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The Circular Benefits of Participation in Nature-Based Solutions

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Abstract: Nature-based solutions (NbS) provide direct benefits to people who live in areas where these approaches are present. The degree of direct benefits (thermal comfort, reduced flood risk, and mental health) varies across temporal and spatial scales, and it can be modelled and quantified. Less clear are the indirect benefits related to opportunities to learn about the environment and its influence on personal behaviour and action. The present study, based on survey data from 1955 participants across 17 cities worldwide, addressed whether participation in NbS through two types of interactions (a passive learning experience about NbS and a more active experience based on Citizen Science) stimulates motivation and willingness to be more environmentally sustainable. Over 75% of participants improved their understanding of environmental sustainability and were highly motivated and more confident in their ability to improve sustainability in their local environment/nature. Similar percentage improvements arose from both types of activity across all cities. Those NbS that had elements of both blue and green infrastructure rated higher than those that had predominantly green NbS. Interestingly, a large percentage of the participants did not live near the NbS that were the focus of these activities. This indicated that expected spatial limitations between benefit and recipient may be overcome when dedicated programmes involve people in learning or monitoring NbS. Therefore, opportunities have arisen to expand inclusion from the immediately local to the larger community through participation and Citizen Science, with potential benefits to social cohesion and urban sustainability.

Keywords: nature-based solutions; Citizen Science; sustainability; environment; participation; green infrastructure; blue Infrastructure; urban; climate change

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1. Introduction

The current health emergency and resulting lockdowns have highlighted that nature, especially urban green spaces, is key for mental health and thriving communities [1,2]. These benefits include psychological relaxation, stress alleviation, and social cohesion [3]. A recent poll found that 57% of British people said their awareness of the importance of such green spaces to mental health and wellbeing had increased during the pandemic [4]. Additionally, nature-based solutions (NbS) provide a range of environmentally-mediated benefits, e.g., thermal comfort [5] and reduced flood risk [6], which vary across temporal and spatial scales and can be modelled and quantified. These benefits are clearly stated in the definition of NbS provided by the International Union for Conservation of Nature (IUCN): "actions to protect, sustainably manage, and restore natural or modified ecosystems, which address societal challenges effectively and adaptively while simultaneously providing human well-being and biodiversity benefits" [7]. Therefore, it is important for policy-makers to be able to gain understanding of what is an optimal design and location

of NbS to maximise the various benefits. This includes considerations of how the proximity of citizens to NbS relates to the strength of the benefits they receive [8]. Proximity and size characteristics of NbS are important factors when assessing human well-being.

A lack of access to green space particularly impacts those living in deprived areas. Children in deprived areas, for example, are nine times less likely to have access to green space and places to play in the UK [9]. The consequences at a societal level for those generations includes a higher risk of mental health conditions and lack of social cohesion [10]. Additionally, access to nature, especially during extreme situations, may also have the potential to increase societal climate resilience [11].

Direct societal benefits or deficiencies in terms of access to green space are well-documented, but there is a more limited understanding of indirect benefits. For example, societal well-being may indirectly benefit through increased awareness of how NbS enhance the sustainability of urban environments [12–14]. Examples of these indirect benefits could include improvements in public interest in environmental sustainability and/or involve individual and community action to care and provide for urban natural spaces. Understanding and then supporting the indirect benefits of NbS are simple yet powerful steps on the pathway to thriving communities [15]. To better understand this dimension, the present study took advantage of a global training programme focused on improving the understanding of the environmental sustainability of employees from a major international bank. The programme consisted of residential training and learning events that included both theoretical and hands-on activities to understand the benefits of nature. Feedback surveys delivered at the events were used to evaluate the effects of participation on people's perception of NbS and sustainability and therefore to quantify the indirect benefits of engaging with NbS. The present study is the first of its kind to explore the relationship between participant actions around NbS and their perception and motivation related to sustainability, as well as potential positive feedback or circular benefit towards nature. Many participants did not live near the NbS that were the focus of these activities, extending the scope of insights to be drawn beyond a local context.

