European Commission

EVALUATING THE IMPACT OF NATURE-BASED SOLUTIONS

Appendix of Methods

Independent Expert Report

Research and Innovation

Evaluating the Impact of Nature-based Solutions: Appendix of Methods

European Commission
Directorate-General for Research and Innovation
Directorate C — Healthy Planet
Unit C3 — Climate and Planetary Boundaries

Contact Laura.PALOMO-RIOS@ec.europa.eu
Sofie.VANDEWOESTIJNE@ec.europa.eu
Email RTD-ENV-NATURE-BASED-SOLUTIONS@ec.europa.eu
RTD-PUBLICATIONS@ec.europa.eu

European Commission
B-1049 Brussels

Manuscript completed in February 2021.
First edition.

PDF ISBN 978-92-76-22960-5 doi:10.2777/11361 KI-02-20-861-EN-N

Luxembourg: Publications Office of the European Union, 2021

EUROPEAN COMMISSION

EVALUATING THE IMPACT OF NATURE-BASED SOLUTIONS

Appendix of Methods

Adina Dumitru and Laura Wendling, Eds.

2021

Directorate-General for Research and Innovation
Healthy Planet - Climate and Planetary Boundaries

Table of Contents

KNOWLEDGE AND SOCIAL CAPACITY BUILDING FOR SUSTAINABLE URBAN TRANSFORMATION

Coordinating Lead authors

Dumitru, A.; Renaud, F.

Lead authors

Baldacchini, C.; Fermoso, J.; González, M.; Skodra, J.; Wendling, L.

Contributing authors

de Bellis, Y.; Dubovik, M.; Fatima, Z.; Gómez, S.; Jermakka, J.; Laikari, A.; Macsinga, I.; Martins, R.; Mendonça, R.; Rinta-Hiiro, V.; Roebeling, P.; Rödl, A.; San José, E.; Sánchez, R.; Sanesi, G.; Sanz, J. M.; Spano, G.; Young, C.; zu-Castell Rüdenhausen, M.

15 RECOMMENDED INDICATORS OF KNOWLEDGE AND SOCIAL CAPACITY BUILDING FOR SUSTAINABLE URBAN TRANSFORMATION

15.1 Citizen involvement in environmental education activities

Project Name: CONNECTING Nature (Grant Agreement no. 730222)

Author/s and affiliations: Adina Dumitru[1], Catalina Young[2], Irina Macsinga[2]

[1] *University of A Coruña, Spain*

[2] *West University of Timisoara, Romania*

Environmental Education Opportunities	Knowledge and Social Capacity Building
Description and justification	Environmental education (EE) is a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action (UNESCO, Tbilisi Declaration, 1978). EE is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution (Stapp, Havlick, Bennett, Bryan, Fulton, & MacGregor, 1969), i.e., *an environmentally literate citizenry*. The term EE refers to education about the environment, including population growth, pollution, resource use and

misuse, urban and rural planning, and modern technology with its demands upon natural resources. The goals and objectives of EE were agreed upon at UNESCO's Tbilisi Intergovernmental Conference (UNESCO, 1978), came to define the aforementioned notion of environmental literacy (i.e., components), and include *awareness, knowledge, affect, skills, and participation*. EE departs from learning opportunities that help people better understand and connect with the environment close to home, i.e., the environment in their own neighborhoods and communities (Carter and Simmons, 2010). Cole (2007) draws attention to local and cultural appropriateness in designing these learning opportunities, in that the ideas taught need to originate from and resonate with locally and culturally appropriate knowledge, values, and ways of living. Although not all EE programs have the potential to generate social capital among participants (e.g., classroom instruction), there are forms of EE that can foster social connectivity, trust, and associational and volunteer involvement (e.g., programs that incorporate collective opportunities for volunteer and associational involvement around stewardship, like community gardening and tree planting, or those that incorporate opportunities for intergenerational learning and collective decision-making, like place-based learning, school-community partnership for sustainability, environmental action, action competence, community-based natural resource management EE, social-ecological systems resilience) (Krasny, Kalbacker, Stedman, & Russ, 2015). For this reason, environmental education opportunities presented to a community are envisioned as a significant indicator of its resources for associational involvement in NBS, and of contexts for building trust.

