


Article

Towards a Sustainable City with a Sensory Garden in the Context of Urban Well-Being

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Abstract: Human well-being is one of the main goals of sustainable development (SDG 3 and SDG 11). Urban green zones are always presented in all global well-being rankings of the cities. The development of new forms of urban green zones is stimulated by such challenges as urban health and the deficit of urban territory. Sensory gardens are one of the innovative forms of urban green zones. They implement intensive and concentrative interaction of citizens with nature, positively influencing objective and subjective human well-being. In the first part of the research, we analyzed the history of the evolution of the concept of a sensory garden from its mono-sensory to multi-sensory form using the bibliographic analysis. The results of the analyses of scientific publications were confirmed by the results of a survey presented in the second part of the research. The survey was conducted in Moscow, Saint-Petersburg, and Yekaterinburg, where 215 citizens spoke about the sensory garden. The research results confirm that the sensory gardens are a prospective form of urban green zones for citizens, and they are interested in the development of its multisensory concept. According to survey results, the zones of smells and colors in the sensory garden were the most attractive for the respondents. The respondents agreed that the main function of sensory gardens is anti-stress therapy for adults.

Keywords: subjective well-being; objective well-being; human well-being; sustainable city; urban green zones; garden; sensory garden; human sense; ecological entrepreneurship



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1. Introduction

Sustainable development goal № 11 “Sustainable Cities and Communities” declares the importance of urban health for global sustainable development. Urban health is an important part of subjective well-being. Urbanization has a negative impact on the physical and psychosomatic health of residents, which, in turn, negatively affects the quality of life of the population and human subjective and objective well-being in the cities. At the same time, more people were recently talking about the prevalence of the negative effects of urbanization over the positive ones in terms of the health status of residents and their satisfaction with the quality of life.

In 2021–2022, in a survey named “Smart Sustainable Cities in Russia”, which was conducted by Radović-Marković et al., the respondents from three big Russian cities (Moscow, Saint-Petersburg, and Yekaterinburg) ranked green urban infrastructure (parks, gardens, and green courtyards) first by their importance to urban smart and sustainable city development [1].

The contemporary academic literature confirms the importance of developing new and innovative forms of green zones, especially sensory gardens, in urban landscapes for health and well-being (see, for instance, Yazici Kubra’s monograph *The Landscape and the City* [2]). Sensory gardens are a new form of urban gardens endowed with several

sense zones (maximum six) for more intensive human interaction with nature. In 2002, C. Shoemaker declared that “Sensory gardens cannot be designed without considering the human element. Unlike traditional display gardens that are meant to be observed from a distance, sensory gardens invite the visitor to touch, smell, and actively experience the garden with all senses” [3]. A sensory garden design incorporates one landscaping zone for each human sense. Landscaping technologies in sensory gardens are designed to influence human senses by colors and smells. At the same time, the garden does not occupy large swaths of territory.

Professor Van Praag, one of the main researchers of objective well-being, put environment and green infrastructure as one of the main conditions of objective human well-being in his first and second monographs on human well-being [4,5]. The main global well-being city rankings include the part about “Environment” and green infrastructure such as parks, gardens, etc. Table 1 presents the list of 8 main international city rankings in well-being. The methodology deals with the environment factors and its indicators. Table 1 also presents possible positive contributions to environmental conditions, which can be promoted by sensory gardens.

Table 1. Ranking of cities by well-being and sensory gardens.

№	International Rankings of Cities by Well-Being Level	Objective Indicators of Human Well-Being in the Segment of “Environment” [4,5].	Possible Input of Sensory Gardens
1	The Knight Frank: City Well-being Index [6]	Green space %	Green diversity
2	The Techtalk: Best Cities Well-being Index [7]	Green spaces, CO ₂ emissions	Green diversity and depositing of CO ₂
3	Mercer quality of living [8]	Natural environment	Natural diversity
4	The Vaay: Stressful Cities Index [9]	Air pollution, noise pollution, light pollution	Green diversity, natural smells, natural lights, depositing of CO ₂
5	Urban Environment Quality Index [10]	Urban form diversity, urban spaces accessibility, green spaces	Green diversity
6	City prosperity initiative-Perception Index [11]	Urban land, public space	Green diversity
7	Quality of life in Russian cities Index [12]	Urban ecology	Green diversity and depositing of CO ₂
8	Global Liveability Index 2022 [13]	Quality of air, water, and parklands	Green diversity, natural smells, natural lights, depositing of CO ₂

Source: Authors.

