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Project Report

Potentials for Optimizing Roadside Greenery to Improve the Quality of Life in Cities

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Abstract: Trees and plants at the roadside or on median strips are called roadside greenery. These are not only beautiful in our environment but are also an important component of the biological system of a city. In addition, roadside greenery provides a variety of design, structural, traffic and ecological functions. These include shading and aesthetics, but also the sense of security and as a measure against the consequences of climate change. Worldwide, more and more people are living in cities and urbanization is steadily increasing. As a result, inner-city development is becoming increasingly dense, and the air is getting worse. In order to make people's living environments as pleasant and healthy as possible, more greenery is needed in cities. In this research work, the relationship between quality of life and street greenery is investigated. The aim is to analyze the different needs and wishes of citizens and to identify and compile positive consequential effects of street greenery on people and the environment, as well as possible deficits in urban areas. A guideline for action with recommendations will support municipalities in upgrading and expanding street greenery in cities. The empirical study shows that street greenery is enormously important for the general and subjective quality of life for every age group. The perception of the population shows different assessments and ideals regarding street greenery. Overall, there is a desire among the population to maintain and optimize street greenery in the city.

Keywords: roadside greenery; street greenery; quality of life; optimization; municipalities; recommendations for action; sustainable cities; climate change

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1. Introduction

1.1. General Background and Research Objectives

Nowadays, more and more people are living in urban areas. In Germany, around 77.7% of the population currently live in densely and moderately populated areas [1]. Worldwide, this figure is currently around 55%. A United Nations report predicts that, by 2050, more than 66% of the world's population will live in cities [2]. In Germany and Europe, the trend is even higher. By 2050, the proportion of city dwellers in Germany is expected to rise to around 85% [3]. The urban lifestyle contributes significantly to the more frequent occurrence of physical and mental illnesses [4]. For example, noise, traffic congestion, poorer air quality and temperature extremes are often more pronounced in cities than in rural areas. In urban areas, much of the land is sealed, thus limiting access to nature for many citizens. On average, around nine percent of settlement and traffic areas in Germany are green and recreational areas. In addition to the creation of living space and the expansion of infrastructure, health, quality of life and urban design are also important factors in the design of cities. Parks, urban forests and, in particular, roadside greenery are not only visually attractive, but also fulfill important social and ecological functions as public spaces. They improve the microclimate in the city, reduce the effects of climate

change and create habitats for animals and plants. In addition, urban green spaces have a positive effect on social interaction, the development of children and adults and thus on well-being. Nature in the city therefore plays an enormous role in the quality of life and health of city dwellers. Healthy and, above all, happy residents are the goal of sustainable urban development [5]. Therefore, it is important to develop measures to maintain and increase the quality of life of urban residents. An increasingly important role in the design of cities is played by street greenery. The mostly unnoticed street greenery also offers, like the urban green, a variety of functions, especially in relation to active mobility [6]. Also, with regard to the Sustainable Development Goals (SDGs), high-quality street greening makes an important contribution to achieving the United Nations' goals of "health and well-being", "livable cities and communities" and "climate action" [7].

This article focuses on the extent to which street greenery affects the quality of life of city dwellers in Germany. In order to create a sustainable and livable urban environment, it is also important to actively involve citizens in the planning processes. Urban sustainability policy is often neglected in city administrations in Germany in terms of citizen participation. Due to the great importance of citizen participation, the willingness of citizens and the possibilities for active participation in the context of roadside greenery are also examined [8].

1.2. Literature Review

Studies on street greening have mostly focused on monitoring the quality of urban street greening, the relationship between street greening and active mobility and the relationship between greening and climate change. Research investigating the relationship between street greening and physical activity in older people in China found that street greening has a positive effect on physical activity. Therefore, street greenery can also contribute to an age-friendly city [9]. Other research investigated the effects of urban greenery on the urban climate and traffic noise. However, this relates more to general green spaces and not explicitly to greenery along roads. However, this study shows that green spaces in the city play an important role in improving the microclimate and reducing pollution [10]. There are also approaches that analyze the urban vegetation system in relation to the effects of climate change and the phenomenon of urban heat islands. It has been found that the urban vegetation system, especially street trees, has an impact on mitigation and adaptation to heat islands [11].

In this context, the "BlueGreenStreets" project of HafenCity university Hamburg should be mentioned, as it redistributes traffic areas in existing streets to create spatial potentials for climate protection and climate impact adaptation. This concept considers not only the effect on climate change, but also the enhancement of the quality of stay through various elements, such as street-side greenery [12]. Another research focuses on the various characteristics of roadside greenery (such as the number and spacing of trees, the arrangement of vegetation, the height of planting, the types of trees and vegetation, etc.) and what influence these have on the visual preference of people in Indonesia [13]. Further studies investigated the relationship between street greenery and mobility behavior in Beijing and the relationship between street greenery and physical activity using Google Street View in Hong Kong [14,15]. The last shows that the quality and quantity of street greenery has a positive influence on leisure activities [15]. In 2016, for example, researchers also investigated roadside vegetation in relation to ecosystem services. This found that awareness of the value of multifunctional ecosystem services in roadside landscapes can lead to the development of livable roads [16]. In downtown Doha, Qatar, it was proven that one of the most preferred ecosystem services is the benefit of roadside vegetation for the aesthetic enhancement of streets [17]. Another research is about the effects of street greenery on the perception of acoustic comfort of pedestrian areas [18].

The effects of street greening on thermal comfort in temperate climates have been researched in terms of physical and psychological aspects. It specifically addressed how street greening can contribute to creating a thermally comfortable environment [19].

General questions on the planning, implementation and maintenance of roadside greenery are addressed in the literature under economic, ecological and road safety aspects [6]. Roadside greenery in inner-city areas and its effects on people's well-being is an area that has been little researched. With regard to the quality of life in connection with street greenery, there are rather few studies or consider the topic under other aspects. Only the research on urban greenery, which deals with general urban greenery and life satisfaction, emphasizes the need to promote green spaces in densely populated urban areas [20].

Research on the design of green infrastructure to promote the subjective well-being of citizens, as well as on the psychological effects of urban design, shows positive associations between green spaces and well-being. These underline the need to promote green spaces in densely populated urban areas [21,22].

Thus, we tie in with existing studies and expand the field of research with the investigation of street greenery in the context of quality of life in cities. The work is intended to show potential for the optimization of street greenery for sustainable urban development.

2. Materials and Methods

Two different methods of data collection were used to investigate the effects of roadside greenery on the quality of life of residents in inner-city areas. A quantitative citizen survey was carried out using an online questionnaire. and a qualitative survey was performed, based on expert interviews. During the qualitative analysis, the experts' opinions were examined with regard to their experience and specialist knowledge of roadside greenery in public spaces. This additional research was carried out as a supplement to the quantitative survey in order to gain a more comprehensive insight into this topic. Recommendations for action for local municipalities were then drawn up on the basis of these studies. These recommendations for action are intended to show the cities and municipalities how roadside greenery in the cities can be further developed and adapted to the wishes and needs of the citizens.

2.1. Introduction of the Questionnaire

Involving citizens in the planning process is an important aspect of creating acceptance for a project. The focus was therefore on the quantitative survey, which was conducted using an online questionnaire. This online survey was conducted using the online survey tool Unipark and analyzed with the statistical software Statistical Package for the Social Sciences (SPSS) from the International Business Machines Cooperation (IBM). A total of 473 German citizens took part in the online survey. A total of 404 people from all over Germany completed the questionnaire in full over a period of four weeks. This resulted in a response rate of around 83%. The questionnaire is divided into three main sections: perception of roadside greenery, participation and demographic data.

In the first section of the questionnaire, the participants were presented with three different situations of different types of roadside greenery in order to assess their perception (see Section 3.1.4). This was followed by questions on the development of roadside greenery at their current place of residence in recent years (see Section 3.1.5) and on satisfaction with roadside greenery in terms of quality and cleanliness (see Section 3.1.6). The participants were then asked about the importance of roadside greenery for the subjective and general quality of life (see Section 3.1.3). This was followed by various statements to which the participants were asked to express their agreement or disagreement (see Section 3.1.7). Another question was the benefits of roadside greenery, for which several answers were possible (see Section 3.1.8).