Hailing the importance of green spaces beyond health benefits, Wolsink (2012a, 2012b) reports data of an explorative study conducted in all secondary schools in Amsterdam that indicates that proximity to green spaces is associated with the number of environmental education excursions. Specifically, the study suggests that increasing urban green spaces has a positive impact on environmental education activities, including the number of visits to green places. The author strongly affirms the environmental justice imperative of recognizing environmental education "as a viable stake in the urban development of green spaces" (Wolsink, 2012 a, p. 179).

Using a quasi-experimental research design, Kudryavtsev, Krasny and Stedman (2012) found empirical support for the hypothesis that interventions such as environmental

	education can nurture sense of place (Kudryavtsev, Stedman, & Krasny, 2012) in high school students. As sense of place has been found to cultivate place-specific pro-environmental behaviors (see Indicator SC 6), data gathered by Kudryavtsev et al. (2012) on youth participants in urban environmental education summer programs in the Bronx support the expectation that urban environmental education programs that cultivate the significance of urban green space "may inspire community-based initiatives to create more urban farms, roof gardens, community gardens and greenways, or to further restore aquatic ecosystems and urban forests" (p. 11). Derr (2017) emphasizes the sustainable benefits of participatory environment education by finding empirical support for *built environment education (BEE)*, an empowering model of education aimed at facilitating a stronger role of young people in decision making and shaping their environments. Elaborating on two cases in the City of Boulder, Colorado where children and youth were involved in the redesign of a natural public space, the author argues that BEE which includes participatory processes that facilitate group action and action competence furnishes "a holistic educational framework in which young people can explore nature, integrate multiple capabilities, and think about care of the social, cultural, and natural environment" (Derr, 2017, p. 14).
Definition	EE opportunities generally designate educational programs sponsored by elementary and secondary schools, colleges and universities, youth camps, municipal recreation departments, local or international not-for-profit organizations, and private entrepreneurs.
Strengths and weaknesses	+ indicator of resources (capacity-building, psychosocial, etc.) that forge participation, pro-activeness and tenacity in the pursuit of environmentally responsible goals + oriented towards inclusiveness, high potential to further sense of belonging and trust within community, and to inculcate a community sense of pride, and efficacy -limited information on outcomes (environmental literacy, EL) - data on EE opportunities reflects enough potential for capacity-building, but the actual quality of EE curricula (e.g., local/cultural appropriateness), as well as the outcome (i.e., environmental literacy) can only be explored through studies aimed at evaluating EE programs (see Cole, 2007; Farmer et al., 2007; Kopnina, 2013; McBeth & Volk, 2010; Merenlender et al., 2016; Tidball & Krasny, 2010; Varela-Losada, et al., 2016)

Measurement procedure (P) and tool (T)	☒ *Quantitative P*: Scale inventory/Questionnaire (survey procedure, paper-and-pencil administration, computer-based administration) ○ T: add-on items to any survey/questionnaire to collect accounts of EE programs attended in the past year, if any, as well as topic/theme covered; open-ended question(s) can be included to collect information about perceived usefulness, and/or how the knowledge/skills garnered have been put to use, if the case. ○ T: adapted items from "Instructor/Student/Parent Environmental Survey" (see Cruz Lasso de la Vega, 2004, p. 25 and Appendix)  de la Vega 2004 see NEP instrument 200(☒ *Qualitative P*: ▪ *Qualitative methodologies can be used to explore the outcomes of EE opportunities experienced by community members in longitudinal research* ○ T: case study methodology – structured interviews, case study analysis, phenomenological analysis ○ T: participatory data collections methods, such as collaborative participatory data collection, bodies as tools for data collection, photo elicitation
Scale of measurement	▪ *EE Opportunities - 4 items* to investigate accounts of EE programs attended in the past year, and their perceived usefulness (formulated for present study) 1. Have you participated in an EE program in the past year? Yes No (skip to …) 2. What was the main theme of the EE program you attended? (*please indicate*) …….. 3. How would you rate the applicability of the knowledge and skills acquired in the EE program? 1 very low …..5 very high 4. Have you had a chance to apply the knowledge and/or skills acquired since your participation in the EE program? If so, please describe. Yes (*please describe*) …….. No
Data source	
Required data	✓ Essential: NBS characteristics for each city/site, more specifically objectives (long-term) and challenges