2. Materials and Methods

2.1. The Sustainability Programme and Citizen Scientists

The study was performed with 1955 participants of an international residential programme focused on global urban sustainability and the environmental challenges of climate change and urbanisation. The programme had a particular focus on the understanding and research of NbS as sustainable options to the environmental challenges. The aim of the programme was to raise awareness amongst employees working in the banking industry across a wide range of sectors but especially in the sustainability and finances teams. The programme was organised in one- or two-day events led by environmental engagement experts and scientists, where the participants would come together to take part (Table 1). There was a total of 99 events that took place in 17 cities between 2016 and 2018 (Table 1). Most participants were between 25 and 50 years of age and with a university level education. The distribution of females to males was in a ratio of 1.14:1. The sample set was not intended to represent the average citizen in each of the study cities but that of predominantly young corporate employees.

Table 1. Cities where the programme was hosted including details of the nature-based solutions (NbS) involved in the research, green space availability for each city, and number of events hosted during the programme at each city.

City	NbS Explored	NbS Benefits Monitored with Citizen Science	Average Green Space Availability (m^2/Capita)	Number of Events
Abu Dhabi	Green (Street trees)	Microclimate and thermal comfort by urban street trees	0.04	9
Bangalore	Blue–Green (Lakes and wetlands)	Water quality improvement and support of urban lakes and green buffer areas for climate resilience and the management of challenges from urbanisation	27.05	6
Birmingham	Green (Trees in parks)	Flood management, tree vitality and productivity, soil health and carbon capture and thermal comfort by urban trees	29.81	8
Buffalo	Green (Bioswales)	Flood protection, support for local groundwater recharge, and reduction of extreme temperature events by bioswales	NA	2
Chicago	Green (Bioswales)	Flood protection, support for local groundwater recharge, and reduction of extreme temperature events by bioswales	12.11	2
Guangzhou	Blue–Green (Wetlands)	Improved water quality, biodiversity, air quality, and microclimate (cooling) by urban wetlands	239.04	7
Hong Kong	Blue–Green (Rivers)	Greenhouse gas emissions and climate regulation by urban rivers	147.63	7
Hyderabad	Blue–Green (Floating wetlands)	Water quality improvement and support of wetlands for climate resilience and the management of challenges from urbanisation	8.08	6
London	Green (Trees in parks)	Flood management, tree vitality and productivity, soil health and carbon capture, and thermal comfort by urban trees	15.77	8
Mexico	Blue–Green (Upland catchment)	Water quality, management, and supply to the city at the catchment level	1.94	11
Mumbai	Blue-Green (Lakes)	Water quality improvement and support of urban lakes for climate resilience and the management of challenges from urbanisation	9.13	6
New York	Green (Bioswales)	Flood protection, support for local groundwater recharge, and reduction of extreme temperature events by bioswales	3.85	3
Paris (suburb)	Green (Trees in parks)	Flood management, tree vitality and productivity, soil health and carbon capture, and thermal comfort by urban trees	14.88	10
San Francisco	Green (Bioswales)	Flood protection, support for local groundwater recharge, and reduction of extreme temperature events by bioswales	17.87	2
Shanghai	Blue Green (Wetlands)	Improved water quality, biodiversity, air quality, and microclimate (cooling) by urban wetlands	106.67	2
Toronto	Green (Bioswales)	Flood protection, support for local groundwater recharge, and reduction of extreme temperature events by bioswales	27.3	4
Vancouver	Green (Bioswales)	Flood protection, support for local groundwater recharge, and reduction of extreme temperature events by bioswales	47.95	6

The type of NbS in each city was defined as green or blue–green. The definition of blue–green was based on the presence of a freshwater ecosystem being an integral part of the NbS. For example, in Abu Dhabi, the focus of the study was the utility of urban trees to improve thermal comfort and sociability, classified as a green NbS. In Guangzhou, the

focus of the study was on multiuse wetlands and their ability to improve water quality, thus classified as a blue–green NbS.