The second section of the questionnaire dealt with citizen participation. In some cities, there are already citizen activities that campaign for more greenery in the city districts and take on various tasks on a voluntary basis. For this reason, the general willingness of the population to participate in the planning, design or maintenance of roadside greenery was also queried. Depending on the answer, it was then asked whether the respective participant was already involved in such voluntary work or for what reasons they would not

participate in any voluntary work relating to roadside greenery. The willingness to provide financial support for roadside greenery projects was also questioned (see Section 3.1.9).

In the third section, demographic data were collected, such as age group and gender (see Section 3.1.2). The last question contains an open question in which the participants could express their wishes or ideas for the roadside greenery in their city (see Section 3.1.10).

The online survey was intended to address a broad spectrum of different groups of people. The survey was therefore aimed at all age and occupational groups from all levels of education in Germany. Participants were given comprehensive information about data collection, storage and analysis before the survey began. The questionnaire could only be completed if agreement was given. In order to reach as many participants as possible, the online survey was distributed both in the participants' own networks and in various social networks.

2.2. Conducting the Expert Interviews

In addition to the citizen surveys, the authors conducted guided interviews using a written questionnaire with eight experts from the fields of architecture, urban and transportation planning and construction. These included a managing director of a landscape architecture firm, a landscape architect and contractor, a university professor, two urban planners, a transportation planner, an architect and a municipal employee responsible for the maintenance of a park. Experts from different fields were chosen to provide a wide range of experience and expertise. These interviews were specifically focused on the issues that are important in the context of this research. This included questions such as the relationship between roadside greenery and quality of life, the opportunities and planning challenges in the planning of roadside greenery, the needs of citizens in this regard and recommendations for municipalities to improve roadside greenery.

2.3. Statistical Analysis of the Data

A statistical analysis was carried out for this survey to prove that the results are based on a reliable foundation. First, the representativeness of the survey was examined to ensure that the results correctly reflect the population. To answer the question of whether roadside greenery has an effect on general and subjective quality of life, a hypothesis test was carried out using IBM's SSPS Version 29 software. The questions were carefully developed, and a pretest was conducted to ensure that the questionnaire measured what it was intended to measure. In addition, the questionnaire was tested for reliability using Cronbach's alpha, to determine if the questionnaire produced similar results when administered repeatedly. The results of the statistical analysis can be found in Section 3.1.1.

3. Results

3.1. Quantitative Study—Citizen Survey

3.1.1. General Introduction and Statistical Analysis

A minimum sample size of 384 participants was necessary to ensure representative results with regard to the population, which, in Germany, comprises around 84 million inhabitants (2022) [23].

With regard to the question of how street greenery affects the general and subjective quality of life, a significance test was carried out. The *t*-test was performed under the hypothesis that roadside greenery has a significant influence on the general and subjective quality of life of citizens. The sample consisted of 404 participants and thus resulted in 403 degrees of freedom. With a confidence level of 95%, this resulted in a significance level of 0.05. The significance level is the maximum probability with which a hypothesis is incorrectly rejected. The calculated t-value of −23.393 was below the critical t-value. This confirms that there was no significant difference between the sample and the population. The hypothesis that roadside greenery has a strong influence on the general and subjective quality of life was therefore confirmed.

To ensure that the questionnaire actually measures what it was supposed to measure, the questions were developed carefully. Only closed questions were used to create the

questionnaire. At the end, an open question was integrated in which the participants could reveal their personal individual opinion. The questions were formulated neutrally so that no suggestive questions would arise and the respondents would not be influenced. The questions were formulated to be as short and concise as possible, to not overwhelm the participants with complex and complicated questions.

In order to check the questionnaire with regard to comprehensibility of the questions, context effects and time duration, a pretest was conducted prior to implementation. For this purpose, the questionnaire was tested by approximately 20 people, to ensure that the questions were interpreted and understood correctly. This served to identify misunderstandings and confusion. With regard to the reliability of the core question of the influence of general and subjective quality of life, Cronbach's alpha was used. This value is used to examine how well the various questions correlate with each other to ensure consistent measurement of the construct. In this case, the Cronbach's alpha value is 0.85. This indicates a high internal consistency and, thus, a high reliability. This calculation thus confirmed that if the measurement were repeated under the same conditions, similar results would be obtained.

3.1.2. Age and Gender Distribution of Participants

In Figure 1, it can be seen that most of recipients in the citizen survey were between the ages of 18 and 45. Many of these were under the age of 30, some were between the ages of 46 and 60, and a few were over the age of 60. In the graphical representation of the results, the total may not add up to exactly 100%, due to rounding.

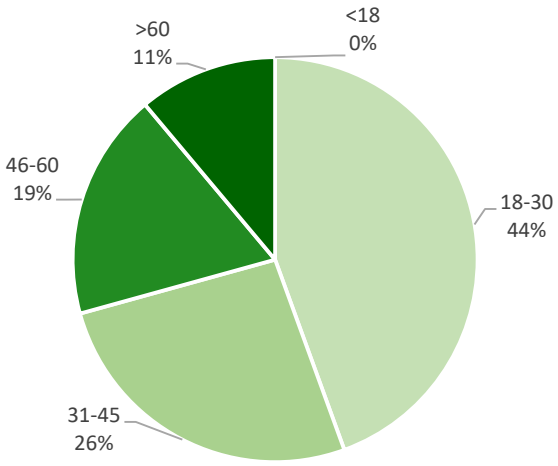

Figure 1. Age distribution of participants in the online survey (n = 404).

As seen in Figure 2, more women participated in the survey than men or other gender categories.

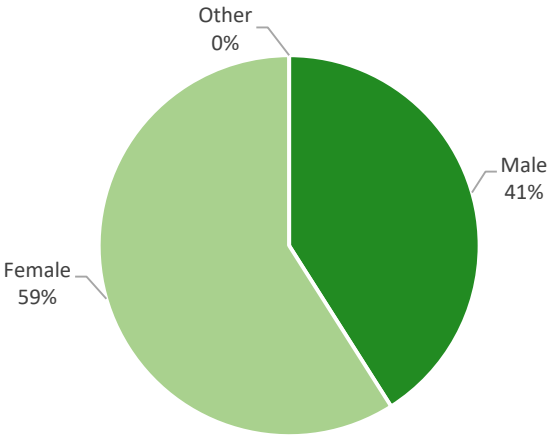

Figure 2. Gender distribution of participants in the online survey (n = 404).

In addition to demographic data on age and gender, several topic-specific questions were asked about perceptions, participation, satisfaction and wishes for street greenery.

3.1.3. Street Greenery for the Quality of Life

At the beginning of the survey, the effect of roadside greenery on the participants' subjective and general quality of life was analyzed. For general quality of life, the participants were asked to assess general factors resources such as their economic situation, quality of environment, living environment and the provision of social infrastructure. The subjective quality of life targeted the participants' perceptions and evaluations of their own lives.

Figure 3 shows that a very large number of respondents stated that street greenery is rather important to very important for their subjective well-being.

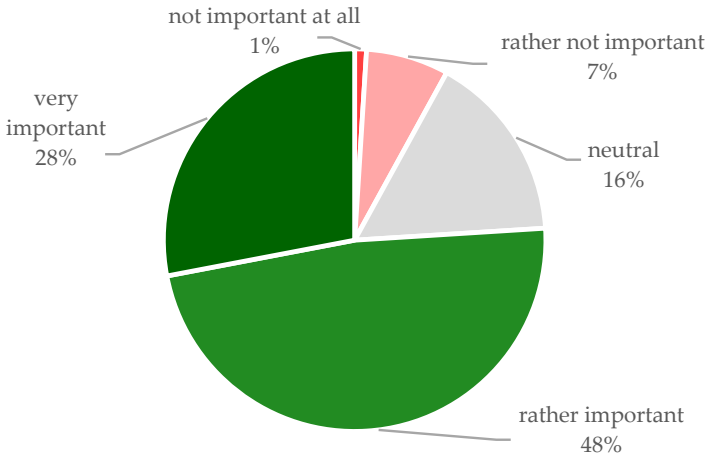

Figure 3. Effect of street greenery on subjective quality of life (n = 404).

