>[1]</sup>) and was available from March–May 2019 at the official website (Stadt Leipzig 2020a). The survey was announced in the local newspaper, the city magazine, the official journal, and via mailing lists. In total, the survey contained 30 thematic questions including closed-end questions, two open questions, and questions about personal data (Appendix A1). In addition to questions about the current use, use frequencies, valuation, and conflicts or problems of GBI, the survey explores ideas, visions, and topics for the future development of Leipzig’s GBI with regard to the five guiding themes. In the last section, the survey asked for socio-demographic data of respondents. For the purpose of this study, our analysis focuses on the two open-ended questions about participants’ ideas, visions, and topics related to GBI in Leipzig. The open questions analyzed for this study were as follows:

- 1) Do you have specific ideas about how Leipzig’s green and water spaces could be improved?
- 2) Are there further topics of GBI that are important to you? Do you have suggestions and topics that should be included in the Master Plan Green?

Answers ranged from a few words to several sentences. The results of the closed questions about current use, valuation, and conflicts or problems of GBI are published in a report (StadtLabor Träger+

Mothes GbR 2019, in German only). Our study complements this report with a quantified qualitative analysis of the respondents’ ideas, visions, and further important topics to improve Leipzig’s GBI.

### Data analysis

All data were processed in MAXQDA (version 12.1.3) and R (version 3.6.1). First, we tagged every answer from the online survey with categories representing frequently mentioned ideas and further topics in MAXQDA. Categories were developed from the ideas, suggestions, and topics addressed in the answers (frequently mentioned words, phrases, and parameters). Respondents were often mentioning more than one category (e.g., suggestions referring to near-natural maintenance and rubbish / more rubbish bins). Counts of each category were quantified in R (R Core Team 2020) and visualized with the R plotting package ggplot2 (Wickham 2016).

Next, we summarized categories of ideas, suggestions, and topics into frequently emerging conflicts and problems occurring in Leipzig’s GBI.

In a third step, categories were allocated to the five guiding themes of the Master Plan Green (biodiversity, climate change adaptation, environmental justice, health, and sustainable mobility). If not comprised by a guiding theme, they form an additional aspect (further themes). The allocation was done on the basis of existing literature and in two expert workshops with the researchers that were co-authoring this paper and one further member of the city’s Office of Green Space and Water. Workshop members had professional backgrounds in landscape and urban ecology, urban and environmental sociology, and green space planning.

In order to reveal deficits and representation, citizens’ ideas, topics and suggestions were contextualized to local planning concepts and strategies that are underlying the Master Plan Green. There are three main documents relevant for GBI development in Leipzig: the integrated urban development concept 2030 (INSEK), the open space strategy, and the street tree concept 2030 (Appendix A2)

## RESULTS

### Ideas, topics, and visions of citizens

The survey had 3559 participants. Of these, 1851 respondents specified one or several ideas and 1228 respondents named one or several topics that are important to them. In total, respondents raised 3808 ideas (question 1) that were aggregated into 40 categories. From the valid responses about further important topics (question 2), we summarized 2917 suggestions that were aggregated into 42 categories (Fig. 1). Ideas and topics mainly cover similar aspects and could thus be arranged into the same comprehensive category framework of 44 categories, of which only six (cultural events and uses, social and environmental justice, more green spaces in residential areas, more beaches/use of water, more housing/parking space, sustainable use of energies) were exclusively used for either ideas or topics. More than 56% of respondents were female, 0.5% specified diverse gender, 39% were male and about 4% did not specify their gender. The average age of respondents was 39 and about two-thirds of respondents have a net income of more than 2000€ per month (Appendix A3). The average net income was 1750€ and was thus slightly above the

**Fig. 1.** Ideas (n = 3808 from 1851 respondents) and further topics (n = 2917 from 1228 respondents) of citizens to improve GBI of Leipzig, aggregated into categories. In an open question, respondents could name ideas to improve Leipzig’s GBI and further topics that are important to them and should be included in the Master Plan Green. The colors represent the allocation to one or several (hatched) of the five guiding themes that are leading the development of the Master Plan Green in Leipzig (Biodiversity, Climate adaptation, Environmental justice, Health, Sustainable mobility). Aspects that were not covered by a guiding theme are colored in gray (Further themes).



average individual net income in Leipzig, which amounted to € 1438 in 2019 (Appendix A3). The majority of respondents (96%) were born in Germany and have a university degree (Appendix A3). In the following, only the ten most frequent categories that were mentioned by respondents in both open-ended questions are described in the text, the others are listed and described in detail in Table A4 in the Appendix and are presented in Figure 1.

The most frequently mentioned category for both questions referred to the installation of rubbish-bins and rubbish-related problems in GBI (498 out of 3808 answers in ideas, 170 out of 2917 answers in topics, Fig. 1). Citizens asked for more rubbish bins, including an adapted design to avoid rubbish dispersion by animals, and possibilities for waste removal of dog feces (“dog

stations”). Following this aspect, two categories referring to quantitative aspects were prevalent among responses, namely generally more green spaces (283 answers in ideas, 236 answers in topics) and more trees in streets, backyards, and parks or less deforestation or removal of existing trees on streets and in the riparian forest (313 responses in ideas, 162 answers in topics). Increasing biodiversity in terms of integration of wildflower meadows as habitats for insects and butterflies in urban parks (increase biodiversity) was suggested by 148 persons within topics and by 209 persons for the ideas question. The subsequent category includes requests for improving and expanding infrastructure in GBI for pedestrians and cyclists, raised by 122 respondents in ideas and 210 respondents in topics. Other categories that are following refer to the improvement and

installation of adequate facilities such as benches, playgrounds, and accessible paths (improve facilities and paths), the preservation or renaturation of brownfields and vacant lots between buildings (preservation of brownfields), the wish for the presence of more regulatory authorities in order to impose more consequences for those disturbing the activities of others in public green spaces, e.g., for dog owners not removing dog feces or users littering (more regulatory authority and fines), less space for parking and speed limits for cars in residential areas in favor of the expansion of GBI (fewer cars/parking space) as well as generally less construction of new houses and soil sealing in the city (less building development). Table A4 in the Appendix displays all other categories including their definition and examples.

### Emerging GBI related conflicts and synergies

Ideas, suggestions, and topics regarding Leipzig's GBI illustrate similar visions but also some diverging or even contradicting perspectives and reveal current problems and conflicts. We summarized categories of suggestions from respondents into three groups of problems and conflicts.

Littering and the request for more rubbish bins were the most frequently mentioned issues among ideas and topics on how to improve GBI. Together with suggestions to increase water usability (more beaches/use of water), to install adequate facilities for recreation (improve facilities and paths, improve/more sports facilities) and to improve of maintenance activities, this illustrates the problem of *quality and usability* of GBI. Ideas about more and adapted facilities implying, for example, citizens asking to promote barbequing, sports, or play for children, synergize demands for more recreational options in GBI. On the other hand, there were several respondents who desire more nature experiences, biodiversity, and tranquility in GBI (increase biodiversity, protection zones). Together with requests for more urban wilderness and near-natural maintenance these requests synergize increasing demands for more biodiversity and naturalness in the city. However, the promotion of biodiversity and tranquility may conflict with some recreational activities, which reflects not only the contradicting demands among citizens but also between citizens and planning accounting for biodiversity on one and increasing demand for recreational space on the other hand. Further ideas and suggestions referring to *quality and usability* aspects brought up the problem of accessibility for people with disabilities, for instance, the need for barrier-free toilets and walkable paths especially for older people (accessibility).

Another main important conflict dimension of GBI in the city can be summarized as *other users and activities*. There were numerous comments that raise disruptive activities and user groups such as people leaving their dogs off leash, cultural events, groups of teenagers being noisy, and barbeques causing smoke and litter. Ideas about how to improve areas for dogs mainly refer to the installation of fences resulting in a clear spatial separation of these (improve dog parks). This goes along with many respondents requesting clearly designated use areas in urban green spaces and an increased presence of regulatory authorities that may impose fines in order to reduce conflicts between activities (separate use areas, more regulatory authority, and fines). Mobility-related answers further illustrates conflicts

between pedestrians and cyclists in urban green spaces exemplified by respondents requesting separated walking and cycling lanes in highly frequented parks (improve cycling and pedestrian infrastructure). The conflict of *other users and activities* thus implies the diverging demands to GBI among citizens ranging from quiet and nature-oriented recreation to active recreation activities.