Urban green zones play a vital role in reducing air pollution, mitigating climate change, and providing various ecosystem services. Therefore, the international research group of Ramaiah and Avtar said that “. . . some major downsides of urbanization are overcrowding and environmental degradation. . . . To realize sustainable and environmentally friendly urbanization, there is an urgent need for comprehensive land use planning of urban settlements by giving due consideration to create and sustain urban green spaces (UGS), such as parks, gardens, etc.” [14].

The main problem of traditional green urban zones and green infrastructure relates to their limited functions and conservative approaches. Modern cities are rapidly developing, and urban infrastructure should be ready to transform due to new challenges. For such cases, cities need new forms of urban infrastructure, and for the environmental infrastructure, a new form of urban green zone could be sensory gardens. One of its main functions

is anti-stress therapy. Due to the research results of an analytical agency “95% of Russians experience stress, and just over a third of respondents (34%) experience it constantly” [15]. Furthermore, the relationship between the artificial urban environment and the health of the urban population, in particular, with the development of diseases such as asthma, other respiratory diseases, and psychological stress, was empirically proven [16].

Therefore, the sensory garden is a new form of urban green area that can solve the problems of improving the quality of life of people and their health, as well as reducing the negative effects through the introduction of innovative technologies in urban planning and landscape architecture. The benefit of gardens is already well known in the world and has deep historical roots, going back to Roman times. These can be considered as the earliest sensory gardens.

2. History of Sensory Gardens

Different kinds of gardens were popular among natural philosophers of ancient India, Greece, Rome, etc. Their first purpose was well-being and healing. The myths and ancient medical texts of many nations tell us about the treatment through nature. Therefore, the term “sensory gardens” began to be used in science in the mid-seventies and has continued developing and transforming ever since.

At the same time, there is no common understanding of the role and significance of sensory gardens in solving environmental, social, and economic problems in urbanized territories, as well as achieving various social goals. The design of sensory gardens varies significantly, largely because of the multi-disciplinary benefits and effects under research, which had different objectives as priorities. The first objective was healing, the following was educational, and nowadays, it is anti-stress benefits. Table 2 presents the evolution of functions of sensory gardens and their main societal purposes.

Table 2. History of Sensory Gardens.

Period of Development	Main Functions	Locations	Basic Zones of Sense	Main Researchers of the Period
Before 1900	Well-being	Globally	Monosensory	Baker P., Shoemaker C., Hussein H.
1900–1950	Healing for adults	Great Britain	Monosensory	Stoneham J., Barker R., Gibson J., Hussein H.
1950–2000	Healing for kids and adults with special needs	Globally	Monosensory	Hussein H., O’Connell J., Spurgeon T.
2000–2010	Education	EU, Russia, Australia	Multisensory	Hussein H., Hanic A., Sikorskaya G.
After 2020	Anti-stress and general well-being	EU, Russia	Multisensory	Shoemaker C., Souter-Brown G., Hinckson E., Duncan S., Zajadacz A., Vukovic N.

Source: Authors.

The first sensory gardens were not identified with the current term. By content, they were mono-sensory gardens [17]. They are the proof of the connection between Roman conceptions of “Pure Air” and physical and mental health in Pompeian gardens [17]. People designed gardens with focus on the smell effects or sounds. Their main task was to improve subjective well-being and mental health.

Later, during the period of 1900–1950, sensory gardens were actively exploited for healing adults in hospitals. Baker noticed that: "... through the sensory process of identification, the beneficial properties of pure air were, in accordance with ancient perceptions of sensory function, taken into the body and affected health. Thus, sensory perception acted as the bridge between the environment and health" [17]. Therefore, healing was the sensory garden's main function. Later, in 1950–2000, the concept was divided into two main inclusive directions:

- (1) Sensory garden therapy for kids with special needs [18–22].
- (2) Sensory garden therapy for adults with special needs [23–28].

Later, the application of a sensory garden concept for adults extended in a new direction, i.e., creating a sensory stimulation garden for older persons to cultivate happiness and high levels of well-being [29,30].

The next step of sensory garden development relates to pre-school, school, and university education [19,31]. The leading global scientist in sensory environment, Professor Hussein, concludes that: "... The main findings showed that the garden attributes challenged the students' perception and movement. Furthermore, motivated them to practice their motor skills and enabled them for wayfinding. This is an essential requirement for children's well-being and happy development" [32]. Universities throughout the world are developing their own sensory gardens on university campuses, for instance, the Siberian Federal University in Russia [33].