The effect of the street greenery on the general quality of life was rated as very important to rather important by a large number of respondents (see Figure 4). Only a few respondents stated that it was rather unimportant or not important at all for the quality of life.

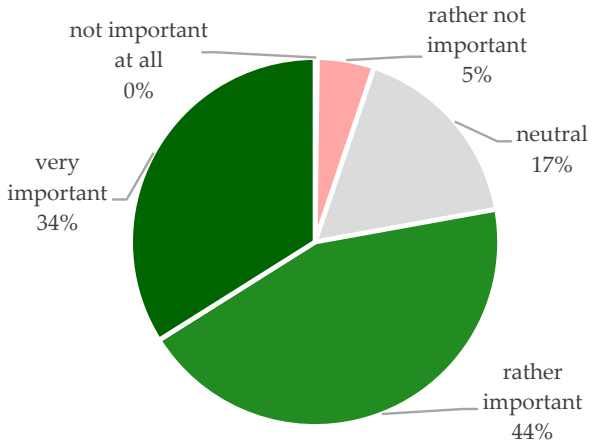

Figure 4. Effect of street greenery on general quality of life (n = 404).

In this context, the effect of roadside greenery on the subjective and general quality of life was analyzed by age group. For an optimal comparability, the number of people in each age group was set in relation to the total number of participants in each age group. Figures 5 and 6 show that street greenery generally played a major role in subjective and general quality of life in every age group. In both cases, only a few respondents stated that it was not important for quality of life.

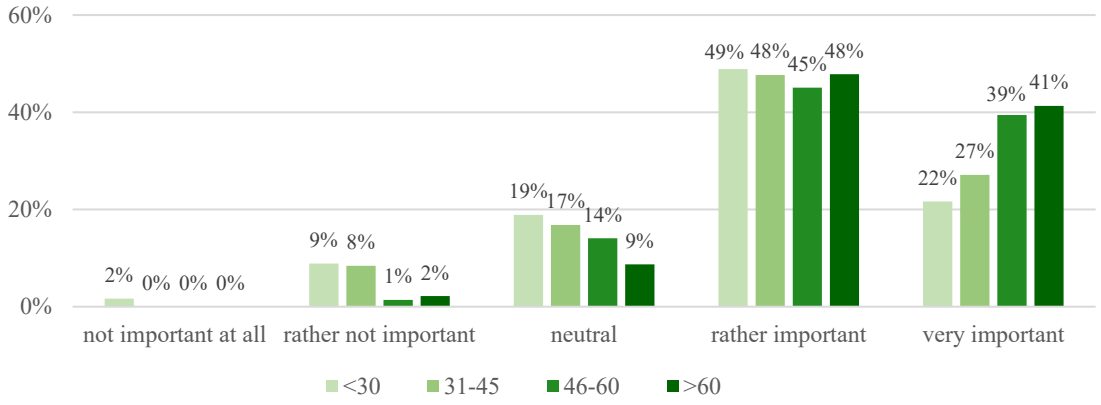

Figure 5. The role of street greening in the subjective quality of life in each age group (n = 404).

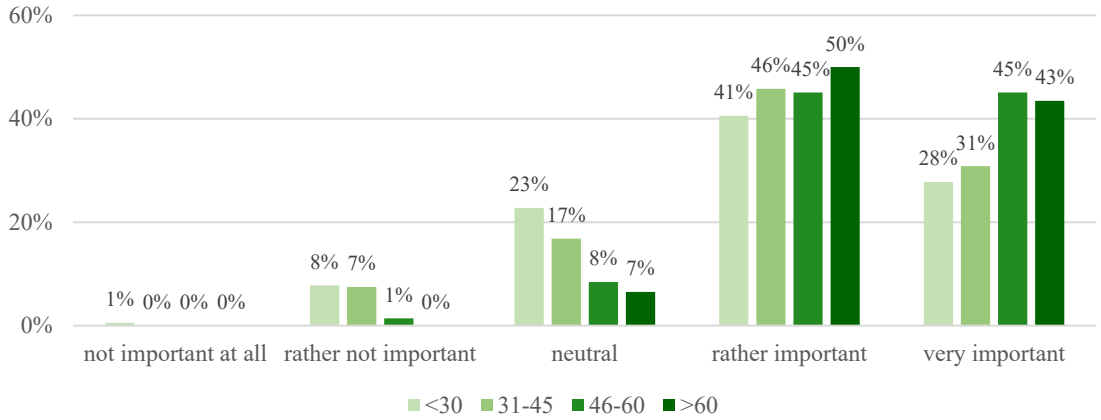

Figure 6. The role of street greening in the general quality of life in each age group (n = 404).

3.1.4. Perception of Roadside Greenery

At the beginning of the citizen survey, the participants were shown three images of different types of roadside greenery to assess their perceptions. The first situation is a typical planted median strip which is designed with ground covers and trees (see Figure 7). This type of roadside green serves as separation function for motorized individual traffic of both traffic directions.



Source: Own image

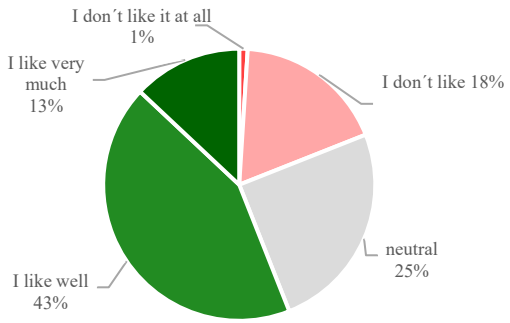

Figure 7. Situation 1—greened median strip (n = 404).

The second situation shows a wide greened median strip with an integrated footpath and the possibility of staying, as well as of local recreation in the neighborhood. The greened median strip is characterized by shrubs, hedges and trees. In this street greening, the footpath is separated from the street by the planting (see Figure 8).



Source: Own image

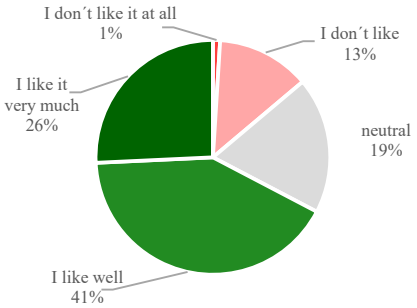

Figure 8. Situation 2—wide green median strip with the possibility of staying, to relax or to enjoy the environment (n = 404).

As a third situation, participants were shown a roadside green that serves as a separation between the road and the sidewalk. In this case, it is a planting between non-motorized individual traffic and motorized individual traffic. This type of street green is characterized by large trees and shrubs (see Figure 9).



Source: Own image

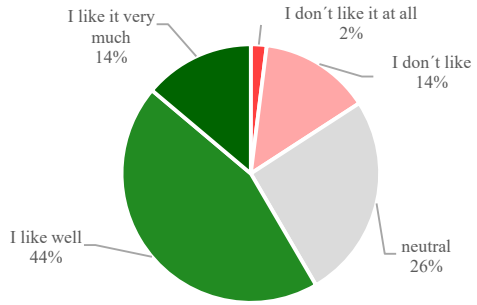

Figure 9. Situation 3—Greened strip separating between street and sidewalk (n = 404).

This question asked the participants to rate the roadside greenery in the image from "I don't like it at all" to "I like it very much". When looking at the results, it is noticeable that many participants liked this type of street greening. However, only a few respondents rated it as very good. Almost none of the respondents did not like this type of street greenery at all.

In the further course, the second situation was presented to the participants (see Figure 8).