	✓ Desirable: evaluations of EE programs, especially of those designed to promote NBS
Data input type	Quantitative (quantitative and qualitative, if participatory data collection methods are opted for)
Data collection frequency	Aligned with NBS implementation and timing of targeted objectives
Level of expertise required	☒ Methodology and data analysis requires high expertise in psycho-social research ☒ Quantitative data collection requires no expertise ☒ Qualitative data collection (case study, for example) requires high expertise in psycho-social research ○ Basic training needed if participatory data collection is opted for
Synergies with other indicators	SC1 Bonding social capital SC2 Bridging social capital SC3 Linking social capital SC4.1 Trust in community SC4.2 Solidarity between neighbours SC4.3 Tolerance and respect SC6 Place attachment (Sense of Place): Place Identity SC9 Empowerment: Perceived control and influence over NBS decision-making SC11.1 Positive environmental attitudes motivated by contact with NBS SC11.2 Environmental Identity SC12 Social desirability
Connection with SDGs	Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation Goal 10. Reduce inequality within and among countries Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable Goal 13. Take urgent action to combat climate change and its impacts Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Opportunities for participatory data collection	Participatory methods (e.g., phenomenological analysis) may be applied to collect community-relevant information on EE programs (and their outcomes) specifically related to a certain NBS/green space initiative in a community/city, and accounting for country/community/place-distinctive culture.
Additional information	
References	Carter, R.L. & Simmons, B. (2010). History and philosophy of environmental education. In A.M. Bodzin, B.S. Klein and S. Weaver (Eds.) *The inclusion of environmental education in science teacher education* (pp. 3-16). Springer: New York, NY. doi: 10.1007/978-90-481-9222-9_1

Cole, A. G. (2007). Expanding the Field: Revisiting Environmental Education Principles through Multidisciplinary Frameworks. *Journal of Environmental Education*, 38, 35–44. Retrieved from: https://www.threecircles.org/wp-content/uploads/2016/04/Expanding-the-Field_Revisiting-EE_Cole.pdf

Cruz Lasso de la Vega, R.M. (2004). *Awareness, Knowledge, And Attitude About Environmental Education: Responses from environmental specialists, high school instructors, students, and parents*. University of Central Florida Electronic Theses and Dissertations, 178. Retrieved from: https://stars.library.ucf.edu/etd/178

Derr, V. (2017). Urban green spaces as participatory learning laboratories. *Proceedings of the Institution of Civil Engineers-Urban Design and Planning*, *171*(1), 25-33.

Derr, V., & Kovács, I. G. (2015). How participatory processes impact children and contribute to planning: a case study of neighborhood design from Boulder, Colorado, USA. *Journal of Urbanism: International Research on Placemaking and Urban Sustainability*, *10*(1), 29-48. doi: 10.1080/17549175.2015.1111925

Farmer, J., Knapp, D., & Benton, G. (2007). An Elementary School Environmental Education Field Trip: Long-Term Effects on Ecological and Environmental Knowledge and Attitude Development. *Journal of Environmental Education*, 38(3), 33-42. doi: 10.3200/JOEE.38.3.33-42

Kopnina, H. (2013). Evaluating education for sustainable development (ESD): Using ecocentric and anthropocentric attitudes toward the sustainable development (EAATSD) scale. *Environment, Development and Sustainability*, 15, 607–623. doi: 10.1007/s10668-012-9395-z

Krasny, M. E., Kalbacker, L., Stedman, R.C., & Russ, A. (2015). Measuring Social Capital among Youth: Applications in Environmental Education. *Environmental Education Research*, 21 (1), 1–23. doi: 10.1080/13504622.2013.843647

Kudryavtsev, A., Stedman, R. C., & Krasny, M. E. (2012). Sense of place in environmental education. *Environmental education research*, *18*(2), 229-250. doi: 10.1080/13504622.2011.609615

Kudryavtsev, A., Krasny, M. E., & Stedman, R. C. (2012). The impact of environmental education on sense of place among urban youth. *Ecosphere*, *3*(4), 1-15. doi: 10.1890/ES11-00318.1

McBeth, W., & Volk, T. L. (2009). The National Environmental Literacy Project: A baseline study of middle grade students in the United States. *The Journal of Environmental Education*, 41(1), 55–67. doi: 10.1080/00958960903210031