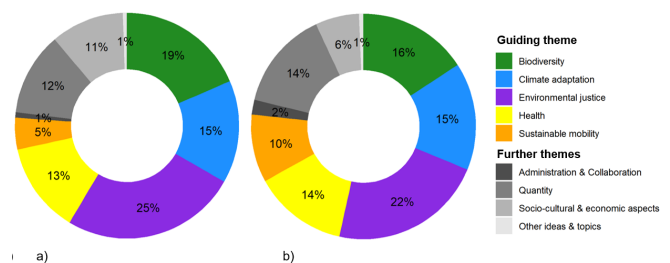
Other comments about specific user groups additionally raised the issue of *safety and security*. Insufficient security in urban green spaces is often caused by past criminal activities, dense vegetation, or poor lighting (more or adapted lighting, safety). Additionally, the problem of drug trafficking and groups of people drinking alcohol was often raised as a reason to avoid specific GBI locations or to increase the presence of regulatory authority staff (more regulatory authority and fines).

### Allocation of ideas and suggestions to the five guiding themes of the Master Plan Green

Based on the analysis above, we link categories of ideas (question 1) and further topics (question 2) that were suggested by respondents with the five guiding themes of the Master Plan Green to underpin citizens' perspectives. The five guiding themes can be cross-categorical, meaning that some categories may be allocated to more than one guiding theme (Table 1, Fig. 1).

Among ideas and topics, biodiversity was the second most important guiding theme (Table 1, Fig. 2). Nineteen percent of the mentioned ideas and 16% of the topics important for respondents refer to the protection or preservation of (urban) biodiversity. Another 15% of ideas and topics respectively were allocated to climate adaptation and measures contributing to the reduction of climate impacts. This guiding theme is ranked third among ideas and topics. Environmental justice including procedural, institutional, and distributional justice aspects comprised 25% of ideas and 22% of topics and is thus the most frequently covered guiding theme in ideas and topics. Health-related suggestions made up 13% of all suggested ideas and 14% of topics mentioned. Five percent of ideas and 10% of topics could be arranged into suggestions contributing to sustainable mobility.

**Fig. 2.** Allocation of a) ideas (n = 3808) and b) topics (n = 2917) for the improvement and development of GBI, raised by survey respondents, to guiding themes of the planning strategy. Categories that were cross-categorical, i.e. could be allocated to two (or more) themes, were counted twice (or more).



About one-quarter of suggestions in ideas and topics respectively (25% of ideas and 23% of topics) were not linked to the five guiding themes and are aggregated into three further themes.

**Table 1.** Allocation of aggregated categories of citizens' ideas (n = 3808) and important topics (n = 2917) to the five guiding themes of the Master Plan Green. Some categories that were allocated to more than one guiding theme are marked in italics.

| Guiding theme                      | Ideas and topics of respondents aggregated into categories  |
|------------------------------------|---|
| Biodiversity                       | Increase urban wilderness (n <sub>ideas</sub> 92, n <sub>topics</sub> 29)<br>Increase biodiversity (n <sub>ideas</sub> 209, n <sub>topics</sub> 148)<br><i>More trees / less clearance of trees</i> (n <sub>ideas</sub> 313, n <sub>topics</sub> 162)<br><i>More urban green spaces</i> (n <sub>ideas</sub> 283, n <sub>topics</sub> 236)<br>Near-natural maintenance (n <sub>ideas</sub> 136, n <sub>topics</sub> 56)<br><i>Preservation of brownfields</i> (n <sub>ideas</sub> 157, n <sub>topics</sub> 116)<br>Protection zones (n <sub>ideas</sub> 41, n <sub>topics</sub> 25)<br>Renaturation of urban water (n <sub>ideas</sub> 43, n <sub>topics</sub> 12)   |
| Climate adaptation                 | Adapt planting & pruning (n <sub>ideas</sub> 36, n <sub>topics</sub> 37)<br>Compensation management (n <sub>ideas</sub> 31, n <sub>topics</sub> 45)<br><i>Heat / increase shade</i> (n <sub>ideas</sub> 45, n <sub>topics</sub> 22)<br>Façade greening / rooftop gardens (n <sub>ideas</sub> 130, n <sub>topics</sub> 108)<br><i>More trees / less clearance of trees</i> (n <sub>ideas</sub> 313, n <sub>topics</sub> 162)<br><i>More urban green spaces</i> (n <sub>ideas</sub> 283, n <sub>topics</sub> 236)<br><i>Preservation of brownfields</i> (n <sub>ideas</sub> 157, n <sub>topics</sub> 116)<br>Sustainable energies (n <sub>topics</sub> =10)<br>Urban climate (n <sub>ideas</sub> 17, n <sub>topics</sub> 29)  |
| Environmental justice              | Procedural justice:<br>Environmental education and awareness (n <sub>ideas</sub> 104, n <sub>topics</sub> 92)<br>Edible city / community gardening (n <sub>ideas</sub> 73, n <sub>topics</sub> 72)<br>Participation of citizens (n <sub>ideas</sub> 129, n <sub>topics</sub> 97)<br>Social & environmental justice (n <sub>topics</sub> =37)<br>Interactional justice:<br>Accessibility (n <sub>ideas</sub> 10, n <sub>topics</sub> 9)<br>Improve dog parks (n <sub>ideas</sub> 18, n <sub>topics</sub> 18)<br>Improve facilities & paths (playgrounds, benches, barbeque areas etc.) (n <sub>ideas</sub> 205, n <sub>topics</sub> 74)<br><i>Improve / more sport facilities</i> (n <sub>ideas</sub> 24, n <sub>topics</sub> 16)<br>Flowerbeds / flowering aspects (n <sub>ideas</sub> 27, n <sub>topics</sub> 21)<br>More or adapted lighting (n <sub>ideas</sub> 27, n <sub>topics</sub> 14)<br>More regulatory authority & fines (n <sub>ideas</sub> 184, n <sub>topics</sub> 65)<br>Safety (n <sub>ideas</sub> 19, n <sub>topics</sub> 26)<br>Separate use areas (n <sub>ideas</sub> 104, n <sub>topics</sub> 45)<br>Distributional justice:<br>More beaches / use of water (n <sub>ideas</sub> =28)<br>More green in residential areas (n <sub>ideas</sub> =31)<br><i>More trees / less clearance of trees</i> (n <sub>ideas</sub> 313, n <sub>topics</sub> 162)<br><i>More urban green spaces</i> (n <sub>ideas</sub> 283, n <sub>topics</sub> 236)<br><i>Preservation of brownfields</i> (n <sub>ideas</sub> 157, n <sub>topics</sub> 116) |
| Health                             | Air quality (n <sub>ideas</sub> 32, n <sub>topics</sub> 63)<br><i>Heat / increase shade</i> (n <sub>ideas</sub> 45, n <sub>topics</sub> 22)<br><i>Improve / more sport facilities</i> (n <sub>ideas</sub> 24, n <sub>topics</sub> 16)<br><i>More trees / less clearance of trees</i> (n <sub>ideas</sub> 313, n <sub>topics</sub> 162)<br><i>More urban green spaces</i> (n <sub>ideas</sub> 283, n <sub>topics</sub> 236)<br>Noise (n <sub>ideas</sub> 41, n <sub>topics</sub> 55)<br><i>Preservation of brownfields</i> (n <sub>ideas</sub> 157, n <sub>topics</sub> 116)   |
| Sustainable mobility               | Connection of GBI (n <sub>ideas</sub> 92, n <sub>topics</sub> 26)<br>Improve public transport / car sharing (n <sub>ideas</sub> 17, n <sub>topics</sub> 83)<br>Improve cycling & pedestrian infrastructure (n <sub>ideas</sub> 122, n <sub>topics</sub> 210)<br>Less cars / parking space (n <sub>ideas</sub> 82, n <sub>topics</sub> 164)  |
| Further themes                     |   |
| Administration and collaboration   | Political & administrative decisions (n <sub>ideas</sub> 33, n <sub>topics</sub> 51)<br>(Inter)national network (n <sub>ideas</sub> 20, n <sub>topics</sub> 54)   |
| Quantity                           | Less building development (n <sub>ideas</sub> 67, n <sub>topics</sub> 171)<br>More housing / parking space (n <sub>topics</sub> =21)<br><i>More trees / less clearance of trees</i> (n <sub>ideas</sub> 313, n <sub>topics</sub> 162)<br><i>More urban green spaces</i> (n <sub>ideas</sub> 283, n <sub>topics</sub> 236)<br><i>Preservation of brownfields</i> (n <sub>ideas</sub> 157, n <sub>topics</sub> 116)   |
| Sociocultural and economic aspects | Cultural events & uses (n <sub>topics</sub> =43)<br>Improve maintenance (n <sub>ideas</sub> 140, n <sub>topics</sub> 53)<br>No motorboats (n <sub>ideas</sub> 63, n <sub>topics</sub> 25)<br>Rubbish / more rubbish bins (n <sub>ideas</sub> 498, n <sub>topics</sub> 170)<br>Sustainable tourism (n <sub>ideas</sub> 22, n <sub>topics</sub> 21)<br>Other ideas & topics (n <sub>ideas</sub> 43, n <sub>topics</sub> 32)   |