2.2. Events and Activities

Each event across all locations followed a common format (expect for Paris; details below) that included three indoor sessions focused on the environmental sustainability in the face of climate change and urbanisation, as well as two outdoor sessions around NbS activities. Events in different cities had differences in the type of NbS studied, the duration of the outdoor events, and the context of each city (Table 2).

Each event engaged a group of up to 20 participants from mixed banking sectors that came from different parts of the study city during working days. The activities (outdoor) analysed in this study were:

(i) "Walk and Reflect:" An observational and intellectual reflection engagement exercise. This activity involved the groups walking within areas that presented real or potential NbS while reflecting on their benefits with respect to local needs.

(ii) Citizen science: A more experiential activity based on training and monitoring NbS-related benefits as citizen scientists. This hands-on activity on environmental data collection around the study NbS was conducted with the involvement of local scientists and supported them in their ongoing studies of the ecosystem services of specific NbS (Table 1).

The format for the content of the Paris events was modified to suit the local interest. The changes to these events consisted of having events with both Walk and Reflect and Citizen Science activities, as well as other events with only the Citizen Science component. The implications of co-design with the engaged parties is also briefly assessed on this article.

2.3. Survey

During the event conclusion, each participant completed a written survey to identify the usefulness and benefits of specific parts of the programme (See S1 in Supplementary Information). The questions were for participants to particularly consider their experience of participation in NbS before and after going through the training. The survey completion rate was 84%.

There were both closed and open questions given in the survey (S1) that covered the activities of participation and the personal outcomes the activities had on their motivation and personal action (Figure 1). Free text observations and comments on the events were recorded on the same survey and regarded the overall programme and not a particular theme.

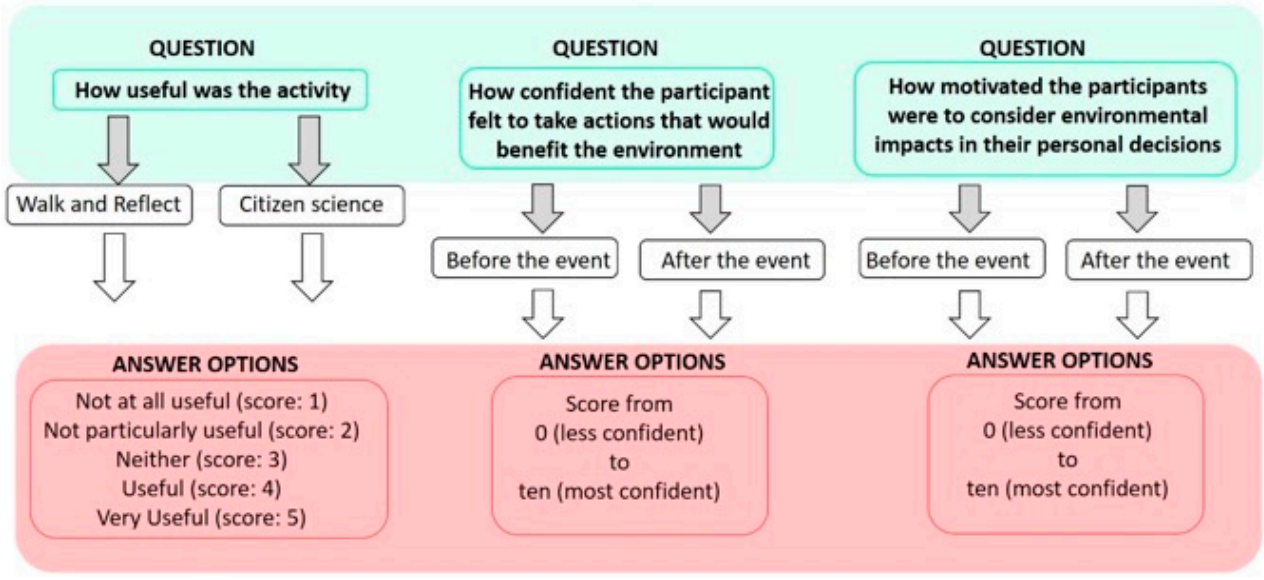

Figure 1. Diagram of the questions and answers or scores given to each option.