Merenlender, A.M., Crall, A.W, & Drill, S. (2016). Evaluating environmental education, citizen science, and stewardship

through naturalist programs. *Conservation Biology*, 00(0), 1-11. doi: 10.1111/cobi.12737
Stapp, W. B., Havlick, S., Bennett, D., Bryan, W., Fulton, J., & MacGregor, J. (1969). The concept of environmental education. The Journal of Environmental Education, 1(1), 30–31. Retrieved from: http://www.hiddencorner.us/html/PDFs/The_Concept_of_EE.pdf
Tidball, K. G. & Krasny, M.E. (2010). Urban environmental education from a social-ecological perspective: conceptual framework for civic ecology education. *Cities and the Environment*, 3(11), 1-20. doi: 10.15365/cate.31112010
UNESCO. (1978). The Tbilisi Declaration. Connect. *UNESCO/UNEP Environmental Education Newsletter*, 3(1), 1–8. Retrieved from: https://unesdoc.unesco.org/ark:/48223/pf0000156393
Varela-Losada, M., Vega-Marcote, P., Pérez-Rodríguez, U., & Álvarez-Lires, M. (2016). Going to action? A literature review on educational proposals in formal Environmental Education. *Environmental Education Research*, 22(3), 390-421. doi: 10.1080/13504622.2015.1101751
Wolsink, M. (2016a). Environmental education excursions and proximity to urban green space–densification in a 'compact city'. *Environmental Education Research*, *22*(7), 1049-1071. doi: 10.1080/13504622.2015.1077504
Wolsink, M. (2016b). 'Sustainable City' requires 'recognition'—The example of environmental education under pressure from the compact city. *Land Use Policy*, *52*, 174-180. doi: 10.1016/j.landusepol.2015.12.018

15.2 Social learning regarding ecosystems and their functions/services

Project Name: URBAN GreenUP (Grant Agreement no. 730426)

Author/s and affiliations: Jose Fermoso[1], Silvia Gómez[1], María González[1], Esther San José[1], Raúl Sánchez[1]

[1] *CARTIF Foundation. Parque Tecnológico de Boecillo, 205, 47151, Boecillo, Valladolid, Spain*

Social learning concerning ecosystems and their functions and services	**Knowledge and Social Capacity Building**
Description and justification	Social learning has long been established as essential to policy change, and thus is essential to mainstreaming NBS. To monitor social learning, it is essential to examine how policies and processes have actually changed. Such changes can encompass adoption of new interventions, techniques, policy, and processes in response to past experience and new information (Hall, 1993). Semi-

	structured interviews, participant observation, and content analysis will all be used as part of baseline monitoring and throughout the project to understand how decision makers, policy makers and practitioners are incorporating new knowledge about NBS into their processes, discussions, and documents.
Definition	Using a mixed methods case study, we will be measuring social learning.
Strengths and weaknesses	- This KPI will require citizens' collaboration, so recovering the data could be difficult.
Measurement procedure and tool	In progress. This KPI will focus on a particular form of social learning known as policy learning. In both baseline and post-intervention monitoring, monitoring for this KPI will include structured content analysis on key policy documents relevant to the study area will be undertaken, using a range of techniques including word-frequency counting, key-word-in-context listings, concordances, classification of words into content categories, content category counts, and retrievals based on content categories and co-occurrences (Druckman 2005; Weber 1990). In addition, using purposive, non-probability sampling, baseline and post-intervention monitoring will includes interviews key individuals involved in making relevant policies and making decisions with respect to green infrastructure and NBS in the City of Liverpool, with data being collected until saturation (Minichiello et al. 2008). Sometimes these adjustments will require small, incremental changes, and sometimes they will require radical shifts in approach, and it may also require time for changes to be made on paper, so interviews will allow access to the most up-to-date thinking and information. To ensure consistency in data collection, an interview guide based on the key theoretical elements of policy learning (Suškevičs et al. 2017; Dovers and Hussey 2013) will be used to analyse baseline knowledge of NBS, examine current processes and implementation of policy, and identify adjustments to processes and policies. At the same time, participant observation will be used to analyse decision-making in real-time and evaluate how it evolves over the course of four years. Two levels of policy learning will be assessed: 10 how policy problems are constructed and how solving the problem should be approached (i.e., scope of policy and its goals), and 2) instrumental learning, where lessons about policy design