Ideas and topics that we did not consider to be covered by one of the five guiding themes referred to administration and collaboration (1% of ideas and 2% of topics) including suggestions to collaborate with stakeholders from NGOs and other German and international municipalities. Another share of suggested ideas and topics referred to the quantity of GBI (12% of ideas, 14% of topics), i.e., respondents call for the establishment of more and the preservation of existing green spaces, trees, or brownfields and for less building construction and soil sealing. Socio-cultural and economic aspects of GBI (11% of ideas, 6% of topics) covered suggestions referring to cultural events, the limitation of motorboats on water, and the development of sustainable tourism in the city. In addition to these three further themes, about 1% of ideas and topics respectively were summarized into other ideas and topics and are not further discussed here due to their variety of suggestions.

## DISCUSSION

The plurality of ideas and topics regarding the improvement of GBI in the city of Leipzig reflects major themes that are guiding not only local but also global strategies such as the SDGs to improve human well-being in cities (United Nations 2015). European cities of tomorrow face similar problems such as biodiversity loss due to increasing land take and share visions about just and inclusive housing conditions, sustainable mobility concepts, and healthy living conditions with attractive and inclusive access to GBI (European Commission 2011, Güneralp et al. 2013). Biodiversity, health, climate adaptation, environmental justice, and sustainable mobility are of high importance for citizens in Leipzig which is substantiated with multiple suggestions and ideas. Disentangling citizens' ideas and suggestions regarding GBI development, however, reveals further important topics and conflicts that should be considered in urban planning strategies. Our analysis identifies deficits in GBI referring to its quality and usability, other users and activities, and safety and security aspects.

The heterogeneity of suggestions from respondents illustrates the synergetic demands but also discrepancies in expectations among citizens and between their preferences and planning objectives. Involving multiple stakeholder preferences and interests, in our case, illustrated by the citizens' ideas and views toward the future development of urban green and blue spaces, supports the implementation of the GBI concept with its multifunctionality (Hansen and Pauleit 2014). The citizens' expertise can provide planners with place-specific information about local actors and experiences, natural and ecological functions in a spatial context, potential and capacity of ecosystem services, quality of the planning process, and the success of planning practices (Faehnle et al. 2014).

In the following discussion sections, we link concrete ideas and suggestions to the five guiding themes to evaluate the citizens' perspectives toward them and discuss further important themes that should be considered in GBI planning strategies. We further depict opportunities to decrease major conflicts and problems in Leipzig's GBI and review the integration of the citizens' ideas and suggestions into local policies and planning strategies that are the basis for the Master Plan Green.

## Biodiversity

According to the respondents' ideas, fostering biodiversity in urban GBI could be supported by protected areas with limited usability for recreation, the use of native and regional plant species instead of exotic plants, and creating diverse habitats to provide space for diverse species across taxonomic groups. Patches with (native) flower meadows, nature-oriented plantings, the integration of unmaintained "wild corners," and near-natural maintenance techniques as suggested by several respondents, would support the creation of diverse habitats for plants, insects, birds, and butterflies (Hunter and Hunter 2008, Kowarik 2013, Aronson et al. 2017). The integration of extensive and near-natural open areas and meadows to compensate for intensively used recreational areas in public green space, is one field of action of the integrated urban development strategy 2030 (INSEK) (Stadt Leipzig 2019a) and is surprisingly frequently requested by our respondents. In addition to other maintenance measures such as grazing (e.g., with sheep) or the renaturation of urban water, that have already been implemented in the city (Mohaupt et al. 2018), these maintenance strategies provide opportunities to offer a high range of (novel) habitats, which can host different species assemblages than their counterparts in rural areas (Niemelä 1999, Kowarik 2011). Furthermore, reduced mowing frequency of urban lawns and the integration of forb-rich perennial meadows can contribute to aesthetical values as well as climate change adaptation by their increased water-retention capacity compared to intensively managed lawns (Yuan et al. 2017, Ignatieva and Hedblom 2018). In addition to preserving biodiversity for its own sake, species-rich urban habitats offer urban residents opportunities to experience, (re)connect, and interact with nature (Miller 2005, Palliwoda et al. 2017) and thus contributing to quality and usability of GBI. However, near-natural maintenance might lead to other costs, for example, transporting and disposing of the increased amount of mowed grass, and a change in management often comes with a negotiation process, for example regarding conflicting preferences among citizens or with historical preservation objectives in Leipzig. Providing appropriate supporting information about the benefits of natural perennial meadows, for example, can increase the citizens' acceptance of these maintenance measures (Southon et al. 2017).

The numerous brownfields and unused spaces of the regrowing city of Leipzig furthermore provide opportunities to account for biological diversity by offering unique habitats for plant and animal species. Planning strategies in Leipzig, therefore, established a brownfield development concept including the assessment of available unused spaces and their potential for revitalization or integration of urban wilderness as alternatives for building development (Stadt Leipzig 2017b). The analysis of the survey suggests that the preservation and renaturation of brownfields is a well-accepted measure to increase available green space and integrate near-natural conditions in the green-blue network of Leipzig.

## Climate adaptation

Cities in Europe are mainly affected by temperatures extremes, flooding, and decreasing precipitation rates in the summer (European Environment Agency 2012, 2016a). A few comments directly refer to climate change effects and adaptation strategies and include, for example, respondents' wishes for more shade from

trees and the use of climate-adapted plant species in urban green spaces with regard to increasing heat and droughts in the summer. The preservation of brownfields and existing urban green spaces together with a strict compensation management for housing development as requested by respondents, can contribute to climate adaptation in dense residential districts by providing additional climate comfort areas and ventilation aisles. The INSEK formulates the integration of such climate comfort zones and a strategy to foster rooftop greening as explicit measures to adapt to climate change (Stadt Leipzig 2017a). More urban vegetation cover in terms of façade greening and rooftop gardens as suggested by respondents further supports adaptation to climate change by increasing stormwater retention, air cleaning, and temperature reduction (Fallmann et al. 2014, Revi et al. 2014). The cooperation of companies in construction and other fields and the support of the city of Leipzig with its recently launched grant program to foster rooftop greening (Stadt Leipzig 2020d), are important steps toward a sustainable and climate change adapted housing development. The street tree concept 2030 of Leipzig, launched in 2019, further formulates the expansion of the urban street tree network as well as the replacement of damaged or sick trees as fields of actions in order to improve urban climate conditions (Stadt Leipzig 2019c). Supported by a citizen initiative for tree sponsorships and a campaign from a local NGO that assesses place-specific knowledge and deficits in tree supply from citizens (Ökolöwe 2021), the program aims at a growth of about 1000 new trees per year until 2030 (Stadt Leipzig 2019c).