With regard to the wide green median strip, around two thirds of respondents rated the wide central reservation as good to very good. Of these, almost half rated it as very good. Few respondents did not like this type of roadside greenery. In conclusion, this type of roadside greenery was perceived as very positive by the respondents.

At last, the third situation was presented to the participants for evaluation (see Figure 9).

Overall, it can be said that the participants found this type of street greenery very appealing. More than half of the respondents stated that they like this type of street greening well or very well. Few respondents disliked this type of street greenery.

3.1.5. Development of the Street Greenery

The next question asked about the development of street greenery in recent years at each respondent's place of residence. In the survey, just over a third were of the opinion that the roadside greenery at their current place of residence had developed positively in recent years (see Figure 10). For a similar number of respondents, the street greenery had remained unchanged in recent years. Few of the participants stated that the roadside greenery had changed negatively.

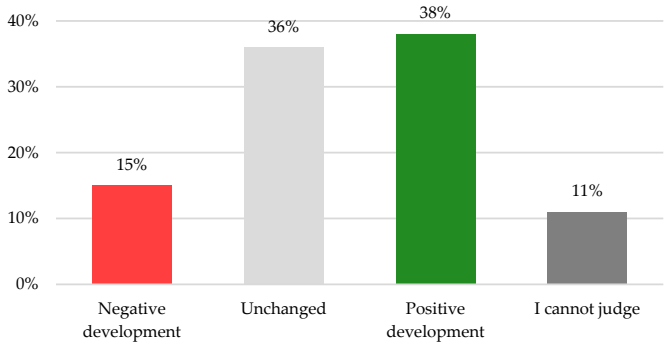

Figure 10. Evaluation of the development of street greenery at the current place of residence (n = 404).

3.1.6. Satisfaction with the Roadside Greenery

The next question asked whether citizens were satisfied with the street greenery at their current residence in terms of quality and cleanliness. Factors such as the vegetation structure and the condition of the street greenery are decisive in assessing the quality.

As seen in Figure 11, quite a large number of respondents indicated that they were rather to very satisfied with the quality. Of these, very few were very satisfied with the current condition. Around a third of respondents were not particularly or not at all satisfied with the quality of the street greenery at their current place of residence.

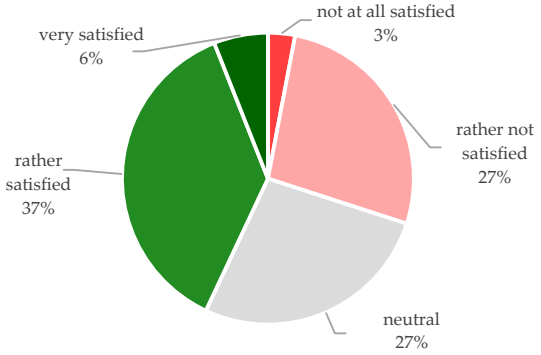

Figure 11. Satisfaction with roadside greenery-quality (n = 404).

The evaluation of the cleanliness of the green spaces in the street area showed similar results to the satisfaction with the quality of the street greenery at the current place of residence. Factors such as litter and waste in the street greenery were decisive for the assessment of cleanliness.

Many of the respondents stated that they were rather or very satisfied with the cleanliness of the roadside green spaces. Of these, only a few were very satisfied (see Figure 12). Around a third of respondents stated that they were generally not satisfied with the cleanliness of roadside green spaces. Of these, very few are very dissatisfied with the current situation.

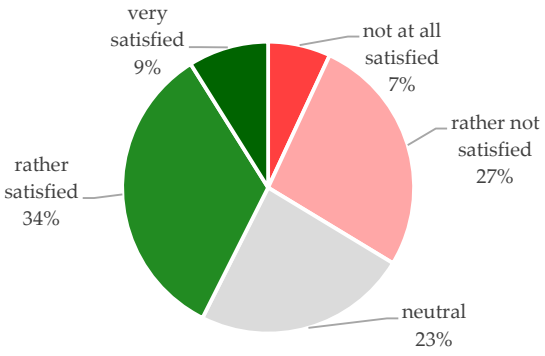

Figure 12. Satisfaction with the roadside greenery—cleanliness (n = 404).

3.1.7. Importance of Roadside Greenery for Citizens

In the survey, participants were presented with various statements on the topic of roadside greenery and asked to express their agreement or disagreement (see Figure 13). Statement 1 asked whether participants would walk more daily journeys if there were more green spaces along the roads. Many of the respondents answered this statement in the affirmative and stated that they would walk their daily journeys more often if there was more street greenery. The question in statement 2, regarding whether they would switch to cycling more often if there were more roadside greenery, demonstrated similar results to statement 1. Many respondents would also cycle more daily journeys if there were more roadside greenery. Agreement with statement 3 "I feel safer when there is a green strip or trees between the road and the sidewalk as a separating effect" was particularly pronounced. Far more than a third of respondents felt safer when there was a green strip between the road and pavement. Only a small number of participants stated that they did not feel safer with such a separating effect. A large majority of respondents in the survey also agreed with statement 4: "Beautiful roadside greenery invites active movement". A very large number of respondents stated that roadside greenery encourages active exercise. Very few participants shared the opinion that roadside greenery does not encourage active exercise.

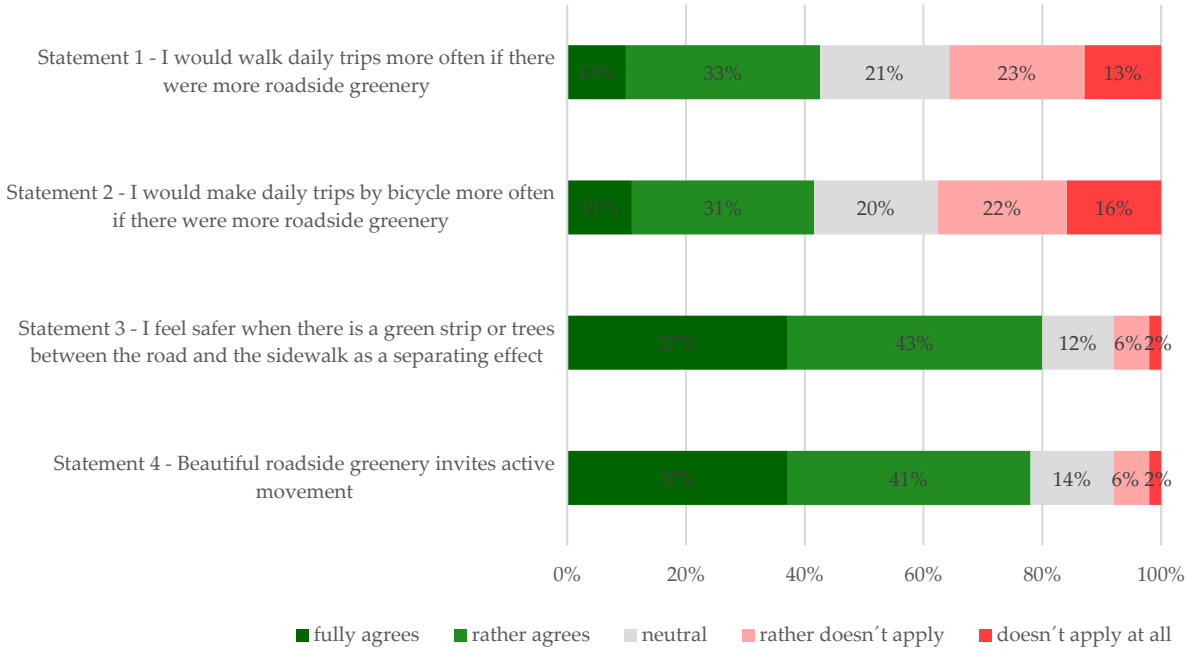

Figure 13. Evaluation of statements 1, 2, 3 and 4 of the survey (n = 404).