2.4. Data Analysis

A comparative analysis was performed using statistical tests including Mann–Whitney, Spearman rho, two-way ANOVA (Analysis of Variance) and ANCOVA (Analysis of Covariance) to explore differences, identify relationships, and identify factors influencing the scores. A sentiment analysis (SA) approach was applied to the free text observations and comments provided by the participants. SA is the computational treatment of the opinions, sentiments, and subjectivity of text [16], and it allows for the interpretation and classification of emotions (positive, negative, and neutral) within studied words. A sentiment relevance score (monkeylearn.com/sentiment) was associated with each a sentence or linguistic expression. Finally, data on the average green space availability (m^2/person) per capita were collected using free online resources (full list of references available in S2, Supplementary Information).

3. Results

The overall results of the survey indicated that a large majority of the participants found the activities were a useful part of the programme (Table 2). Differences between activity type, time dedicated to each activity, category of NbS (green versus blue–green), and average green space availability showed differences between activities and events.

Table 2. Type of activities studied, the time spent doing each activity, the percentages of scores (not at all useful, not particularly useful, neither, useful, or very useful) given to each activity by participants at the events, total score (total sum of = not at all useful: 1; not particularly useful: 2; neither: 3; useful: 4; and very useful: 5), and average score for: (A) all events (one and two day events), for the programme, (B) one day, and (C) two days. (D) for events for Paris with both activities (Walk and Reflect and Citizen Science) and (E) for events in Paris with Citizen Science but without Walk and Reflect.

	Activity	Duration of Activity	% Not at All Useful	% Not Particularly Useful	% Neither	% Useful	% Very Useful	Total Score	Average Score
(A) All (one and two days)	**Walk and Reflect (*n* = 1235)**	45 min to 1 h 15 min	0	2	3	43	52	6199	4.47
	Citizen Science (*n* = 1536)	3–5 h	0	1	2	44	53	6906	4.48
(B) One day	**Walk and Reflect (*n* = 295)**	45 min	0	1	2	44	53	1411	4.48
	Citizen Science (*n* = 443)	3–3.5 h	0	1	2	39	58	2095	4.54
(C) Two days	**Walk and Reflect (*n* = 940)**	1 h 15 min	0	2	3	43	52	4788	4.46
	Citizen Science (*n* = 1093)	4.5–5 h	0	1	3	47	50	4811	4.46
(D) Paris: Two days—Walk and Reflect and Citizen Science	**Walk and Reflect (*n* = 14)**	1 h 15 min	0	7	7	57	29	57	4.07
	Citizen Science (*n* = 14)	4.5–5 h	0	0	0	71	29	60	4.29
(E) Paris: Two days Citizen Science only	**Walk and Reflect (*n* = *n*/A)**	0 h	n/a	n/a	n/a	n/a	n/a	0	n/a
	Citizen Science (*n* = 24)	4.5–5 h	0	2	3	48	46	681	4.39

3.1. Time Duration of Activities

The total time dedicated to each activity was accessed to examine if activity duration influenced the usefulness scores given by the participants by comparing one-day and two-day programmes (Table 2). For the Walk and Reflect component, there was no significant difference in the perceived positive benefits between the shorter time dedicated in the one-day events (45 min) and two day events (75 min) (Mann–Whitney, $p = 0.43$; Table 3).

A significant difference was found for the Citizen Science component, where the two-day events (5 h) showed lower total score (Table 2) than the one-day events (2 h) ($p = 0.02$).