#### **Environmental justice**

The participation of citizens in campaigns and programs initiated by the GBI planning authorities reflects procedural justice referring to the equal access to GBI and involvement of all residents in planning (Low 2013), which is a component of the environmental justice guiding theme. The INSEK formulates active citizenship including the strengthening of participation processes in GBI planning as an explicit aim (Stadt Leipzig 2017a). Concrete suggestions about participating in design, implementation, and maintenance of Leipzig's GBI via cleaning activities or self-organized gardening groups exemplify the citizens' ideas for possible application opportunities for procedural justice aspects. Bottom-up processes, participation of residents, and the inclusion of the community members can reduce negative consequences such as green gentrification due to new urban green spaces in residential areas (Haase et al. 2017, Ali et al. 2020) and increase perceived GBI quality (Fors et al. 2018). Urban gardening initiatives, for example, enhance social and ecological diversity and justice, strengthen ecological knowledge, and social cohesion among other benefits (Camps-Calvet et al. 2015). Referring to the interactional dimension of environmental justice about safe and nondiscriminatory international possibilities, especially for vulnerable groups (Low 2013), the open space strategy of Leipzig aims at a universal design of GBI for users of different age, education, socio-economic status, or mobility, yet lacks a clear definition of fields of actions (Stadt Leipzig 2017b). Citizens' ideas and topics reflect interactional justice aspects and the problem of quality and usability as well as safety and security aspects of GBI by adding concrete requests for appropriate and safe facilities (e.g., playgrounds, toilets, benches, and sports facilities), improved lighting, paths, and

safety of GBI. Specific groups desire specific facilities and a balanced supply will increase the usability of GBI. Sports facilities such as skate parks or football fields, for example, facilitate social interactions, especially for kids and teens and simultaneously encourage physical activity supporting physical health (Kaczynski and Henderson 2008, Peters et al. 2010). In contrast, older or less mobile persons have a more urgent need for adequate seating possibilities and safe paths facilitating recreational quality and usability of GBI (Kabisch and Kraemer 2020). Combined with the installation of sufficient lighting, increasing the presence of the regulatory authority in public GBI, can support perceived safety and security and therefore justice of GBI, especially for vulnerable groups like older persons or women (Koskela and Pain 2000, Veitch et al. 2006, McCormack et al. 2010). The separation of use areas for active (doing sports, cycling) and passive (quiet relaxation in GBI) recreational activities has been a frequent request from citizens and the peaceful coexistence of several activities is already a major focus of local planning strategies, enforced by fairness zones with mutual respect, the establishment of attractive areas for doing sports, and opening schools' sports grounds for team sports off teaching time (Stadt Leipzig 2017b). Distributional justice about the fair and equal distribution of GBI in the city (Low 2013) includes requests for more urban green spaces, especially in districts of Leipzig that are undersupplied with urban green spaces. Meeting this aspect, the INSEK has set up an evaluation of districts with deficits in urban green space supply illustrating focus areas for developing and preserving urban green spaces, for example, by the renaturation of brownfields (Stadt Leipzig 2017a).

#### **Health**

Responses in the survey mentioned health-related pressures in the growing city such as noise and air pollution caused by increasing traffic. The relatively low number of responses directly referring to these health problems (2% of ideas and 4% of topics) may be caused by better air quality values in Leipzig as compared to other European cities such as Paris or Barcelona (IQ Air 2021). However, noise reduction and air quality improvement capacity of GBI are acknowledged by respondents, and equal access to GBI is vital to extend these health-related functions to the maximum number of citizens. Closely connected to climate adaptation, this guiding theme covers ideas and suggestions about integrating climate comfort areas by preserving open spaces, brownfields, and ventilation aisles in priority residential areas. Heat and the provision of tree shade was another frequently mentioned topic that should be considered in GBI planning and management. The INSEK focuses on the integration of climate comfort zones in areas with socioeconomic and GBI deficits to meet climate-related health issues like heat stress (Ren et al. 2011, Revi et al. 2014, Stadt Leipzig 2017a). Well-equipped and easily accessible public GBI further facilitate psychological and physical health by providing sports facilities that encourage physical activity, which is requested by many respondents (Tzoulas et al. 2007, Lee and Maheswaran 2011, Akpinar 2016). Local planning strategies respond to this request by aiming at opening sports grounds from schools and sports clubs for public use and physical activity (Stadt Leipzig 2017b, 2019a).

#### **Sustainable mobility**

Although not all ideas and visions about sustainable mobility can be linked to GBI design and management, respondents provide



GBI-relevant suggestions for this guiding theme. For instance, several respondents suggested the removal of parking spaces for cars in favor of green spaces or cycling paths underpinning priorities for urban green and sustainable means of transport instead of motorized traffic. The establishment of a compact green city promoting green mobility measures like cycling can contribute to reduced energy consumption used for transport (European Environment Agency 2015). The city of Leipzig already invests in the establishment of sustainable means of transport in the city's lake area and the connection of green and blue spaces along a ring-radial system to support mobility on motorized streets (Stadt Leipzig 2017a, b). The connection of green and blue spaces and the establishment of greenways including the integration of street trees combined with other roadside vegetation were often requested by respondents and can encourage inhabitants to shift to walking or using their bicycles (Cerin et al. 2017). A study in Berlin underpins the potential of green roads by pointing out that cyclists prefer streets with high levels of street trees and would even accept a longer route to avoid streets with low vegetation levels (Nawrath et al. 2019). Furthermore, creating more greenways and green roads outside of parks could shift cyclists from passing through parks and thus reduce conflicts between pedestrians and cyclists.

#### **Further important themes addressed by respondents**

Although most ideas and suggestions could be directly or indirectly linked to one or several of the five guiding themes of the Master Plan Green, we identified three additional GBI-relevant important themes, that should be highlighted as stand-alone themes here: (i) increasing the quantity and spatial extent of accessible GBI under the pressure of growing inhabitant numbers, (ii) administration and collaboration strengthening the cooperation with stakeholders, and (iii) integrating a wider perspective of socio-cultural and economic values of GBI.

There are plenty of ideas and comments referring to the quantity of GBI and open spaces illustrated by the request for more GBI and less soil sealing caused by housing development. Increasing the quantity of GBI in terms of more green spaces, brownfields, or urban trees is considered cross-categorical contributing to numerous challenges that are bothering cities. A greening statute, as requested by a local NGO in Leipzig, for example, calls for more urban green spaces in order to improve biological diversity, human health, and equal access to urban green spaces and thus underlines the cross-categorical character of quantitative aspects (Ökolöwe 2020). Increasing the spatial extent of GBI is a challenging task in a growing city due to competing land demands for social, economic, and environmental needs (European Environment Agency 2015) which is also illustrated by other comments that request more housing development to tackle housing shortage. However, only a few comments requested more housing development or parking space instead of green space (less than 1%) compared to those asking for more urban green spaces or trees (14–16% of ideas and topics) but they exemplify the challenging task of urban planning accounting for multiple needs. Local planning strategies in Leipzig aim at increasing the quantity of GBI by establishing a municipal real estate management that preserves and connects the city-wide GBI, for example, on inner-city brownfields or agricultural areas in the urban fringe (Stadt Leipzig 2017a). Strong partnerships between the municipality and adjacent regions in the periphery are thus needed to ensure an

adequate GBI supply for residents of a growing city. We argue for the explicit consideration of the quantity of GBI in the Master Plan Green going beyond improving the quality and thus consider this as a stand-alone theme in addition to the five guiding themes. Deficits in the quantity of urban green spaces express the urgent need for accessible urban and peri-urban GBI. This need became especially visible during the COVID-19 pandemic revealing an increased use of urban green spaces during lockdowns (Venter et al. 2020). The authors highlight the importance of large inner-city GBI as well as accessible and not overcrowded GBI in the urban periphery for human well-being during the crisis. Improved connectivity to peri-urban GBI, small green spaces in neighborhoods, and planting more trees in the cityscape could offer opportunities to increase the quantity of accessible GBI in compact green cities (Artmann et al. 2017).

Another theme not clearly covered by the five guiding themes comprises ideas and suggestions about administrative decisions including the cooperation with other (inter)national authorities and NGOs (administration and collaboration). This theme points to the chances of local planning authorities to integrate the multiple views of diverse stakeholders into planning and management of GBI. The consideration of heterogeneous demands and best practice examples from different actors can then help to develop multifunctional GBI (Hansen and Pauleit 2014) and furthermore foster a comprehensive planning authority that integrates stakeholders' multiple apparent objectives relevant for urban development (Ribalayagua Batalla and García Sánchez 2016).