3.1.8. Benefit of Roadside Greenery

Roadside greenery is associated with a variety of benefits. For this reason, participants were asked what the most important benefits of street greenery are (see Figure 14). The majority of the participants stated that an increase in well-being is the greatest benefit in everyday life. The design of the street space through the visual effect of the street greenery and the protection against pollutants, which is caused by the emissions of vehicles, were also considered by the residents to be important benefits of the street greenery. The improvement of the climate through the cooling effect during heat and the water absorption during heavy rain events, the protective and separating effect between the different road users, as well as the shading by trees, for example, were also given a high priority, with over than a third of respondents in agreement.

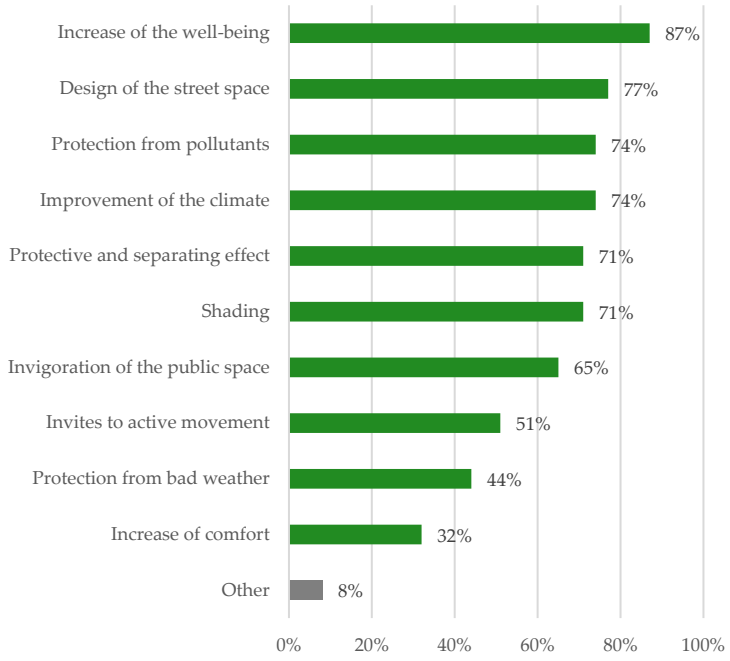

Figure 14. Use of roadside greenery (n = 404).

Public space is the basis for community coexistence and offers people the possibility to spend time, to be active and to communicate. In the opinion of very many respondents, street greenery makes an important contribution to the revitalization of public space. This illustrates that street greenery plays a significant role in social coexistence. The aspects "invites active movement", protection from bad weather and increase in comfort were mentioned as less serious advantages. Other benefits cited by respondents included a reduction in road traffic noise and an overall increase in the quality of living and life. The most common response to the open-ended questions was the creation of wildlife habitats. When looking at the benefits by age and gender group, no significant differences were found.

3.1.9. Willingness to Participate in the Planning and Maintenance of Roadside Greenery

In the next question, the participants were asked whether they were willing to volunteer and actively participate in the planning, design or maintenance of street greenery. Figure 15 shows that the willingness to regularly take on work to improve or maintain street greenery on a voluntary basis was relatively low among citizens, with less than two thirds of respondents in agreement. Among the subgroup that was open to such activities, tree sponsorship or planting work received the highest level of agreement. Few participants would take on work such as weeding, small-scale mowing or grove maintenance. Very few of the participants stated that they could imagine participating in other work, such as watering, planting vegetables or herbs, collecting garbage, planning planting, buying seeds, installing and maintaining birdhouses, tree donations, flower sponsorships or providing care at certain events.

In Figure 16, a comparison was made in which the age groups were examined in terms of their willingness to engage in volunteer activities. The values are based on the number of participants who were willing to actively participate in such voluntary activities in the future, in relation to the total number of participants in the respective age group. According to the survey, very few respondents already engaged in such activity on a voluntary basis in a municipality and would continue to do this. This tended to be the group of people over the age of 46. The citizen survey also showed that interest in volunteering was significantly lower among the under-30s than among other age groups.

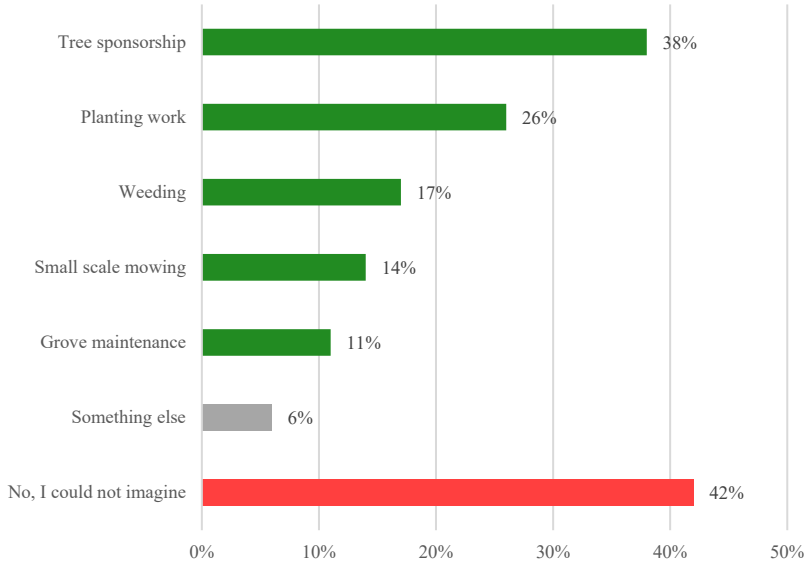

Figure 15. Willingness for citizen participation (n = 404).

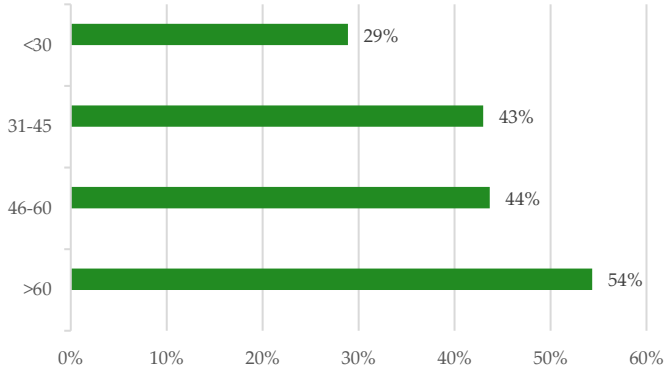

Figure 16. Willingness of citizens to participate actively by age group (n = 404).

In contrast, more than half of respondents over the age of 60 could imagine taking on such an activity. The two middle age groups also showed a relatively high level of willingness.

The citizens who were not willing to actively participate in the planning, design or maintenance of roadside greenery cited various reasons (see Figure 17). Around three quarters of the respondents see the time aspect as critical.

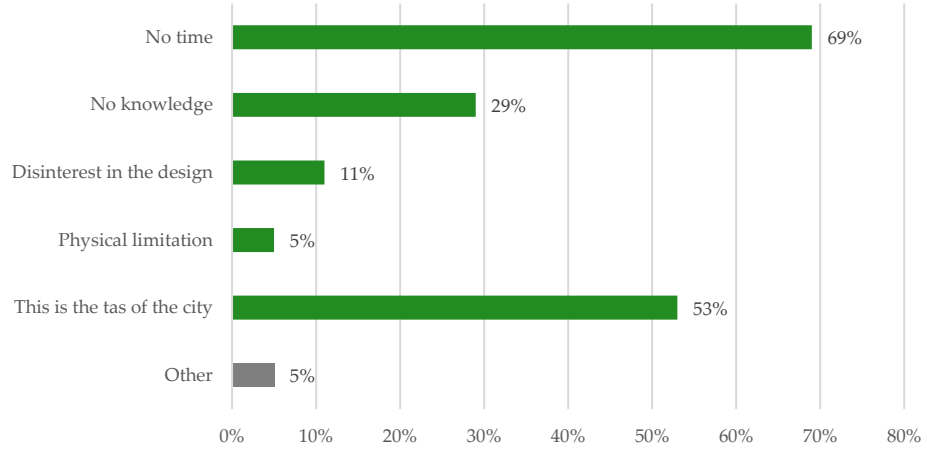

Figure 17. Reasons for not volunteering (n = 404).