Modern challenges influence all spheres of life. For example, the COVID-19 pandemic thoroughly and negatively affected all aspects of urban life. After the beginning of the COVID-19 Pandemic, the period of using sensory gardens for anti-stress therapy started [34–37]. Furthermore, more focused research emerged on the application of sensory gardens for mental health, which is a part of general objective human well-being [35,37].

The current level of sensory garden evolution contains all previous steps (see Table 2). Due to much scientific research, the sensory garden concept can be applied to improving overall human well-being, both subjective and objective. Souter-Brown, Hinckson, and Duncan stipulated that: "... a sensory garden effectively reduces stress, enhances wellbeing, and improves productivity of 'apparently well' people in the workplace. Future wellbeing initiatives should explore opportunities for nature connection in their setting" [37].

The recent research on the influence of the environment on human well-being has started to prioritize the sense of color. The general influence of environment design was proven in the monograph of Lee, where she also pointed out the important influence of the environment on humans, especially smell and color: "We ... have surprising and powerful effects on our mood. Drawing on insights from neuroscience and psychology, she explains why one setting makes us feel anxious or competitive, while another fosters acceptance and delight—and, most importantly, she reveals how we can harness the power of our surroundings to live fuller, healthier, and truly joyful lives" [38]. Spence in (2020) researched sensor zones, namely, the architectural design for the multisensory mind and five main human senses, in which he believed our attention to be captured by the various senses. According to Spence's research rankings: vision, 70%; audition, 20%; olfaction, 5%; touch, 4%; and taste, 1% [36]. The influence of color on human well-being and health is described in a monograph of Haller, where she noticed that: "our reactions to color are largely unconscious, yet it has the power to affect our quality of life and our wellbeing. This chapter outlines the important color considerations taken by an interior designer in the process of creating effective color schemes for residential and commercial spaces, including personal color preferences, cultural, geographic and economic influences, trends forecasts, applied color psychology and human centered design" [39].

Thus, the sensory garden is a special form of urban green zone that can solve the variable problems in improving the quality of life of people and their health, as well as reducing the negative consequences of various factors that reduce the quality of life for urban residents, through the introduction of innovative technologies of urban planning and landscape architecture.

The main research questions of this study are the following:

- Are the sensory gardens a prospective form of urban green zone for citizens as much as it is claimed in academic publications?
- What main characteristics of a sensory garden should be included in the concept or design of an ordinary sensory garden according to the priorities of citizens?

The study is devoted to assessing the attractiveness of the sensory garden as a new form of urban green area for urban residents and identifying the preferences of citizens in its functionality (design and concept).

To answer this question, we conducted a survey of residents in the largest megapolises in Russia, i.e., Moscow, St. Petersburg, and Yekaterinburg, to determine the cities' potential to meet the needs of the population regarding sensory gardens.

3. Methods and Materials

The study is devoted to assessing the attractiveness of the sensory garden as a new form of urban green area for urban residents and identifying the preferences of citizens in its functionality, design, and concept. The main research questions of this study are the following:

- Are the sensory gardens a prospective form of urban green zone? (H1)
- What main characteristics of a sensory garden should be included in the concept or design of an ordinary sensory garden? (H2)

The methodological framework of the research is presented in Figure 1. We have formulated two research questions and investigated them using the bibliographic analysis of scientific publications (Phase one). The results were tested by conducting a survey in the three biggest Russian megapolises (Phase two). Finally, we compared the received results, i.e., scientific point (Result 1) with practical results (Result 2) from Figure 1 and came to a general conclusion.

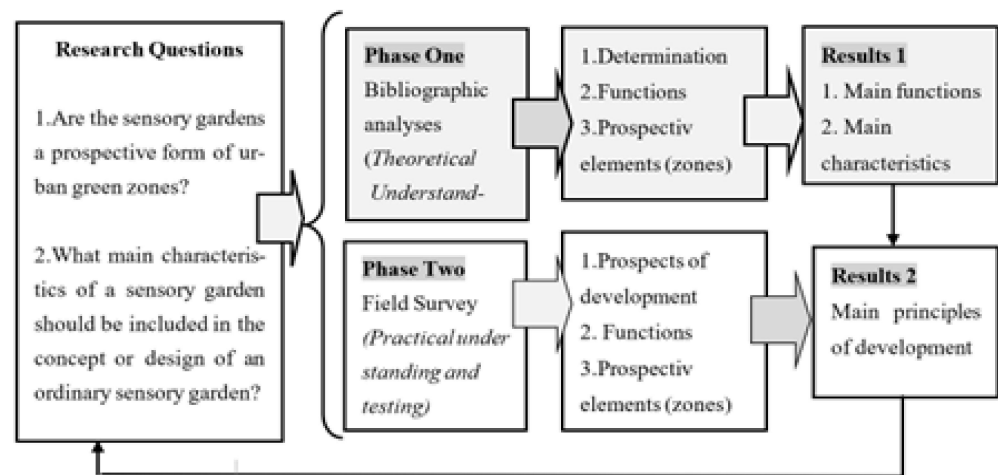


Figure 1. Methodological Framework. Source: Authors.