Lastly, we summarized ideas and suggestions referring to fostering cultural events, the installation of rubbish bins, and promoting sustainable tourism in the city as socio-cultural and economic aspects of GBI. Going along with the focus of the Master Plan Green on ecological aspects of GBI, i.e., biodiversity, socio-cultural, and economic functions should be part of the planning strategy in the same measure. Socio-cultural aspects should aim to include the whole range of cultural uses and, particularly, improve waste management to enhance GBI quality. Requests for the implementation of more rubbish bins was the most frequently mentioned suggestion among respondents underlining the significance of sufficient GBI maintenance for citizens. In addition to space, nature, quietness, and facilities, Van Herzele and Wiedemann (2003) define culture and history including sufficient maintenance as one important quality attribute of urban green spaces. Clearly, the problem with rubbish and an insufficient number of rubbish bins in GBI are a major focus in citizens' suggestions for socio-cultural aspects, and planning should concentrate on use-density adapted waste management with shorter cleaning and maintenance cycles. The economic dimension, however, is taken up by the open space strategy of Leipzig by highlighting the economic potential of GBI for tourism and property value. Substantiated by several requests for prohibiting motorized boats on water, the strategy aims at integrating a sustainable tourism concept with sustainable means of transport on land and water and fostering nature-oriented activities for tourists (Stadt Leipzig 2017b). Generally, economic aspects are scarcely integrated into European GBI planning, yet it remains an important component of multifunctionality (Hansen et al. 2019).

### Limitations of the study

This survey showed limitations in representing views and opinions of a heterogeneous urban population. Not all ideas, suggestions, and topics important to individual respondents can be discussed here nor be integrated into a strategic plan focusing on the city-wide GBI network. The planning strategy does not aim to reflect individual users' views but rather balance multiple views at the various GBI locations. Specific user demands and expectations, such as the installation of specific sporting areas or platforms for events in GBI, are limited by the holistic approach of city-wide GBI planning respecting regulatory conditions and legal restrictions. The analysis of socioeconomic and demographic characteristics of survey respondents further reveals a medium to a strong bias toward younger, female persons with a slightly higher monthly income than the average Leipzig citizen (Stadt Leipzig 2019b, StadtLabor Tröger+Mothes GbR 2019, Appendix A3). Older persons and people who were not born in Germany or with different ethnic and cultural backgrounds are underrepresented although it is crucial to integrate the demands of vulnerable groups in planning processes to meet environmental justice aspects of GBI (Kabisch and Haase 2014).

### CONCLUSION

With this analysis, we attempt to illustrate the citizens' perspectives, ideas, and suggestions regarding guiding themes that are shaping local and global urban planning strategies using the example of Leipzig, Germany. We highlight ideas, visions, and topics from respondents of an online survey as part of a participation process for the local GBI planning strategy "Master Plan Green", which aims at maintaining ecosystem services and enhancing a multifunctional GBI in the city of Leipzig. Categorized responses illustrate heterogeneous perspectives that also imply major conflicts and problems in GBI. Different demands and functions of GBI must therefore be constantly negotiated between citizens and planners and between multiple planning aims.

A majority of suggestions can be linked to leading guiding themes that are shaping not only the Master Plan Green in Leipzig but also planning strategies in other global cities: biodiversity, climate adaptation, environmental justice, health, and sustainable mobility. Numerous ideas and suggestions substantiate these guiding themes and highlight further important GBI related aspects such as socioeconomic aspects and increasing GBI quantity by preserving existing open space. Leipzig and other major cities are facing increasing population and thus demand for areas for housing, education, or transport is also increasing. Survey responses clearly highlight that more GBI in terms of urban trees, façade and rooftop greening, and revitalized brownfields should be central planning objectives. Enhancing GBI quality and usability by providing safe facilities for all user groups as well as more biodiversity and near-natural conditions are further important planning approaches that are most frequently requested by citizens. Integrating these diverse expectations of citizens into local planning strategies can increase acceptance of planning objectives among citizens and contribute to a resilient plan of GBI meeting specific demands of the local population and reducing conflicts.

Responses to this article can be read online at:

<https://www.ecologyandsociety.org/issues/responses.php/13129>

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### Data Availability:

The data/code that support the findings of this study are openly available in Open Science Framework at <https://doi.org/10.17605/OSF.IO/AC4HG>. Ethical approval for this research study was granted by Stadt Labor <https://www.stadtlabor.de/>.

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## Appendix A1: Survey about urban green and water in the city of Leipzig

### Your opinion about urban green and water

- 1) How important is urban green and water for your personal well-being and quality of life in the city of Leipzig?

|                                   |
|-----------------------------------|
| Very important                    |
| Important                         |
| Neither important nor unimportant |
| Unimportant                       |
| Not important at all              |

- 2) What about urban green and water is especially important to you?

|  | Very important | Important | Yes and no/partly | Unimportant | Not important at all | I don't know |
|--|----------------|-----------|-------------------|-------------|----------------------|--------------|
| A lot of urban green all over the city |                |           |                   |             |                      |              |
| Large urban green spaces               |                |           |                   |             |                      |              |
| Urban green near my flat/house         |                |           |                   |             |                      |              |
| Playgrounds                            |                |           |                   |             |                      |              |
| Sport facilities                       |                |           |                   |             |                      |              |
| Barrier-free access                    |                |           |                   |             |                      |              |
| Quietness                              |                |           |                   |             |                      |              |
| Good conditions of paths               |                |           |                   |             |                      |              |
| Safety                                 |                |           |                   |             |                      |              |
| Seating possibilities                  |                |           |                   |             |                      |              |
| Cleanliness/ orderliness               |                |           |                   |             |                      |              |
| Lightning                              |                |           |                   |             |                      |              |
| Access to urban water                  |                |           |                   |             |                      |              |
| Quality of urban water                 |                |           |                   |             |                      |              |
| Green and blue connections             |                |           |                   |             |                      |              |

- 3) Which of the following activities do you mainly do/use in urban green spaces/ on urban water? (1-5 answers)

|  |
|--|
| To relax                               |
| To go for a walk                       |
| To spend time in nature                |
| To watch plants or animals             |
| To spend time outside with my children |
| To do sports                           |
| Because of fresh air                   |
| To use shade when it is hot            |
| To see other people                    |
| As a connection between locations      |
| For events                             |
| To walk the dog                        |
| For gardening                          |
| To spend time at urban waters          |
|  |
| Any other uses:                        |

- 4) There are different user groups with varying interests in urban green and water that might lead to conflicts. Which conflict disturbs you the most?

|                       |
|-----------------------|
| Rubbish and dirt      |
| Barbecuing            |
| Loud groups of people |
| Loud music            |

|  |
|--|
| Dogs   |
| Dog faeces                                     |
| Certain sports                                 |
| I am not feel disturbed by any of these things |
|  |
| Other:   |

5) Are there specific places of urban green and water that you avoid?

|  |
|--|
| No   |
| Yes, the following place (please add the specific location and the reason why you feel disturbed): |

6) Do you agree that parts of urban green are less or near-naturally maintained to create habitats for plants and animals?

|  |
|--|
| Yes, absolutely, I think urban green should mainly be maintained less or near-naturally                      |
| Highly maintained as well as less or near-naturally maintained urban green should be included in urban green |
| No, I think urban green should mainly be highly maintained   |
| I do not have an opinion towards this issue  |

7) Do you have a concrete favorite spot in urban green or water? If yes, which one is it?

8) What do you like there?

9) Do you have specific ideas about how Leipzig's green could be improved?