It is striking that, for some respondents, interest in design played a role. In this context, few of respondents cited disinterest in design as a reason that prevented them from participating. More than half of participants considered the planning, design and maintenance of roadside greenery to be the responsibility of the city. For very few of the participants, their physical condition prevented them from participating in the maintenance of the street greenery. The reason of physical limitation was mainly given by elderly people over 60 years old. Other reasons given were allergies or the strain of landscaping their own garden.

When asked if citizens would financially support roadside greening projects, some respondents answered "yes" (see Figure 18). Overall, almost two thirds of respondents indicated that they could, in principle, imagine co-financing roadside greening. However, almost half of these responded with the answer option "maybe". With regard to the age groups, the two middle age groups tended to be more willing to financially support the roadside greenery.

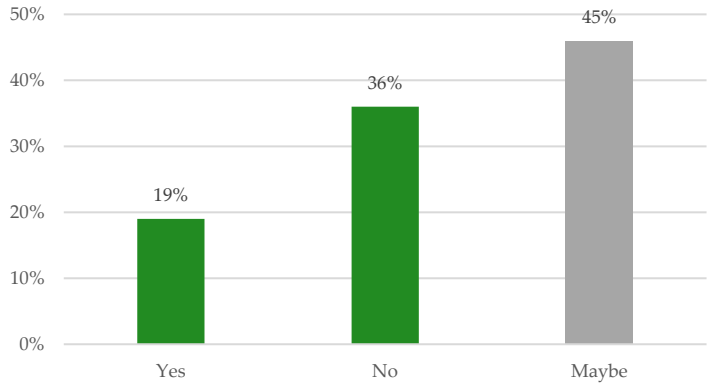

Figure 18. Willingness of citizens to finance roadside greenery (n = 404).

3.1.10. Wishes of the Citizens

With regard to the design of the roadside greenery, there were various ideas and wishes of the population. The citizens were therefore asked to indicate what they would like to see for the roadside greenery in their hometown (see Figure 19). Many of the respondents stated that they prefer beautiful trees. Flowering shrubs, near-natural wild beds, planting beds and flower borders were also popular. Green facades or other street greening measures, such as green streetlamps or bus stops, were also given similar importance. Uniformly designed planting, as well as planting in concrete pots, was rather less desired by the respondents. Very few respondents generally did not consider design features to be important.

In this context, citizens were asked to indicate how important greening on various street elements is to them. The road elements were divided into the following: traffic circles, median strips, planting as a separating effect between the road and the sidewalk and bicycle path, track greening measures and other greening measures, such as greened bus stops or lanterns. Planting at traffic circles was most important to respondents, along with planting as a separator between the road and the sidewalk or bike lane and on the median. A very large number indicated that planting on traffic circles was rather important to very important. For only a few, greening at traffic circles played a rather minor role. The planting of medians was also important to citizens. Here, almost two thirds stated that planting on medians was rather important to very important. Almost nobody considered this type of greening in the road space to be completely unimportant.

The statement whether citizens feel safer if there is planting between the street and the sidewalk already received a high approval in Section 3.1.7. Also in this question, the popularity of the planting as a demarcation to the road traffic was confirmed. Most respondents rated this type of street planting as rather important to very important. The survey also showed that greening on roadway elements, such as route greening measures, was only considered important by over a third of respondents. For about half of the respondents, roadway greening measures were irrelevant. Other greening measures, such

as green bus stops or lanterns, were also rated as important by many participants. Only a few stated that these greening measures were not important. Around a third of respondents had a neutral opinion of such greening measures.

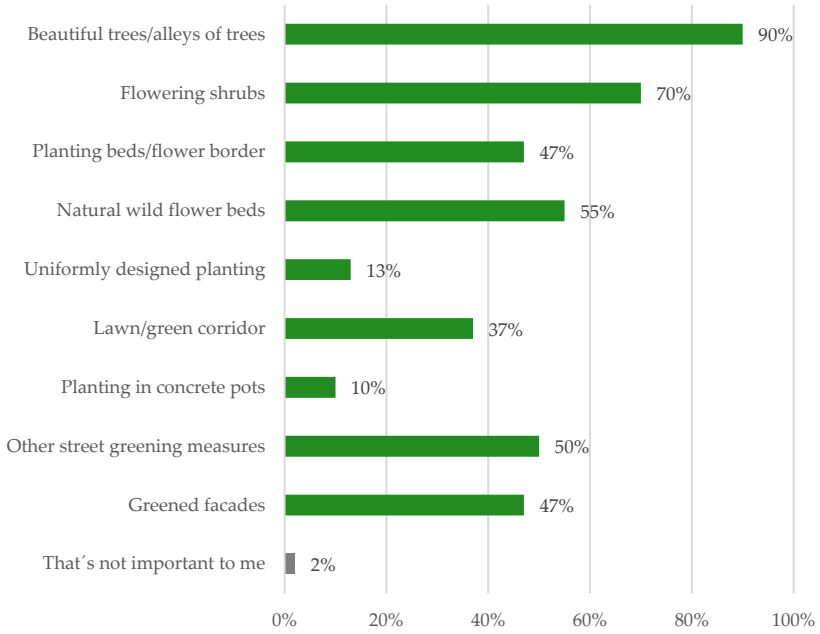

Figure 19. Design of roadside greenery (n = 404).

In the final open question, citizens were able to express their wishes with regard to the street greenery in their hometown. A total of 184 participants gave different answers. In the evaluation, the answers were divided into five priorities by the researchers. Depending on the frequency of the indication, the answers were classified into respective priorities. Priority 1 is the wish most frequently mentioned by the participants and priority 5 is, accordingly, the wish least frequently mentioned. Figure 20 lists the respective priorities in relation to the number of responses given.

Priority 1	More roadside greenery
Priority 2	More maintenance
	Planting closer to nature
Priority 3	Creation of habitats for animals
	Increasing plant diversity
	More trees
Priority 4	Cleanliness (less garbage, ...)
	Flowering planting
	Innovative green projects
	Raising awareness
Priority 5	Native plants
	Greenery for climate protection
	Using appropriate plants
	Seasonal planting
	Low maintenance

Figure 20. Wishes of the respondents according to priorities (n = 184).

This feedback shows people's different ideas and needs with regard to street greening and provides valuable suggestions for future planning and design.

As shown in Figure 20, most citizens who commented on the open-ended question generally wanted more street greenery in the city. One of the highest priorities was also placed on maintenance. Many saw the street greenery as needing more maintenance and would like to see more maintenance for this purpose. Other citizens would like to see near-natural plantings, such as wildflowers. Increasing plant diversity and the associated creation of habitats for animals (insects, birds and small mammals) was also given high priority. Respondents indicated that insect-friendly plants, including those specifically for wild bees, should be planted in the urban area. Related to this is the promotion of biodiversity and the planting of appropriate species so that insects or other animals can find food throughout the year. The planting of native or regional plants, as well as trees in various forms such as individual trees, rows of trees or avenues in the urban area, were also in high demand among citizens.

Another suggestion of the citizens was the cleanliness in street green areas. Other respondents stated that more attention should be paid to cleanliness, with regard to litter and dog excrement. This topic goes hand in hand with the strengthening of awareness and appreciation among the population with regard to green and open spaces in the city center. In this context, according to some citizens, more innovative green projects should be promoted. Residents should be able to participate in various projects, such as plant sponsorship, cultivation or urban gardening projects. Other suggestions and requests from citizens included flowering, native, seasonal and low-maintenance plantings. Some respondents also indicated that more street greenery should be created for climate change.

3.2. Qualitative Study—Interviewing Experts

3.2.1. Improving Roadside Greenery in Cities

There are various approaches and measures for the planning, design and maintenance of roadside greenery in cities. According to the experts, it is important to adapt these individually to the urban planning situation, traffic and the quality of life of the urban population. The experts also emphasized that even small changes can achieve great added value, especially with regard to the awareness and appreciation of city dwellers for street greenery. Raising awareness and appreciation of such areas plays a major role in ensuring appropriate use and maintenance. This can be improved through investment in education or, for example, through citizens' movements such as guerrilla gardening.