Table 3 presents the main survey geography characteristics of Moscow, Saint-Petersburg, and Yekaterinburg in 2022. For short testing, we implemented a survey about green urban zones (parks, etc.) and sensory gardens by interviewing visitors in public parks of Moscow, Saint-Petersburg, and Yekaterinburg (Table 3). Table 3 is based on information from open data sources published by the Statistics Agency Goskomstat of the Russian Federation [40] and the Results of a Survey about human stress in Russian cities of Romir agency from 2017 [41] and they are freely available on the Internet, and it contains calculated data derived from them, compiled personally by the authors.

Table 3. Survey cities characteristics, 2021.

№	Characteristics	Cities		
		Moscow	Saint-Petersburg	Yekaterinburg
1	Population, thous. People ¹	12.655	5.384	1.495
2	Square of the city, km ² ¹	2.511	1.439	468
3	Square of green zones in the city, km ² ¹	196 km ² (19.600 ha)	78.18 km ² (7817.82 ha)	24.94 km ² (2493.95 ha)
4	% of green zones in the city ³	7.81	5.43	5.33
5	km ² of green zones for one citizens ³	15.49	14.52	16.68
6	% of stress of adults (before COVID-19 Pandemic) ²	22%	23%	17%
7	Number of sensory gardens ³	5	2	1

Source: ¹ Statistic Agency Goskomstat of Russian Federation [40]. ² Results of Survey about human stress in Russian cities of Romir agency. 2017 [41]. ³ Authors' calculation.

In September 2020–September 2022 project research group interviewed people by project survey. The aim of the research was to identify expectations regarding the development of modern gardens in urban environments. The primary data collection method was social surveys on the opinions of the inhabitants and their expectations regarding the development of sensory gardens in the city.

We interviewed the visitors of the VDNH Park in Moscow, Primorsky Victory Park in Saint-Petersburg, and the Manor of the Rastorguevs-Kharitonovs in Ekaterinburg. These are the largest cities in Russia. They are also economic and cultural capitals of their regions. For short testing, we implemented a survey about green urban zones (parks, etc.) and sensory gardens by interviewing visitors in public parks of Moscow, Saint-Petersburg, and Yekaterinburg (Table 4). We interviewed the visitors of the VDNH Park in Moscow, Primorsky Victory Park in Saint-Petersburg, and the Manor of the Rastorguevs-Kharitonovs in Ekaterinburg. These are the largest cities in Russia. They are also economic and cultural capitals of their regions. The questionnaire included two parts, which are given in Appendix A.

For investigation, the research questions for the article were provided using an internet survey application. The questions of the survey were both open and closed and related to issues such as:

- Q1: Do you know about any sensory garden project? (H1)
- Q2: Do you ever visit any sensory garden? (H1)
- Q3: What is the main task of urban parks and gardens? (H1)
- Q4: What main functions the city gardens and parks should fulfill in the future? (H1)
- Q5: How often will you visit the sensory garden (available within walking distance)? (H2)
- Q6: Which zone of sensory garden is the most interesting to visit for you? (H2)
- Q7: If a visit to the sensory garden will entail costs, would you visit it? (H2)
- Q8: What is the number of people in the household? (H2)

The sample of the respondents from Moscow, Saint-Petersburg, and Yekaterinburg, who took part in the internet survey was diverse in terms of many demographic characteristics (Table 4).

Table 4. Survey participants characteristics.

N ^o	Characteristics of Participants	Descriptions
1	Age	less than 25 years old—50%, 25–45 years old—20%, 45–65 years old—25%, others—5%.
2	Gender	male—40%, female—60%
3	Living location	city—54%, suburb—46%
4	Character of the housing development	an apartment in “old buildings” in the historic part of the city—7%, modern apartment house—57%, low-rise house—20.0%, own house (living in a house with a garden)—16%
5	Number of people in the household	less than 3—15%, from 3 to 5 persons—66%, more than 5 persons—19%.
6	Employment Status	employed—90%, not-employed—10%
7	Education	secondary and higher education—4%, higher education—80%, scientific degree—15%
8	Location of Survey	Moscow—VDNH park, Saint-Petersburg-Primorsky Victory Park Yekaterinburg-Manor of the Rastorguevs-Kharitonovs

Source: Authors.