**Categories of urban green and water**

10) How often did you use the following categories of urban green and water in the past year?

|                    | A few times a week | About once a week | One to three times a week | Once to a few times a year | (almost) never | I don't know |
|--------------------|--------------------|-------------------|---------------------------|----------------------------|----------------|--------------|
| Urban parks        |                    |                   |                           |                            |                |              |
| Forest             |                    |                   |                           |                            |                |              |
| Green urban places |                    |                   |                           |                            |                |              |
| Green streets      |                    |                   |                           |                            |                |              |
| Canals/ rivers     |                    |                   |                           |                            |                |              |
| Lakes              |                    |                   |                           |                            |                |              |
| Allotment gardens  |                    |                   |                           |                            |                |              |
| Community gardens  |                    |                   |                           |                            |                |              |
| Sports grounds     |                    |                   |                           |                            |                |              |
| Cemeteries         |                    |                   |                           |                            |                |              |
| Agricultural areas |                    |                   |                           |                            |                |              |

11) What do you associate with the following categories of urban green and water? (several answers possible)

|                    | Relaxation | Activity and sports | Social interacion | Experiencie nature | Everyday routes | culture |
|--------------------|------------|---------------------|-------------------|--------------------|-----------------|---------|
| Urban parks        |            |                     |                   |                    |                 |         |
| Forest             |            |                     |                   |                    |                 |         |
| Green urban places |            |                     |                   |                    |                 |         |
| Green streets      |            |                     |                   |                    |                 |         |
| Canals/ rivers     |            |                     |                   |                    |                 |         |
| Lakes              |            |                     |                   |                    |                 |         |
| Allotment gardens  |            |                     |                   |                    |                 |         |
| Community gardens  |            |                     |                   |                    |                 |         |



|                    |  |  |  |  |  |  |
|--------------------|--|--|--|--|--|--|
| Sports grounds     |  |  |  |  |  |  |
| Cemeteries         |  |  |  |  |  |  |
| Agricultural areas |  |  |  |  |  |  |

### Functions of urban green and water

There are five major themes that are guiding the Master Plan Green:

**Health:** Urban green provides healthy living conditions in the city of Leipzig. It provides fresh air and space for physical activities and recreation. The aim is to reduce environmental pollution, create space for recreation and physical activity and to enhance health and human well-being.

**Climate adaptation:** Urban climate is changing as the heat waves of the past years were showing. Important functions of urban green are functions, rainwater drainage and CO2 storage. The aim is to adapt Leipzig to changing climate conditions and exposure for Leipzig's inhabitants and the local urban green itself.

**Biodiversity:** The city provides not only habitats for people but also for several plants and animals. The aim is to increase biological diversity in the city and let people experience nature and biodiversity.

**Environmental justice:** Every person should have just access to urban green and water. The aim is to create equal access to urban green and water and to develop it for different user groups, exchange between people and communication.

**Sustainable mobility:** The city wants to promote environmental friendly mobility. Green pathways through urban green and blue spaces can promote sustainable mobility by foot or bicycle. The aim is to connect green and blue spaces to provide safe and attractive paths for everyday routes.

12) How important are the following guiding themes to you?

|                       | Very important | Important | Unimportant | Not important at all |
|-----------------------|----------------|-----------|-------------|----------------------|
| Health                |                |           |             |                      |
| Climate adaptation    |                |           |             |                      |
| Biodiversity          |                |           |             |                      |
| Environmental justice |                |           |             |                      |
| Sustainable mobility  |                |           |             |                      |

### Urban green in my neighborhood

13) Please insert you zip-code:

14) My neighborhood contains sufficient green space.

|                            |
|----------------------------|
| Totally agree              |
| Agree                      |
| Neither agree nor disagree |
| Not agree                  |
| Do not agree at all        |

15) Which categories of urban green would you like to have more in your neighborhood? (1-5 answers possible)

|             |
|-------------|
|             |
| Urban parks |

|                              |
|------------------------------|
| Forest                       |
| Green urban places           |
| Green streets (street trees) |
| Green brownfields            |
| Allotment gardens            |
| Community gardens            |
| Sports grounds               |
| Green connections            |
| Urban water                  |

16) How important was the presence of urban green for the choice of your residential location?

|                      |
|----------------------|
| Very important       |
| Important            |
| Yes and no/ partly   |
| Unimportant          |
| Not important at all |

17) My flat or house has a (several answers possible):

|  |
|--|
| Balcony/terrasse                                       |
| Garden for myself/ourselves                            |
| Garden, that I share with my neighbors                 |
| Green inner courtyard                                  |
| Rooftop garden/greening                                |
| Façade greening  |
| None of these, and it is not important to me           |
| None of these unfortunately, but I would like to have: |

18) Which of the following issues affects you at your residential location:

|                 | Strongly | Strongly | Neither<br>nor | Less | No<br>affection |
|-----------------|----------|----------|----------------|------|-----------------|
| Bad air quality |          |          |                |      |                 |
| Noise           |          |          |                |      |                 |
| Heat            |          |          |                |      |                 |

19) I have the possibility to use green or blue connections on my everyday routes to work, school, shopping or leisure activities.

|               |
|---------------|
| Yes           |
| Partly        |
| No            |
| I do not know |

20) Would you accept a longer route to use green connections for walking or cycling?

|                 |
|-----------------|
| Yes, absolutely |
| Partly          |
| No              |
| Not at all      |

21) What is your main mean of transport in the city?

|                  | Regularly | Seldom | Never |
|------------------|-----------|--------|-------|
| Public transport |           |        |       |
| Private car      |           |        |       |
| Bicycle          |           |        |       |
| By foot          |           |        |       |
| Carsharing       |           |        |       |

22) Are you gardening? (Several answers possible)

|            |
|------------|
| Not at all |
|------------|

|                                       |
|---------------------------------------|
| Yes, on my balcony                    |
| Yes, in my garden at my house/flat    |
| Yes, in my allotment garden           |
| Yes, in a community garden in my city |
| Yes, in a garden outside the city     |
| Yes, at:                              |

**Personal data:**

23) How old are you?

24) What is your gender?

|               |
|---------------|
| Female        |
| Male          |
| Inter/diverse |
| No entry      |

25) What is your average monthly income?

|                 |
|-----------------|
| Below 150€      |
| 150 - < 400€    |
| 400 - < 600€    |
| 600 - < 800€    |
| 800 - < 1200€   |
| 1200 - < 1600€  |
| 1600- < 2000€   |
| 2000- < 2600€   |
| 2600- < 3400€   |
| 3400- < 4200€   |
| More than 4200€ |

26) What is your highest degree of education?

|  |
|--|
| None (yet)                             |
| German Hauptschulabschluss             |
| Secondary school diploma               |
| Advanced technical college certificate |
| High school graduation                 |

27) What is your highest professional degree?

|                                   |
|-----------------------------------|
| None (yet)                        |
| Completed professional training   |
| Foreman/ technical college degree |
| Polytechnic degree                |
| University degree/ college degree |

28) Were you born in Germany?

|     |
|-----|
| Yes |
| No  |

**Last but not least...**

29) How did you find out about this survey?

|                  |
|------------------|
| Newspaper        |
| City magazine    |
| Official journal |

|                             |
|-----------------------------|
| Website city of Liepzig     |
| Environmental NGOs          |
| Family/ friends/ colleagues |
| Social media                |
| Other:                      |

30) Are there further topics of urban green and water that are important to you? Do you have suggestions and topics that should be included in the Master Plan Green?

**Thank you for participating in the survey!**

## **Appendix A2: Relevant planning documents and strategies**

**Master Plan Green:** The strategy is currently being developed and focusses on the spatially explicit implementation of the objectives and fields of actions regarding the green and blue infrastructure that have been formulated in the INSEK and the open space strategy in order to improve the quality of life in a growing city with increasing land use change and soil sealing. The process is characterized by an extensive participation process including workshops, presentations for the public and surveys with citizens.

**Integrated Urban development concept 2030 (INSEK):** Strategy for the development of the city of Leipzig until 2030 summarizing and integrating different relevant sectors for sustainable urban development such as housing, economy and work, culture, education and open spaces and the environment. The concept for open spaces and the environment formulates objectives, aims and fields of actions to improve the urban green and blue infrastructure. The INSEK is the result of an integrated working process including actors from different urban planning sectors as well as citizen's participation.

**Open space strategy:** The strategy highlights the different categories of GBI and their relevant functions and services in the city of Leipzig. It further formulates propositions for their future development in order to improve environmental quality and quality of life in the city.

**Street tree concept 2030:** The strategy formulates guidelines and fields of actions to extend and preserve the urban tree inventory adding up to the objectives and aims of the INSEK and the open space strategy. It was supported by a participation process with relevant stakeholders and citizens to include different interests.