According to the experts, another important approach is to increase the number of green spaces and make traffic areas more sustainable. In order to be able to implement this, more budget funds are required for the creation and maintenance of roadside greenery. The experts also discussed the professional care of planting. In particular, the life cycle of plants and urban trees, as well as the need for sufficient root space, should be taken into account. Holistic planning and implementation of such areas can contribute to great added value and a higher quality of life in cities.

3.2.2. Opinions and Recommendations of the Experts

In the context of these interviews, the experts were asked to express their wishes with regard to the roadside greenery. Accordingly, the focus in the coming years should be on a stable and sufficiently dimensioned roadside green structure, with, if necessary, amenity qualities in the form of green corridors. They emphasize that roadside green spaces are important functional elements on city streets that must be maintained and expanded. A university professor demanded that the awareness and relevance of roadside greenery must be increased among the public. Citizens should be made aware of why roadside greenery is important and how it can help to counteract the challenges of climate change.

Another expert emphasized that we are currently in a turnaround period where the relevance of roadside greenery is becoming increasingly important. The term "relevance" will, in his opinion, be one of the most important in the coming decades. The priority is to improve the current condition, in order to derive a benefit for climate change, for example, and not just to achieve a visual design. Roadside greenery must be preserved and citizens'

awareness of this must be raised. It is also important that the issue of street greenery be more integrated into teaching and education. The experts agreed that roadside greenery should be developed in the future to fulfill its functions and maximize its impact on the environment and society. This could be realized, for example, by increasing the quantity and quality of roadside greenery, creating suitable roadside greenery to combat to climate change or integrating it into alternative streetscape concepts.

3.3. Further Research and Outlook

The present study on roadside greenery has provided valuable insights into the effect of roadside greenery on the quality of life and visual preferences of citizens through various surveys. However, in order to gain an even deeper insight into this topic, further analysis methods could be included. The integration of analysis tools, such as the use of structural equation modeling (SEM) or partial least squares structural equation modeling (PLS-SEM) via SPSS from IBM would be conceivable, for example. The inclusion of multi-layered and quantitative analysis methods could reveal further complex relationships between different variables and enable a more precise interpretation of the survey results. The data could be stratified according to different dimensions or groups to show the differences between, for example, different groups of participants or response categories. Taking into account the different needs of the population groups would enable targeted and optimally coordinated planning of roadside greenery.

4. Discussion

As mentioned in the first chapter, inner-city green spaces have various social aspects. Urban green spaces make a significant contribution to social interaction in the neighborhood and influence the well-being of city dwellers. Green spaces in the city, therefore, have a positive effect on the quality of life and health of residents. This study investigated the role played by roadside greenery in this respect. As shown in Sections 3.1 and 3.2, citizens and experts agreed that roadside greenery has a positive effect on the general and subjective quality of life. In this context, it should be mentioned that roadside greenery generally accounts for a relatively small proportion of inner-city green spaces and can therefore only have a limited influence on quality of life. Nevertheless, increasing the amount of high-quality roadside greenery can help to improve the quality of life in cities. Compared to other urban green spaces, roadside greenery is usually not of natural origin but is created by humans. These are places where natural elements and habitats are created for selected species of living organisms.

In addition, Section 3.1.7 shows that street greening is strongly linked to the promotion of active mobility. Many respondents would make their daily journeys more frequently on foot or by bicycle if there were more roadside greenery. This underlines the current challenges in urban planning, including minimizing traffic congestion, increasing road user safety and promoting sustainable modes of transport. Sections 3.1.7 and 3.1.8 show that non-motorized users such as pedestrians and cyclists feel safer and more comfortable when there is green space between the road and the sidewalk. This contributes significantly to an increased feeling of safety and consequently to a greater general sense of well-being.

Section 3.1.8 emphasizes that the increase in well-being is one of the most important benefits of street greenery for many respondents. With regard to the ecological functions mentioned at the beginning, the results in Section 3.1.8 show that protection against pollutants and the improvement of the urban climate are perceived by citizens as particularly important aspects. In the last open question, it is clear that many respondents expressed a desire for a greater presence of roadside greenery. This once again shows the importance and positive effect of roadside greenery in various situations of urban life and thus also confirms the initial question of this study.

The recommendations for action developed in this study can be an effective tool for increasing the quantity and quality of roadside greenery in inner-city areas. The potential of this study lies particularly in the fact that it provides concrete recommendations for cities

and municipalities. These recommendations offer valuable suggestions on how to expand roadside greenery in cities in a targeted manner and at the same time raise public awareness of the importance of inner-city green spaces. By suggesting concrete ways of optimizing roadside greenery that are adapted to the needs of citizens, it contributes to increasing the well-being of city dwellers. In this way, it also helps to promote citizen involvement and participation. These aspects are particularly important, as a higher quality of life and increased environmental awareness among residents are essential building blocks for sustainable urban development. In addition, the recommendations can support cities in finding suitable measures to mitigate the consequences of climate change.

By implementing these recommendations for action, it is therefore possible to promote holistic, environmentally friendly urban development that meets both the current needs of citizens and the long-term ecological challenges. In this context, it should be noted that the spatial scale of the study relates to Germany. Therefore, the statements cannot simply be extrapolated to all countries.

4.1. Connection to Previous Studies

The importance of urban green spaces was viewed and assessed by citizens from different perspectives. This is particularly evident in this survey, in which participants stated that street greenery has a significant influence on subjective and general quality of life. Other studies also confirm that our psyche can be influenced by various urban aspects such as green spaces. Urban design in general can evoke both positive and negative emotions and, thus, influence our mood and behavior. This study further emphasizes the importance of this topic in the planning of cities [22]. Another study shows that different types of green measures in conjunction with different locations can significantly increase happiness and temporarily reduce stress [21]. This is also shown in the study entitled "Urban greenery mitigates the negative effect of urban density on older adults' life satisfaction: Evidence from Shanghai, China", which concluded that urban greenery has a positive effect on the life satisfaction of older people [20]. The results of the study "Association of street greenery and physical activity in older adults: A novel study using pedestrian-centred photographs", which examined the relationship between street greenery and physical activity, were also confirmed by the participants of the survey in Germany, e.g., in Section 3.1.7 [9].

In addition, the visual preferences of people with regard to different characteristics of roadside greenery, such as the type of roadside greenery or planting, were investigated [12]. The finding from this study is that the perception of different types of roadside greenery (see Section 3.1.4) and also the type of planting (see Section 3.1.10) has a relevant influence on the preference of roadside greenery [12]. Research conducted in the urban centre of Doha, Qatar, also showed that the vegetation type with the highest proportion of greenery and thermal comfort is the most preferred [17].

Climate change is becoming an increasingly important concept today. Both citizens and the experts in this study saw roadside greenery as a good opportunity to counteract the effects of climate change. The study "The effects of street tree planting on Urban Heat Island mitigation in Montreal" proves that the urban vegetation system, especially trees, makes an enormous contribution to mitigating and adapting to climate change [11]. Another strongly discussed point in the survey was the participation of citizens in the planning and maintenance of roadside greenery. The opportunity to actively participate in the planning, design or maintenance of roadside greenery received a positive response from citizens in the survey. The experts were also of the opinion that active citizen participation is an important instrument in urban planning. The findings from the survey are confirmed by a study entitled "Toward livable and healthy urban streets: Roadside vegetation provides ecosystem services where people live and move". This shows that cooperation between different interest groups would make a major contribution to creating livable streetscapes [16].