	and knowledge about when a particular policy instrument is appropriate or viable (May 1992). Data from all methods will be analysed using Nvivo, using a combination of deduction and induction, using a priori codes from theory (Creswell 2013), followed by a second level of analysis where emergent themes were identified from coding patterns in the data (Miles and Huberman 1994). A selection of interviews will also be blindly coded by another researcher to check intercoder reliability is at least 85%.
Scale of measurement	City / neighbourhood
Data source	
Required data	
Data input type	
Data collection frequency	
Level of expertise required	Technical / Expert
Synergies with other indicators	
Connection with SDGs	SDG4 / SDG8 / **SDG10** / **SDG11**
Opportunities for participatory data collection	--
Additional information	
References	URBAN GreenUP Deliverable D3.4 - Monitoring program to Liverpool https://www.urbangreenup.eu/insights/deliverables/d3-4---monitoring-program-to-liverpool.kl URBAN GreenUP Deliverable D5.3: City Diagnosis and Monitoring Procedures https://www.urbangreenup.eu/insights/deliverables/d5-3-city-diagnosis-and-monitoring-procedures.kl

15.3 Pro-environmental identity

Project Name: CONNECTING Nature (Grant Agreement no. 730222)

Author/s and affiliations: Adina Dumitru[1], Catalina Young[2], Irina Macsinga[2]

[1] *Universitry of A Coruña, Spain*

[2] *West University of Timisoara, Romania*

Environmental Identity	Knowledge and Social Capacity Building
Description and justification	Another concept that describes human-nature relationship and presents the promise of explaining/predicting pro-environmental behavior relevant to NBS is that of environmental identity (EID), understood as a dimension of social identity that resides in our ties to the natural world, like connections to pets, trees, mountain formations, or particular geographic locations which have commonly been studied under the construct of "place identity" (Clayton, 2003). In the overall analysis, environmental identity has been theoretically and methodologically invested with the potency to prompt and sustain ecological behavior both as a product of complex interactions between our self-concept and the natural world (i.e., self-relevant beliefs infused by contact with natural environment), and as a driving force behind personal, social, and political choices and actions (i.e., environmentally sustainable behavior) (Clayton, 2003; Balundė, Jovarauskaitė, & Poškus, 2019; Freed, 2015; Olivos & Aragonés, 2011). For instance., Dresner, Handelman, Steven Braun, and Rollwagen-Bollens (2014) surveyed and interviewed 172 adults participating in 18 urban volunteer events in area parks across Portland, Oregon between February and June 2012. Based on the annual frequency of participation in such events, the stewards were differentiated as first-time volunteers, mid-level volunteers (3-10 events/year), and frequent volunteers (>10 events/year). Environmental identity was reported as one of the main three factors that explained the variation in survey response across the board, alongside pro-environmental behavior and civic engagement. Environmental identity, pro-environmental behavior, and civic engagement were positively correlated with the frequency of volunteer participation in park area events, with frequent volunteers scoring the highest degree of attention to environmental issues, environmental identity, and self-reported pro-environmental behaviors (Dresner et al., 2014). Clayton (2003) devised a psychometric instrument for the measurement of EI (i.e., Environmental Identity Scale - EIS), and advanced research data in support of "the idea that environmental identity is a meaningful and measurable construct, with consequences for attitudes and behavior, and that by thinking about environmental identity we learn something beyond what we learn by talking about attitudes and values" (pp. 52-58). Balundė et al. (2019) carried out a meta-analysis to investigate the relationship between EI and other two constructs devised to represent the human-nature relations, namely "connectedness with nature" (Schultz, 2002) and "environmental self-identity" (van der Werff, Steg, & Keizer, 2013). Their results confirmed a strong correlation between measures of connectedness with