**Appendix A3: Socio-demographic data of respondents and citizens of Leipzig**

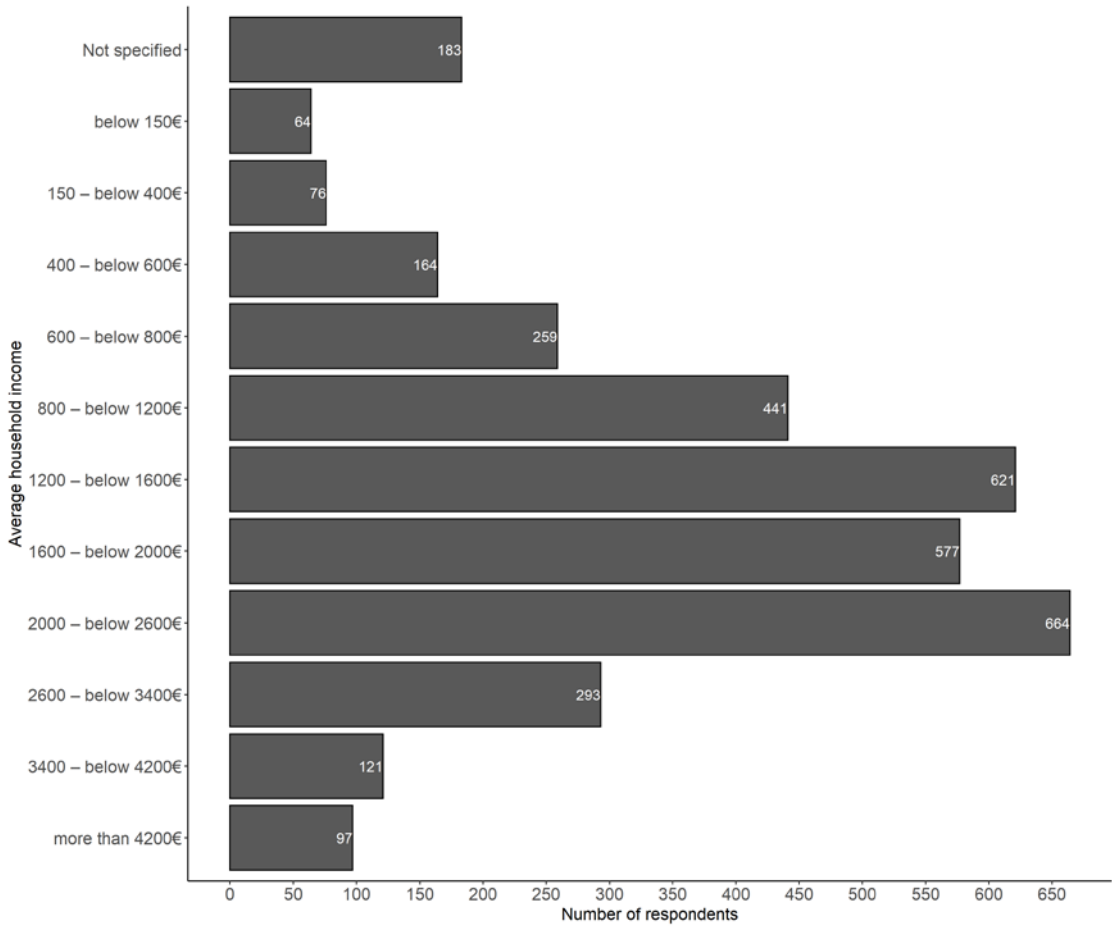


Figure A3.1: Average net income of survey respondents

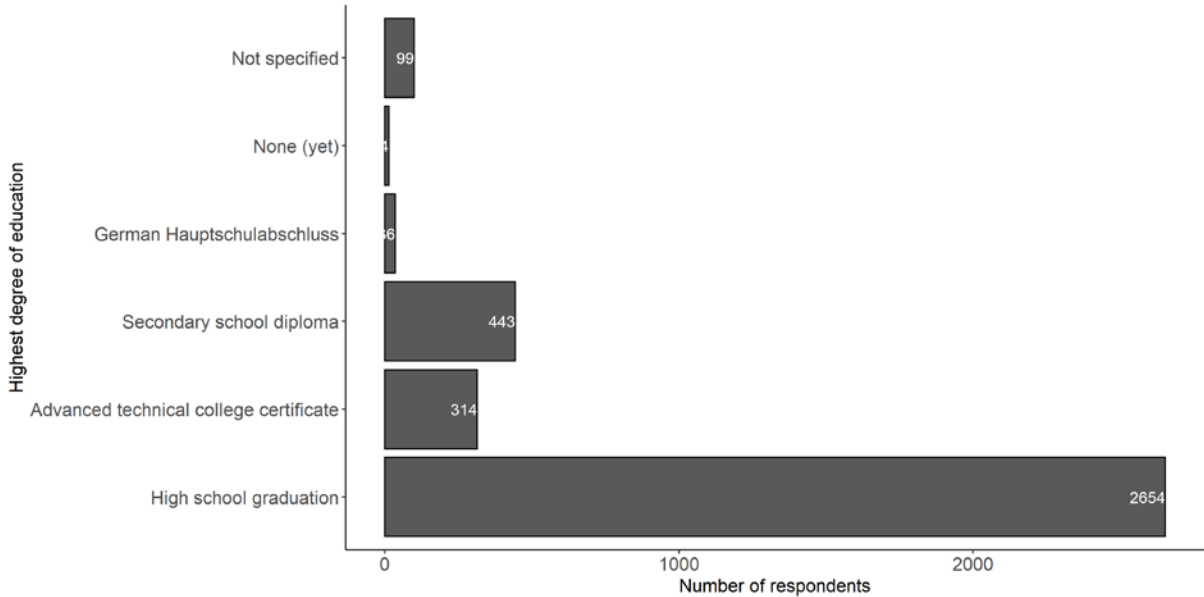


Figure A3.2: Highest educational degree of survey respondents

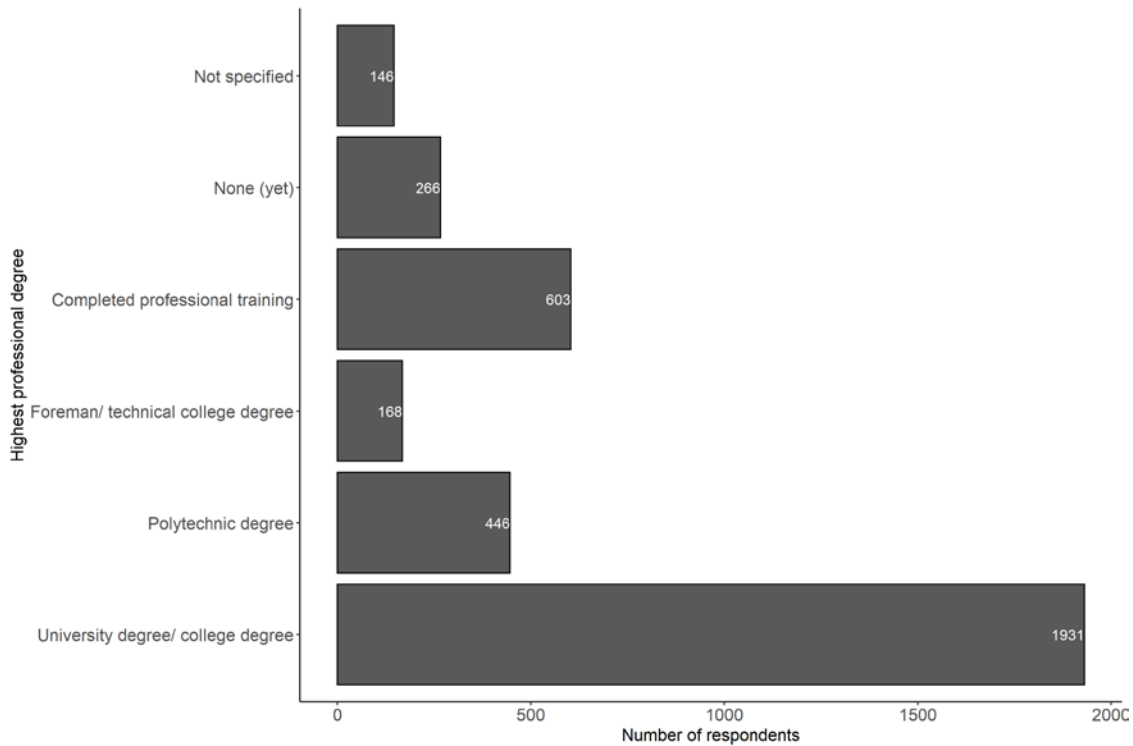


Figure A3.3: Highest professional degree of survey 3,559 respondents

Table A3.4: Selected socio-demographic data of Leipzig

|  |         |
|--|---------|
| Total population (in 2020)                               | 597,493 |
| Average household personal income (€) (2019)             | 1,438   |
| Average age of inhabitants (years) (2020)                | 42.3    |
| Share of migrants among inhabitants (%)                  | 14.1    |
| Total migration balance (number of persons) (2017)       | +10,375 |
| Total migration balance (number of persons) (2020)       | +4,649  |
| Persons without professional degree (%) (2017)           | 15      |
| Persons with completed professional training (%) (2017)  | 45      |
| Persons with foreman/technical college degree (%) (2017) | 14      |
| Persons with polytechnic degree (%) (2017)               | 8       |
| Persons with university/college degree (%) (2017)        | 18      |

Data sources:

Stadt Leipzig 2018: Ortsteilkatalog 2018 (*in German only*). Amt für Statistik und Wahlen. Available at: [https://static.leipzig.de/fileadmin/mediendatenbank/leipzig-de/Stadt/02.1\\_De21\\_Allgemeine\\_Verwaltung/12\\_Statistik\\_und\\_Wahlen/Raumbezug/Ortsteilkatalog/Ortsteilkatalog\\_2018.pdf](https://static.leipzig.de/fileadmin/mediendatenbank/leipzig-de/Stadt/02.1_De21_Allgemeine_Verwaltung/12_Statistik_und_Wahlen/Raumbezug/Ortsteilkatalog/Ortsteilkatalog_2018.pdf). Last access: 09/2021

Stadt Leipzig 2021: Leipzig-Informationssystem (LIS). Available at: <https://statistik.leipzig.de/index.aspx>. Last access: 09/2021

**Appendix A4: Categories of ideas and topics on how to improve GBI in Leipzig and themes that are important to citizens with examples.**

| <b>Category</b>                             | <b>Group</b>  | <b>Definition</b>  |
|---|---------------|--|
| (Inter)national network                     | Ideas, Topics | Exchange with other cities (national or international), best practice from other cities  |
| Adapt planting & pruning                    |               | Climate adapted maintenance of urban vegetation (Use of climate adapted species, pruning of trees adapted to changing climate)   |
| Accessibility                               | Ideas, Topics | Barrier-free GBI, improve accessibility for persons with disabilities  |
| Air quality                                 | Ideas, Topics | Preservation of ventilation isles, improve air quality in residential areas  |
| Compensation management                     | Ideas, Topics | Compensation of soil sealing and housing construction  |
| Connection of UGBI                          | Ideas, Topics | Connecting green and blue spaces, create network for cycling, walking  |
| Cultural events & uses                      | Topics        | Support cultural events and uses in GBI  |
| Edible city / community gardening           | Ideas, Topics | Community gardens, edible plants and fruit trees in public green, support regional food provision by urban gardens   |
| Environmental education & awareness         | Ideas, Topics | Environmental education for children, school, raise awareness for nature and biodiversity, installation of information signs   |
| Facade greening / rooftop gardens           | Ideas, Topics | Support façade and rooftop green, especially on public buildings   |
| Flowerbeds/ flowering aspects               | Ideas, Topics | More flowering aspects in public green   |
| Heat / increase shade                       | Ideas, Topics | Increase shade provision in the summer, heat stress  |
| Improve facilities and paths                | Ideas         | Improve condition of paths (pot-holes, pavement), more and improved playgrounds and facilities for children, drinking water/ fountains in public parks, benches and seating possibilities, toilets, bathrooms, more gastronomic supply |
| Improve cycling & pedestrian infrastructure | Ideas, Topics | Improve cycling lanes, safety for cyclists and pedestrians   |
| Improve dog parks                           | Ideas, Topics | More dog facilities and improved dog meadows (e.g. with fences)  |