In total, the responses of 215 respondents were accepted in the study sample. The sample is sufficient for the existing general population, since the study was conducted based on cities with a million-plus population. In such cases (the general population is more than 100,000 people), the principle of the law of large numbers is applied to determine the sample size, and Formula (1) is applied.

$$n = \frac{Z^2 pq}{\Delta^2} \quad (1)$$

where, n is the sample size,

Z —coefficient depending on the confidence level chosen by the researcher,

p —the proportion of respondents with the presence of the studied trait,

$q = 1 - p$ —the proportion of respondents who do not have the studied trait,

Δ —maximum sampling error.

The choice of specific values for Formula (1) is justified by the following. Since our study does not involve the adoption of a strategically important business decision but is an overview and determines the range of tasks in general, the degree of reliability (z) is not critically important for the results of the study. Therefore, an 85% confidence level was used as a sufficient level to calculate the sample. In accordance with this, the coefficient $Z = 1.44$.

The values of p and q are assumed to be 0.5 since they were not exactly known before the start of the study. At the same time, the authors understand that with such values, the size of the sampling error is maximal. Therefore, the Δ —limit sampling error is taken as the amount of ± 5 , which is also sufficient for this study. The sample of the interviewed respondents was random.

The sample of the interviewed respondents was random. As the analysis of the structure of respondents showed, more than half of the respondents were working young

people with higher education, living in apartment buildings in families of 3 to 5 people. These are traditional young families with 1–2 small children. These young people have ample knowledge about a healthy lifestyle and share it with others. High activity was shown by respondents aged 45–65 who, on the one hand, already experience serious difficulties with the psychological aspects of the urban environment and, on the other hand, have more free time to visit green areas and sensory gardens. They also have enough income to pay for visits to the sensory garden several times a month.

The most common ways to deal with stress among Russians include complacency, maintaining the mood for a positive outcome of the situation (9%), the analysis of the situation and the search for a solution (9%), and the use of sedatives (7%) [42]. The results of previous studies concerning the features of human capital in urban territories; the assessment of the susceptibility of people and various urban communities to innovative, IT, and digital forms of health care, leisure, recreation [43], development prospects, and sensory gardens as new directions of ecological entrepreneurship development [44] are also used as sources of information.

4. Survey Results

According to the survey results, only 21% of respondents know the term “sensory garden” or have visited one (Q1 of survey). More than 11% of survey participants visited a sensory garden (Q2 of survey). Therefore, the sensory garden is a new form of urban green zones that is still not so well-known to citizens of Moscow, Saint-Petersburg, and Yekaterinburg.

Furthermore, the respondents noted that the task of modern urban gardens and parks (Q3 of survey) is to restore the connection between humans and nature and to be the oases of nature in the city (Figure 2), according to more than 70% of respondents. Other kinds of activities such as sport, educational, and cultural events are less important than engaging with nature. As can be seen from Figure 2, most of the respondents assess the importance of sensory gardens in terms of fulfilling the task of connecting urban residents with nature. It is the interaction with wildlife that is clearly lacking in large cities with an urbanized structure. The educational function is perceived by the respondents as much less important. This is explained by the fact that educational opportunities in large cities are quite extensive and allow one to receive information in a wide variety of areas.

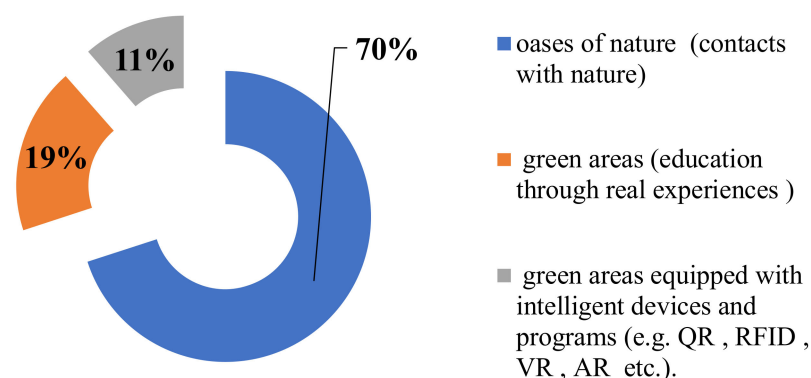


Figure 2. Main task of urban parks and gardens (Q3). Source: Authors.