Table 3. Results of Mann–Whitney analyses, *p*-value and average rank sum, for the scores for each activity (Walk and Reflect and Citizen Science) with regards to the time spent at each activity.

	Activity	*p*-Value	Average Rank Sum
One vs. two days	Walk and Reflect	0.43	One day: 614.8; two days: 619.0
	Citizen Science	0.02	One day: 804.3; two-days: 753.99
One day	Walk and Reflect vs. Citizen Science	0.018	Walk and Reflect: 279.9, Citizen Science: 309.14
Paris events (two days, events with and without Walk and Reflect)	Citizen Science	0.39	Events with Walk and Reflect and Citizen Science: 18.8; Citizen Science only: 19.9

Time spent at each activity was also considered to be a relevant factor when comparing improved confidence in taking action and motivation to consider environmental sustainability in personal decisions (Table 4). Significantly higher scores in both confidence to take action ($p < 0.001$), as well as motivation to consider nature in personal decisions ($p = 0.002$), were reported by participants in the two-day events.

Table 4. Increase (average scored difference between after and before the event) on how confident participants felt: (i) in their ability to take action for sustainable environment and (ii) motivation to consider the environmental sustainability in personal decisions for: (A) all events (one- and two-day events), per event: (B) one day, (C) two days, (D) for events in Paris with both activities and (E) for events in Paris with Citizen Science but without Walk and Reflect. *p*-values and rank sum for the comparison between the different factors (length and activities in Paris) for Mann–Whitney are also shown. n/a: no analyses performed for these data.

Event Length and Activities	(i) Average Score: Confidence in Ability to Take Action	Mann–Whitney Confidence to Take Action (*p*-Value; Average Rank Sum)	(ii) Average Score: Motivation to Consider the Environment	Mann–Whitney Motivation to Consider the Environment (*p*-Value; Average Rank Sum)
(A) All (one and two days, with Walk and Reflect and Citizen Science, $n = 1758$)	2.27	n/a	2.11	n/a
(B) One day (Walk and Reflect and Citizen Science, $n = 478$)	2.00	One vs. two days: $p < 0.001$; one day: 717.4; two days: 822.2	2.03	One vs. two days: $p = 0.002$; one day: 740.7; two days: 812.1)
(C) Two days (Walk and Reflect and Citizen Science, $n = 1102$)	2.54		2.19	
(D) Paris: Two days, Walk and Reflect and Citizen Science ($n = 14$)	1.71	Paris Walk and Reflect and Citizen Science vs. Citizen Science only: $p = 0.49$; Walk and Reflect and Citizen Science: 89.3; Citizen Science only: 88.9	1.86	Paris Walk and Reflect and Citizen Science vs. Citizen Science only: $p = 0.47$; Walk and Reflect and Citizen Science: 90.1; Citizen Science only: 88.9)
(E) Paris: Two days Citizen Science only ($n = 163$)	1.75		1.85	

3.2. Types of Engagement Activities

Programme activities included the two experiential activities, Walk and Reflect and Citizen Science, assessed with the survey. Survey results for two day events did not show a significant overall different in usefulness scores between Walk and Reflect and Citizen Science activities where both were performed (Wilcoxon signed rank test $p = 0.35$). For events that were held on a single day, Citizen Science activities were more favourably

rated (p = 0.018; Table 3). In Paris, where a limited number of events without the Walk and talk activity occurred, no significant differences in motivation or confidence to take action were found between events with and without the Walk and Reflect (p = 0.47 and p = 0.39, respectively).

The written comments given by the participants were explored for evidence of preferences towards either activity (See Supplementary Information S3). The overall sentiment analysis of all comments was positive (97% confidence). The most common keywords used were: climate change (relevance: 0.990), sustainability (0.679), eye-opener (0.438), better understanding (0.438), personal life (0.317), environmental issues (0.317), and sustainable development (0.268). Additionally, there were more positive comments directed towards the Citizen Science activities of the program than towards Walk and Reflect (ratio of 9:1). Many comments were focused on the development of personal and work-based action plans, reflecting confidence and motivation for personal action (See S3 in Supplementary Information).