4.2. Context Experts and Citizens

The results of the surveys showed that the experts and citizens agreed that roadside greenery, especially in urban areas, has a positive effect on the quality of life and, thus, also on citizens' well-being. Both experts and citizens were of the opinion that the amount of roadside greenery in urban areas should be increased and that these green spaces often require better maintenance. They also considered roadside greenery to be an important ecological and design asset. They saw it as an opportunity to promote quality of life, an opportunity to counteract the effects of climate change and, at the same time, to raise the aesthetic design of urban space to a new level. These findings demonstrate the importance of cooperation between experts and citizens and, above all, the active involvement of citizens in various phases of the planning of roadside greenery.

5. Recommendations for Municipalities

In this section, general recommendations for action for high-quality roadside greenery are given, based on studies in Germany. In the context of these recommendations for action, it should be explicitly noted that these are the aggregated opinions of several citizens and experts and not the subjective viewpoints of individuals. The recommendations are the results of the analysis of the data from the citizen surveys and expert interviews in this study. The aim is to provide cities and municipalities, as well as external planners, with guidelines for promoting high-quality roadside greenery in urban public spaces. In addition, the recommendations for action should support the realization of climate and environmental protection goals and also help to minimize possible follow-up costs in the area of maintenance. These recommendations for action are intended to serve as inspiring approaches for the planning and implementation of roadside greenery in inner-city areas.

The expert interviews and the citizen survey have shown that many citizens would like to see an increased presence of street greenery in the city. Street greenery encourages citizens to be active and spend more time in public spaces. For this reason, it is very important to expand street greenery in inner-city areas and thus improve the quality of places in which citizens spend time. In this context, there are some possibilities to implement green structures along streets. Both temporary and permanent greening measures offer considerable potential for sustainably increasing the quantity and quality of roadside greenery in cities.

The following section describes recommendations for action and possible solutions that emerged from the surveys and interviews.

Measures for the optimization of greening in the street space

There are various possibilities to design the street space with greenery and thus use it multifunctionally. Mobile greenery, such as potted plants or green parklets, are ideal for making the best use of limited street space. Greened bus and train stops can also increase the diversity of green spaces. According to the citizens, the greening of traffic circles and the creation of wide, green medians with quality amenities should be emphasized as permanent solutions. A landscaped divider between the street and sidewalk is also popular with citizens. Potential areas such as paved medians or traffic islands can be easily transformed into green spaces without consuming land. Another option is the greening of guardrails in the form of planters to separate lanes. Roadways or building facades also lend themselves to planting.

When it comes to the type of planting, citizens prefer trees, for example in the form of avenues or rows, flowering shrubs, near-natural planting and well-tended flower beds. Other measures to increase the amount of greenery in the street space can include the greening of noise barriers or bridge piers on city bridges. Financing by private investors, who in return are allowed to place advertising on selected bridge piers, is conceivable here. When planning a new street space, attention should always be paid to providing sufficiently dimensioned greenery. Innovative street space designs, such as the approach of the HafenCity University Hamburg research project "BlueGreenStreets", can help to

integrate more greenery and a higher quality of stay for residents and counteract the consequences of climate change [10].

Care and maintenance

With regard to the care and maintenance of roadside green spaces, there is a demand for increased maintenance. The citizen survey has shown that the presence of roadside green spaces is associated with an increased quality of life. Therefore, it is necessary to carefully plan and maintain these green spaces. Many residents are not satisfied with the quality of the street green spaces. Therefore, the focus should also be on species-appropriate tree planting. Due to the high degree of sealing, many trees have too little space for their roots. Without proper care, trees and plants can die, senselessly destroying investments. More attention should also be paid to cleanliness of street greening in this context. Poor maintenance reduces, among other things, the quality of stay, the climate impact and, thus, the positive effect on the general well-being of citizens. In addition, green spaces are important meeting places and make a significant contribution to urban culture. It is therefore essential to invest more money and personnel in urban budgets for the maintenance of street green spaces.

Participation in urban planning

Participation is an important link in urban planning. More and more municipalities in Germany are actively involving citizens in their urban planning activities. Such citizen participation creates legitimacy, acceptance and quality in urban planning. Possibilities for bringing nature into the city can be urban gardening and guerilla gardening. The survey indicated that planting sponsorships, planting work and weeding would be considered by engaged citizens. Many respondents believe that more land should be made available for innovative community projects in the city. Although projects such as urban gardening cannot be integrated into every type of roadside greenery, it is a useful approach in suitable locations. A suitable location for such a project could be, for example, a wide median strip with integrated recreational facilities in residential areas (as shown in Figure 8). The use of participatory geographic information system (GIS) application, in which citizens can note suggestions and evaluations on the equipment, quality and perception of street greenery on a map, is also a viable tool. It would also be conceivable to offer this service not only in an app but also on the municipal website, for example. Community projects or areas to be maintained could be entered on the map and citizens could take care of trees or plantings. Citizens could also view information such as the age or type of tree or planting. The administration could then access this information and respond better to the needs and sensitivities of citizens. Such cooperation between the administration and citizens would take urban development to a new level.

The willingness of citizens to participate in voluntary activities such as tree sponsorship or planting work (see Figure 15) is still relatively low. Creating more awareness of roadside greenery among citizens automatically increases acceptance of general measures. Greater participation can therefore be a side effect of raising awareness. It is therefore necessary to raise citizens' awareness of public spaces and green areas in particular. In this regard, greening measures can be promoted with active mobility, e.g., through pedestrian checks, planting campaigns, local press or communication platforms, in order to raise awareness. Public actions such as the well-known Parking Day can also help to focus more attention on public spaces. Temporary green spaces are set up in parking lots, to transform public spaces into green and social areas for a short period of time.

To support planning, an urban street greening cadastre could be useful. It could be an extension of the green space register and contains relevant information such as area details, type of planting and the effort required for maintenance. This register should be constantly updated so that municipalities can select areas where social projects, such as urban gardening, can be established. Committed citizens have the advantage of being able to see all areas with community projects at a glance and thus have the opportunity to become actively involved. This clarity can lower the hurdle for active participation in such projects.

6. Conclusions

Street greenery offers various ecological, design and social functions in urban areas. As mentioned at the beginning, nature in a city has a positive effect on the psychosocial well-being of residents. The qualitative and quantitative survey conducted in this context shows that street greenery and the quality of life of urban residents are strongly related.

Research has shown that street greenery is enormously important for the subjective and general quality of life of citizens. This type of green space has a major impact on the psychosocial well-being of urban residents and makes an important contribution to increasing the quality of stays in public spaces.

In terms of satisfaction with the development of their current place of residence in recent years, the population has a rather negative attitude. Particularly noticeable is the dissatisfaction of citizens with the maintenance and cleanliness of the roadside greenery. Despite a certain dissatisfaction among the citizens regarding the maintenance and cleanliness of the roadside greenery, this is attributed a high importance in the further course of the survey. Beautiful street greenery increases the quality of stays and encourages citizens to spend more time in public spaces.

The willingness of citizens to participate is particularly interesting. Relatively few citizens are willing to actively participate in the planning, design or maintenance of roadside greenery.

In order to upgrade the street greenery in cities, this study makes various recommendations for action. Higher maintenance intensity, more street greenery in principle and innovative community projects are just some of the recommendations mentioned. In addition, awareness of public spaces and appreciation of green spaces should be increased among citizens. Innovative streetscape concepts should be considered in new planning. In principle, it is important to specifically promote and maintain street greenery in cities in order to create a sustainable and livable environment for all residents.

In summary, it can be said that street greenery significantly influences the subjective as well as the general quality of life of citizens. Essentially, the following recommendations for action can be derived for cities and municipalities:

- Increasing the quantity of roadside greenery;
- Higher maintenance effort;
- Initiate innovative community projects;
- Raise awareness of public green space;
- Innovative streetscape design should be more strongly considered in new planning efforts.

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Institutional Review Board Statement: Ethical review and approval were waived for this study as the data collection was anonymous and therefore no personal data were collected. In addition, no intrusive or stigmatizing questions were asked and no vulnerable groups such as children or people with disabilities were interviewed. The participants were also informed before the survey that the survey was voluntary and that they could stop the survey at any time without giving reasons.

Data Availability Statement: Data are contained within the article.

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

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