The second most important for the respondents is the implementation of educational, entertainment, and sports functions on the territory of the city parks. This is explained by the fact that these cities have a rather high level of development of social infrastructure in general. The megatrend for digitalization also influences sensory gardens and, in many cases, the use of QR-code technology in a sensory garden as a study tool has become popular [45]. This example is highly implemented in the VDNH park in Moscow.

Figure 3 shows the distribution of the respondents in terms of their assessment of the importance of the main functions of sensory gardens. Our hypothesis on the antistress

effect of sensory gardens for citizens is confirmed by the survey results (Figure 3) (Q4 of survey). The survey results (Figure 3) show that residents of large cities are interested in visiting sensory areas most of all for the purpose of anti-stress therapy.

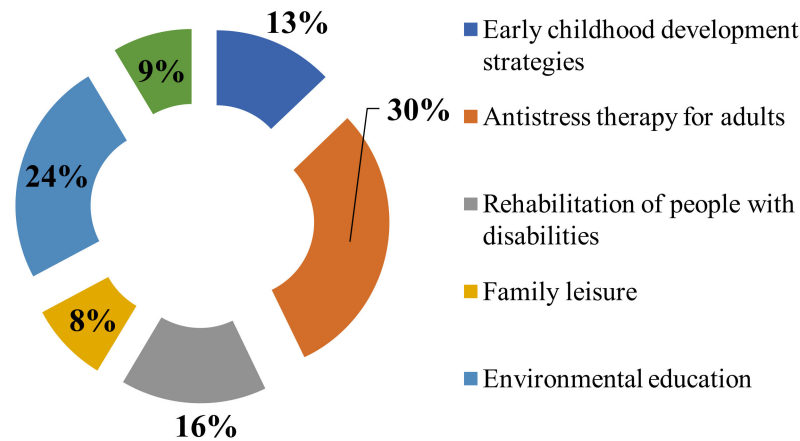


Figure 3. Main functions of gardens and city parks in the future (Q4). Source: Authors.

The second most important function is the rehabilitation of people (24%). In general, the anti-stress and rehabilitation orientation of sensory gardens occupies more than 50% of the respondents' preferences and is dominant in their priorities.

The distribution of answers to the question Q5 is important for the purposes of our study: How often you will visit the sensory garden (within walking distance). Figure 4 shows the distribution of respondents according to their activity in visiting sensory gardens (Q5).

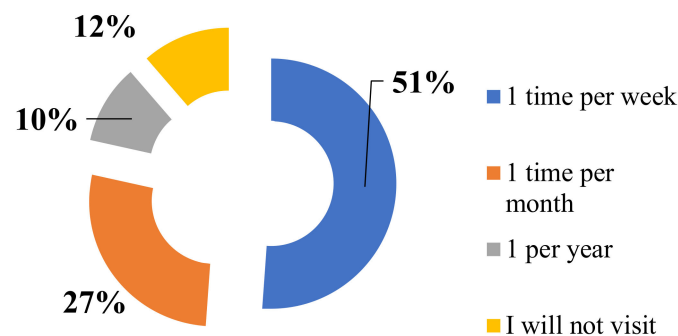


Figure 4. Desired activity in visiting sensory gardens (Q5). Source: Authors.

As can be seen from Figure 4 (Q5), more than 51% of the respondents, if they live within walking distance (15 min), could and would like to visit a sensory garden at least once a week. Another 27% of respondents are ready to visit a sensory garden at least once a month. Thus, almost 80% of the respondents are interested in having a sensory garden in the zone of the nearest walking distance.

The results of the survey show that aroma and colors zones are a priority for citizens, 27.2% and 22.7% of respondents (see Figure 5). Therefore, an ordinary sensory garden could be zoned only by different smell and color zones formed by different flowers and grasses, including the smell effect of waterfalls. The general influence of environment design was proved in the monograph of Lee, where she also pointed at the important influence of the environment on humans, especially smell and color [38]. Spence in (2020) researched sensor zones, namely the architectural design for the multisensory mind and five main human senses in which he believed our attention to be captured by the various senses. According to Spence research rankings: vision, 70%; audition, 20%; olfaction, 5%; touch, 4%; and taste, 1%" [36].