3.3. Type of NbS Experienced

NbS were divided into green types—bioswales, street trees, and park trees—and three blue–green types—wetlands, river buffer areas, and lake buffer areas. There was a higher usefulness score associated with both Citizen Science and Walk and Reflect activities where blue–green NbS were the focus ($p < 0.001$ and $p < 0.001$, respectively; Table 5). To explore if city specific differences were present, adjusted averages were compared after considering the paired Walk and Reflect score as a covariate. The improved score for blue–green NbS remained (ANCOVA; $p < 0.001$).

Table 5. Feedback on Citizen Science and Walk and Reflect organised by the type of NbS to which participants experienced. The feedback is expressed in percentages for each voted score, total score (total sum of = not at all useful: 1; not particularly useful: 2; neither: 3; useful: 4; and very useful: 5) and average score for each activity (Walk and Reflect and Citizen Science) performed around green infrastructure or blue–green infrastructure.

Nature Based Solution	Activity	Not at All Useful	Not Particularly Useful	Neither	Useful	Very Useful	Total Score	Average Score
Green	Walk and Reflect	0.17%	1.91%	3.47%	56.08%	38.37%	2480	4.306
	Citizen Science	0.11%	1.35%	3.27%	52.93%	42.33%	3863	4.360
Blue–Green	Walk and Reflect	0.00%	1.53%	2.12%	34.04%	62.31%	3881	4.571
	Citizen Science	0.12%	0.47%	1.65%	35.02%	62.74%	3899	4.598

On the other hand, the analysis showed a more complex scenario when the interaction of factors were considered. The results indicated that how ready people felt to take action was not influenced by NbS alone, but it was influenced by time alone ($p < 0.001$; Table 6), as well as when both NbS type and time were considered together ($p < 0.001$; Table 6). Moreover, motivation was influenced by the type of NbS alone, as well as by time and type of NbS ($p < 0.001$; Table 6).

Table 6. Results of two-way ANOVA for NbS type, time as factors, and their interaction for the scores given to Citizen Science, Walk and Reflect, motivation, and action.

	Walk and Reflect *p*-Value	**Citizen Science *p*-Value**	**Action *p*-Value**	**Motivation *p*-Value**
Green vs. Green–Blue	**<0.001**	**<0.001**	0.49	**<0.001**
Time (one vs. two days)	0.08	**<0.001**	**<0.001**	**0.03**
Interaction	**<0.001**	**<0.001**	**<0.001**	**<0.001**

3.4. City Average Green Space Deprivation

The availability or lack of green space in an urban area has a number of consequences on the mental and physical health of the people living there [1]. We explored whether the average coverage of green space between study cities influenced the participatory experience. The cities had a wide range of available green space (Table 7), which was calculated by considering the green space availability (m^2) per capita. Interestingly, the highest percentages of positive feedback ("Usefulness of activity;" Table 2) per activity were found in some of the most green-deficient areas, such as Abu Dhabi and Mexico (Table 7). However, overall green space availability was not correlated with feedback related to the activities event-related, motivation, or action (Spearman ϱ (rho)= 0.15. ϱ = 0.16, ϱ = 0.025, and ϱ = 0.102, respectively) in this study.

Table 7. Study cities green space availability (m^2) per capita organized and the respective values of total score of participant feedback for each one of the studied activities, Walk and Reflect and Citizen Science, as well as overall scores for their confidence to take action for environmental sustainability and motivation to consider environmental sustainability in personal decisions.