| Improve maintenance                         | Ideas, Topics | More cleanliness, more maintenance of flowerbeds, adapted cutting of trees, improve maintenance and quality of urban water (ponds in public green, lakes, streams)   |
| Improve public transport / car sharing      | Ideas, Topics | Improve public transport and transport connection, more bus/ tram stops, cheaper tickets, support car sharing concepts   |



|  |                  |  |
|--|------------------|--|
| Improve/<br>more sport<br>facilities       | Ideas,<br>Topics | More sport facilities (fitness parcours, table tennis, football fields)  |
| Increase<br>biodiversity                   | Ideas,<br>Topics | Preserve biodiversity, create habitats for animals (e.g. nesting boxes, shrubs for nesting birds), flower meadows for insects, more native plant species |
| Increase<br>urban<br>wilderness            | Ideas,<br>Topics | More wild corners with low maintenance activities, near-natural corners  |
| Less building<br>development               | Ideas,<br>Topics | Sustainable land use and construction of new housing   |
| Less cars /<br>parking space               | Ideas,<br>Topics | Reduce parking space for cars for green spaces, speed limits or banning cars in certain areas (e.g. in residential areas)                                |
| More<br>beaches/ use<br>of water           | Ideas            | Increase sustainable use and access to urban water canoeing, swimming, water sports)   |
| More green in<br>residential<br>areas      | Ideas            | More green close to home   |
| More housing<br>/ parking<br>space         | Topics           | More parking space for cars, more houses instead of more green spaces  |
| More or<br>adapted<br>lighting             | Ideas,<br>Topics | Installation of lights in public parks, adapted light concept  |
| More<br>regulatory<br>authority &<br>fines | Ideas,<br>Topics | Increase the presence of regulatory authority and fines (e.g. for dog owners, loud music) in public green and blue spaces                                |
| More trees /<br>less clearance<br>of trees | Ideas,<br>Topics | Planting of trees in streets and public green spaces, less clearance of old trees  |
| More urban<br>green spaces                 | Ideas,<br>Topics | More green spaces in Leipzig, preservation of present GBI, micro-greening  |
| Near-natural<br>maintenance                | Ideas,<br>Topics | Less mowing, no leaf litter removal, no heavy machines, no pesticides  |
| No<br>motorboats                           | Ideas,<br>Topics | Prohibit the use of motorboats and motorized tourism on urban water  |
| Noise                                      | Ideas,<br>Topics | GBI for noise reduction, reduce noise exposure in residential areas  |
| Other ideas                                | Ideas,<br>Topics | Other ideas and topics   |
| Participation<br>of citizens               | Ideas,<br>Topics | More transparency in planning and governance, more participation in design, implementation and management of GBI   |
| Political &<br>administrative<br>decisions | Ideas,<br>Topics | More cooperation with NGOs, scientific communities   |
| Preservation<br>of brownfields             | Ideas,<br>Topics | Preservation or renaturation of gaps between houses/ brownfields instead of building houses  |
| Protection<br>zones                        | Ideas,<br>Topics | Designation of No-Go areas, protection zones for plants and animals  |

|                                |               |  |
|--------------------------------|---------------|--|
| Renaturation of urban water    | Ideas, Topics | Renaturation of streams, rivers, riparian forest   |
| Rubbish / more rubbish bins    | Ideas, Topics | Installation of rubbish bins and waste containers, adapted design of rubbish bins (e.g. protected from animals looking for food) |
| Safety                         | Ideas, Topics | Increase safety, crime prevention  |
| Separate use areas             | Ideas, Topics | Designated use zones in public green (e.g. for barbequing, dogs, specific sports)  |
| Social & environmental justice | Topics only   | More social housing, support alternative housing projects  |
| Sustainable energies           | Topics only   | Support sustainable energy consumption (wind, solar)   |
| Sustainable tourism            | Ideas, Topics | Support sustainable tourism/ eco-tourism   |
| Urban climate                  | Ideas, Topics | Reference to climate change (increasing temperatures in the summer, less rain fall)  |