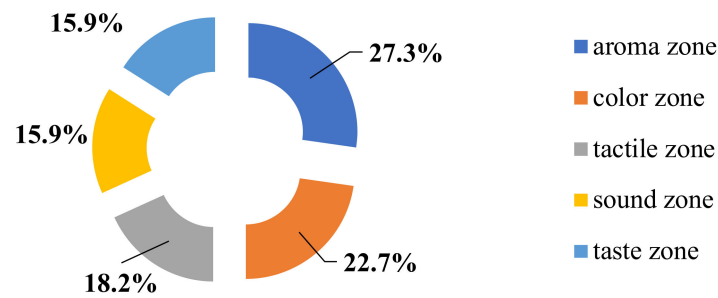


Figure 5. Visiting Priorities of Sensory Garden Zones (Q6). Source: Authors.

Furthermore, according to the results of the survey mainly respondents are living with families (approximately 16% of survey participants have less than 3 persons in the family and approximately 36%—between 3–5 persons) and they are interested to visit sensory garden with entrance fee, 43% (Figure 6). Therefore, we can see that families with more than 5 persons in the family will visit sensory gardens on a commercial basis and some of the families with 3–5 persons in the family as well. Therefore, it means that for the development of a sensory garden in the city, the municipality should plan some municipal support for different social urban groups.

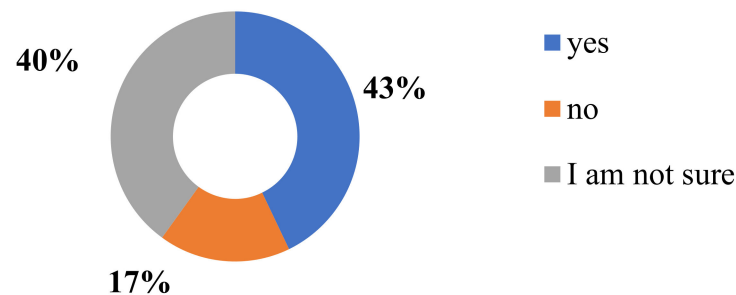


Figure 6. Possibility to visit sensory garden with entrance fee (Q7). Source: Authors.

5. Discussion

For urban health goals, modern city infrastructure should transfer urban green zones from traditional to more smart and sustainable forms. Spence, in his article, noticed that: "... Looking to the future, the hope is that architectural design practice will increasingly incorporate our growing understanding of the human senses, and how they influence one another. Such a multisensory approach will hopefully lead to the development of buildings and urban spaces that do a better job of promoting our social, cognitive, and emotional development, rather than hindering it, as has too often been the case previously" [36].

Furthermore, it is important to notice that the interest of citizens in sensory gardens stimulates a new form of ecological entrepreneurship. For example, in Moscow, more than 8 years were spent developing the project "People and Gardens". The results of the survey show that aroma zones are a priority for citizens—27.2% of respondents (see Figure 5). Therefore, an ordinary sensory garden could be zoned only by different smell and color zones formed by different flowers and grasses, including the smell effect of waterfalls. For implementing different smells or color in sensory gardens, the main expenses should relate to biodiversity such as in trees, grasses, and flowers.

The starting point for the development of sensory gardens could be a mobile sensory garden, which needs a low level of costs in landscape and could be exhibited on renting land in the most attractive way for business days such as holidays, weekends, etc.

To stimulate the development of sensory gardens, sustainable cities could practice different forms of private–government partnership. It would be very effective in the costs of renting and buying the land for a sensory garden.

Table 5 shows examples of the creation of three types of sensory gardens, indicating the minimum requirements for conditions and investments. As for the assessment of the economic efficiency of creating a sensory garden, the calculations showed that for entrepreneurship it should be exhibited all year, and for these criteria, it should be implemented with the maximum scenario with coniferous trees in the landscape design.

Table 5. Sensory garden project characteristic.

N ^o	Characteristics	Minimum Scenario	Middle Scenario	Maximum Scenario
1	Number of sensory zones	1	2–3	4–5
2	Mobility	Stable	With removable wooden basements (modules)	Stable
3	Presence of trees in landscape	– *	–/+ *	+ *
4	Presence of grasses in landscape	+ *	+ *	+ *
5	Square, square meters	Less than 70 square meters	70–100 square meters	More than 100 square meters
6	Period of exhibition	Summer	Summer	All Year
7	Ownership on the land	Not necessary	Not necessary	Preferably
8	Minimum level of investments	From \$2.000	from \$4.300	from \$5.000
9	Case study from Russia	Project “Sensory Garden of Far East Federal University”	Project “Gardens and People”	Project “Five Senses Garden plants or Mobius Strip” (VDNH)

* “–” —not presented, “+” —presented. Source: Authors.