Study City	**Per Capita Green Space Availability**	**Average Score Walk and Reflect**	**Average Score Citizen Science**	**Confidence in Ability to Take Action**	**Personal Motivation**
UAE—Abu Dhabi	0.04	4.45	4.36	2.78	2.68
Mexico	1.94	4.73	4.89	2.31	2.36
New York	3.85	4.23	4.47	1.60	1.73
Hyderabad	8.08	4.65	4.61	2.69	1.12
Mumbai	9.13	4.48	4.43	2.43	2.35
Chicago	12.11	NA	4.47	2.05	1.79
France—Paris	14.88	4.07	4.40	1.75	1.85
London	15.77	4.21	4.21	2.72	2.82
San Francisco	17.87	4.33	4.30	1.41	1.90
Bangalore	27.05	4.64	4.61	2.32	0.99
Toronto	27.3	4.29	4.18	2.08	2.05
Birmingham	29.81	4.25	4.33	3.24	3.38
Vancouver	47.95	4.28	4.42	1.76	1.73
Shanghai	106.67	4.70	4.67	2.34	2.28
Hong Kong	147.63	4.08	4.31	2.04	1.99
Guangzhou	239.04	4.64	4.57	2.43	2.21
Buffalo	NA	4	4.39	2.09	2.06

4. Discussion

The elevated scores associated with both reflective and participative activities around NbS, in a wide range of cities, indicated that NbS can play an important role in increasing personal motivation to consider and improve environmental sustainability (Figure 2). These findings agree with previous studies showing an increase in pro-environmental attitudes following participation in environmental actions such as Citizen Science [17,18]. Participation in the planning, implementing, and monitoring of NbS has been shown to be a transformative experience that is important to assuring their sustainability [19,20].

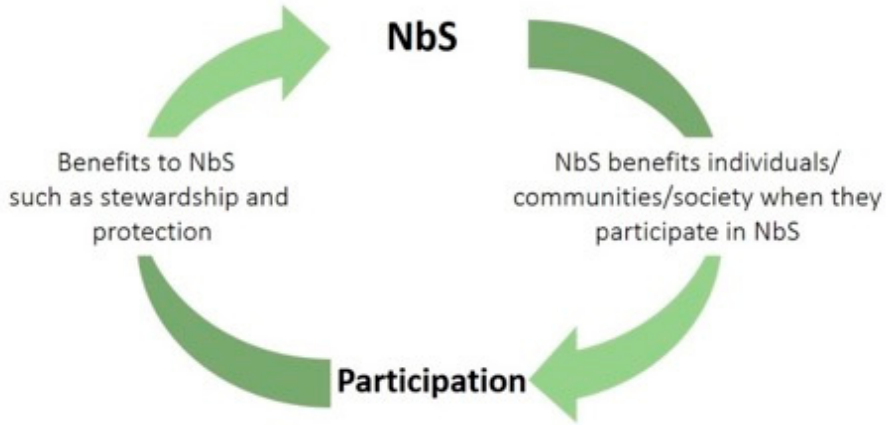

Figure 2. The circular benefit of participation in NbS. Individuals, communities, and society benefit by their participation with NbS in improving their mental health and giving them a sense of achievement and empowerment. At the same time, NbS benefit through improved support, monitoring, mainstreaming, and protection.

Hands-on activities such as Citizen Science showed a more generalised impact when compared to more reflective participation (Table 8). However, both activities showed strong benefits to motivation and a willingness to take action. Increased awareness and understanding of environmental issues through Citizen Science has also been also shown by other studies [18,21–23]. Nevertheless, the long-lasting effects of these impacts on people would need to be studied with regular follow ups with participants posting the same or similar questions on environmental sustainability and whether they have met their pledges.

Table 8. Simplified summary of the findings for each factor considered in this study for each activity and personal impact (confidence to take action to support environmental sustainability and motivation to consider environmental sustainability in personal decisions). 1D: one day; 2D: two days; BG: blue–green infrastructure; G: green infrastructure; Red: not significant effect; green: significant effect.