	nature and environmental identity (see also Olivos, Aragonés, & Amérigo, 2011) as well as environmental self-identity, indicative of the fact that, although theoretically discernible, they may be psychometrically undistinguishable, thus redundant (Balundė et al., 2019). Accordingly, we have included EIS (Clayton, 2003) as measurement of participants' relationship with nature, environment, and NBS, in view of its psychometric properties having been examined and confirmed cross-culturally (i.e., Spain) (Olivos & Aragonés, 2011). In line with research on environmental education and the evolution of environmental attitudes (see SC 10 and SC 11.1), Bremer (2014) argues that childhood experiences with nature are highly influential in shaping an environmental identity. Her qualitative analysis of interviews and surveys of six students and their parents indicate that caregivers have a significant role in environmental identity development. The authors concludes that the greatest influence upon environmental identity formation is accomplished when parents "are deeply involved in their child's life, engage in a positive relationship with the child, and guide their child's attention toward the environment while also allowing their child to make discoveries and develop independent moral reasoning" (Bremer, 2014, p. 64). Along similar lines, Prévot, Clayton, and Mathevet (2018) advocate for access and opportunities for children and young people to experience nature freely and bring forth data collected on 919 French students that support the contention that there is a strong positive correlation between childhood experiences with nature (i.e., rurality) and environmental identity. The authors show that this relation is mediated by adult behavior (i.e., visiting natural areas) which "promotes higher scores of environmental identity in a virtuous cycle: previous experiences predict both identity and current behavior, and identity and current behavior reinforce each other." (Prévot et al., 2014, p. 271-272).
Definition	. . . environmental identity is one part of the way in which people form their self-concept; a sense of connection to some parts of the nonhuman natural environment, based on history, emotional attachment, and/or similarity, that affects the way in which we perceive and act towards the world; a belief that the environment is important to us and an important part of who we are. (Clayton, 2003, pp. 45-46)
Strengths and weaknesses	+indicator of resources (beliefs, motivation, affect, etc.) that create preconditions for environmentally responsible choices, decisions, or behaviors +better predictor of behavior than environmental attitudes (EA) (Clayton, 2003; Olivos & Aragonés, 2011), but not a solidly proven predictor of pro-environmental behavior – e.g., Freed (2015) sheds light on how environmental structures (i.e., recycling bins outside classrooms and around campus) can

	influence behaviors without changing a person's environmental identity -variability across cultures of constructs applied to the EI operationalization - as part of social identity, "understanding of oneself in a natural environment cannot be fully separated from the social meanings given to nature and to environmental issues, which will vary according to culture, world view, and religion" (Clayton, 2003, p. 53); EIS is based on North American understandings of the ways in which we value and interact with nature, and thus far cross-cultural validated only on Spanish population (Olivos & Aragonés, 2011)
Measurement procedure (P) and tool (T)	☒ *Quantitative P – self-report measures*: Scale inventory/Questionnaire (survey procedure, paper-and-pencil administration, computer-based administration) ○ T: *Environmental Identity Scale* (Clayton, 2003) made up of 24 items that measures the relationship between self and nature, inspired by identity theory. The structure of the scale was based in part on discussions of the factors that determine a collective social identity, and include the salience of the identity, the identification of oneself as a group member, agreement with an ideology associated with the group, and the positive emotions associated with the collective (Clayton, 2003, p. 52).
Scale of measurement	▪ EIS (Clayton, 2003) – 24 items *Please indicate the extent to which each of the following statements describes you by using the appropriate number from the scale below.* *1 - not at all true of me ...2...3...4 - neither true nor untrue...5...6...7 - completely true of me* _____ *1. I spend a lot of time in natural settings (woods, mountains, desert, lakes, ocean).* _____ *2. Engaging in environmental behaviors is important to me.* _____ *3. I think of myself as a part of nature, not separate from it.* _____ *4. If I had enough time or money, I would certainly devote some of it to working for environmental causes.* _____ *5. When I am upset or stressed, I can feel better by spending some time outdoors "communing with nature".* _____ *6. Living near wildlife is important to me; I would not want to live in a city all the time.* _____ *7. I have a lot in common with environmentalists as a group.*