The result of the conducted research shows that people are interested in visiting a sensory garden 10–30 times per year with a middle duration of approximately 20–40 min and are willing to pay EUR 3–7 per one lesson at a sensory garden. According to that, one person who is interested in visiting a sensory garden on that occasion can spend from EUR 30 to 210 per year where the revenue of one middle sensory garden, per year, according to our research results, can be between EUR 5.400–16.800 per year.

Based on data from previous studies, sensory gardens are a good possibility from both sides: they improve ecological standards in society, and they are profitable in the long run [44]. Thus, the interest of citizens in the sensory garden stimulates a new form of technological entrepreneurship. For example, Moscow has been developing the project “People and Gardens” for more than 8 years. In the sensory garden Entrepreneurship Prospects study conducted by Hanic and Vukovic in 2017 [44], they note that “... Environmental entrepreneurship is a relatively new term, and some authors use other terms such as “green entrepreneurship” or “environmental entrepreneurship” or “environmental entrepreneurship”. People today are willing to pay their own money for the opportunity to spend time in nature, especially with children [44]. In general, sensory gardens as a new type of urban green zone with a multiplicative effect:

- allow you to implement an innovative approach to the development of urban infrastructure.
- develop a new direction in environmental urban entrepreneurship.
- due to the intense impact on humans, create opportunities to compensate for the shortage of green areas in the city.
- solve the problems of stress management and anti-stress therapy for the urban population.

These questions are actively investigated in Poland. There, an international research center of sensory garden research for sustainable city development and well-being is

under development. Such scientists as Krzeptowska-Moszkowicz, Moszkowicz, and Porada are investigating the evolution of the concept of sensory gardens in the generally accessible space of a large city for the tasks of citizens' well-being and sustainable city development [46,47]. Furthermore, Zajadacz, Wajchman-Świtalska, Woźniak, Jaszczak, and Lubarska have developed the concept of a sensory garden for recreational urban forests and urban environment for the citizens' well-being [48–50].

6. Conclusions

Modern academic multidisciplinary research proves the positive influence of sensory gardens on objective and subjective human-wellbeing. The topic of sensory gardens attracts much research every year and the number of annual scientific publications in this field is growing. Furthermore, the results of our survey emphasize the high interest of urban society in the topic of a sensory garden: More than 70% of the respondents would like to meet nature in the territory of modern parks and gardens, which is the core concept of sensory gardens. People would like to visit sensory gardens every week, and more than 43% of visitors are even ready to pay a fee for entrance.

International researchers (Spence, Lee, etc.) point out that the most important and positive influences for human senses are smells and colors. The results of our survey prove this conclusion. According to the interviews conducted, the most attractive are aroma zones with a share of 27% and color zones with 23%, respectively.

The long history of the evolution of the sensory garden concept developed its functional range, which is pertinent for sustainable development goals, such as inclusive education, healing, anti-stress therapy, and well-being. The survey results indicate that more than 30% of the respondents would like to undergo anti-stress therapy on the territory of modern sensory gardens.

The results of the analysis of modern academic research on sensory gardens and the results of a conducted survey in Moscow, St. Petersburg, and Yekaterinburg present the same conclusions about the positive prospects of sensory gardens for sustainable urban development and human-well-being (SDG 3 and SDG 11).

In the future, we plan to develop our research and conduct complex international surveys about sensory gardens and collect more than one thousand respondents from all over the world. Other promising areas of research include the creation of mobile sensory gardens with one or two thematic zones for various festivals, fairs, and major city events with short-term placement of the garden at the venues of such events. The idea of indoor sensory gardens is another promising venue of research for countries with colder climates located in the Northern hemisphere.

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Appendix A

Survey “Sensory Garden in the context of Urban Well-Being”

The questions of the survey consist of two sections, namely:

PART I

Q1: Do you know about any sensory garden project?

Q2: Do you ever visit any sensory garden?

Q3: What is the main task of urban parks and gardens?

Q4: What main functions the city gardens and parks should fulfill in the future?

Q5: How often will you visit the sensory garden (available within walking distance)?

Q6: Which zone of sensory garden is the most interesting to visit for you?

Q7: If a visit to the sensory garden will entail costs, would you visit it?

Q8: What is the number of people in the household?

PART II

Q9: What is your age?

Q10: What is your gender?

Q11: What is your living location, city or suburb?

Q12: What is the character of the housing development: modern or “old style”?

Q13: What is the number of people in the household?

Q14: What is your employment status?

Q15: What is the level of your education?

Q16: What is the city of interview?

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