Factor	Walk and Reflect	Citizen Science	Action Supporting Environmental Sustainability	Motivation to Consider Environmental Sustainability
Time		1D > 2D	1D < 2D	1D < 2D
Type of activity				
Type of NbS	BG > G	BG > G		BG < G
Interaction activity-time				
Green deprivation				

The written comments from the surveys showed an increased understanding of the topics highlighted about the importance of NbS in the Walk and Reflect and Citizen Science activities. These comments showed the benefits of active but also of simple reflective activities focused on participated environmental learning to raise public understanding of science and supporting environment stewardship [23].

The duration of the events (one or two days) was not a major factor in the survey results, implying that it may be the experience itself that solicits attitude change and not the extent of the activities themselves. This highlights the importance of exploring co-design with all interested and engaged parties in the development of similar environmental and sustainability training programmes around NbS. In fact, variations in the Paris programme were the result of participant design requests and resulted in an improved Citizen Science

score. Flexibility in the organisation of activities around NbS can therefore provide benefits and improved effectiveness [24].

NbS that included both blue and green elements had more positive results compared to NbS limited to green elements only. While it is not possible to identify whether this was related to the presence of water or simply a more articulated or less common type of urban NbS, exposing participants to systems with multiple ecosystem services may have a greater positive impact, such as mental health benefits provided by blue NbS [25,26].

The present study did not show any direct relationship between city-averaged green space availability and overall positive ratings towards each activity of participation or the degree of motivation or action towards the environment. This may suggest an absence of a direct relationship between green space and the benefits obtained by the studied participatory activities. Benefits received by participants may have therefore been independent of potential benefits from proximity and more related to the actual activities and immersion in nature. Previous studies that have assessed a wide variety of NbS benefits, particularly detecting a spatial relationship to most of them [8]. The results in this study suggest that attention should be given to aspects of participation with NbS as part of the environmental quality indicators (EQIs) assessment, as participation is an EQI that does not necessarily rapidly decrease with increasing distance from the NbS intervention.

This also highlights the opportunity for similar programmes to focus on people living in economic and/or socially deprived areas who may have limited possibilities to experience nature in their local area. Participative experiences in learning about and monitoring NbS were shown to improve connection to nature and willingness to act more sustainably, especially critical in urban areas [19]. This highlights that benefits of participation in NbS goes beyond the local scale, thereby potentially modifying the expected spatial relationships between NbS and their benefits [8]. This non-proximal benefit of NbS should be considered in planning and development.

The indirect benefits of NbS have been previously identified [26] but not well-quantified. The present study shows practical implications from determining the benefit of implementing mixed NbS in urban planning with participative aspects that include education and Citizen Science. Ultimately, these results show that a new understanding that NbS should be conceived with the participation of people.

Further studies about participation with NbS should address a wider distribution of the local population in each of the study cities, as benefits of types and characteristics of participation may be differently appreciated. Further studies could also address online participation in NbS monitoring and planning, in relation to their potential benefits for more isolated people or those with health or mobility issues.

It should be noted that, in the present analysis, the benefits of the Citizen Science monitoring to the management and monitoring of the NbS were not addressed (Figure 1). The information from Citizen Science activities represents a potentially large and complementary dataset that can be used by project scientists and local planners to better understand and manage these environments [27]. The stewardship of local NbS and local support for similar initiatives have also been shown to favour long term success and influence policy [28,29]. The present study shows that both active Citizen Science and more reflective activities focused on understanding NbS have the potential to support NbS and mainstream considerations of sustainability and climate change.

5. Conclusions

This research brings the first insights into the positive impact that participation in nature has towards learning and personal behaviours such as prompting motivation and environmentally sustainable actions. The positive impact is shown in both passive and active (Citizen Science) participation around NbS, where Citizen Science and blue–green NbS demonstrate enhanced effects. The study suggests that the spatial limitations of NbS availability may be overcome by participation in these natural urban spaces.

The benefits of participation in NbS may therefore provide a sustainable alternative pathway to support socially deprived communities, to create social cohesion and resilience in difficult circumstances, and to create positive returns for nature.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/su13084344/s1. S1: Questions; S2: Green Space; S3: Comments from participants.

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