	_____ 8. I believe that some of today's social problems could be cured by returning to a more rural lifestyle in which people live in harmony with the land. *_____ 9. I feel that I have a lot in common with other species.* *_____ 10. I like to garden.* *_____ 11. Being a part of the ecosystem is an important part of who I am.* *_____ 12. I feel that I have roots to a particular geographical location that had a significant impact on my development.* *_____ 13. Behaving responsibly toward the earth -- living a sustainable lifestyle -- is part of my moral code.* *_____ 14. Learning about the natural world should be an important part of every child's upbringing.* *_____ 15. In general, being part of the natural world is an important part of my self-image.* *_____ 16. I would rather live in a small room or house with a nice view than a bigger room or house with a view of other buildings.* *_____ 17. I really enjoy camping and hiking outdoors.* *_____ 18. Sometimes I feel like parts of nature -- certain trees, or storms, or mountains-- have a personality of their own.* *_____ 19. I would feel that an important part of my life was missing if I was not able to get out and enjoy nature from time to time.* *_____ 20. I take pride in the fact that I could survive outdoors on my own for a few days.* *_____ 21. I have never seen a work of art that is as beautiful as a work of nature, like a sunset or a mountain range.* *_____ 22. My own interests usually seem to coincide with the position advocated by environmentalists.* *_____ 23. I feel that I receive spiritual sustenance from experiences with nature.* *_____ 24. I keep mementos from the outdoors in my room, like shells or rocks or feathers.*
Data source	
Required data	✓ Essential: NBS characteristics for each city/site, more specifically objectives (short-, medium-, and long-term) and challenges ✓ Desirable: Data on pro-environmental behaviour relevant to NBS
Data input type	Quantitative
Data collection frequency	Before/after NBS implementation, aligned with medium and long-term objectives.
Level of expertise required	☒ Methodology and data analysis requires high expertise in psycho-social research ☒ Quantitative data collection requires no expertise

Synergies with other indicators	SC1 Bonding social capital SC2 Bridging social capital SC3 Linking social capital SC4.1 Trust in community SC4.2 Solidarity between neighbours SC4.3 Tolerance and respect SC6 Place attachment (Sense of Place): Place Identity SC9 Empowerment: Perceived control and influence over NBS decision-making SC10 Environmental education opportunities SC11.1 Positive environmental attitudes motivated by contact with NBS SC14 Social desirability
Connection with SDGs	Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation Goal 10. Reduce inequality within and among countries Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable Goal 13. Take urgent action to combat climate change and its impacts Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Opportunities for participatory data collection	-
Additional information	
References	Balundė, A., Jovarauskaitė, L., & Poškus, M. S. (2019). Exploring the Relationship Between Connectedness With Nature, Environmental Identity, and Environmental Self-Identity: A Systematic Review and Meta-Analysis. *SAGE Open*, 1-12. doi: 10.1177/2158244019841925 Bremer, A. E. (2014). Cultivating human-nature relationships: The role of parents and primary caregivers in development of environmental identity. *Pitzer Senior Theses.* Paper 49. Retrieved from https://scholarship.claremont.edu/cgi/viewcontent.cgi?article=1048&context=pitzer_theses Clayton, S. (2003). Environmental identity: A conceptual and an operational definition. In S. Clayton & S. Opotow (Eds.), *Identity and the natural environment* (pp. 45-65). Cambridge, MA: MIT Press Dresner, M., Handelman, C., Braun, S., & Rollwagen-Bollens, G. (2015). Environmental identity, pro-environmental behaviors, and civic engagement of volunteer stewards in Portland area parks. *Environmental Education Research*, *21*(7), 991-1010. Freed, A. (2015). *Exploring the link between environmental identity, behaviors and decision making*. Dissertation Abstracts

International, 77-01(E), 1-190. Retrieved from http://adsabs.harvard.edu/abs/2015PhDT.....52F
Olivos, P., & Aragonés, J. I. (2011). Psychometric Properties of the Environmental Identity Scale. *Psychology*, 2(1), 65-74. doi: 10.1174/217119711794394653
Olivos, P., Aragonés, J. I., & Amérigo, M. (2011). The connectedness with nature scale and its relationship with environmental beliefs and identity. *International Journal of Hispanic Psychology*, 4(1), 5-19. Retrieved from https://www.researchgate.net/
Prévot, A. C., Clayton, S., & Mathevet, R. (2018). The relationship of childhood upbringing and university degree program to environmental identity: Experience in nature matters. *Environmental Education Research*, *24*(2), 263-279.
Schultz, P. W. (2002). Inclusion with nature: The psychology of human-nature relations. In: P. Schmuck & W. P. Schultz (Eds.), *Psychology of sustainable development*. Boston, MA: Springer. doi: 10.1007/978-1-4615-0995-0_4
Van der Werff, E., Steg, L., & Keizer, K. (2014). I Am What I Am, by Looking Past the Present: The Influence of Biospheric Values and Past Behavior on Environmental Self-Identity. *Environment and Behavior*, 46(5), 626–657. doi: 10.1177/0013916512475209

15.4 Pro-environmental behaviour

Project Name: CONNECTING Nature (Grant Agreement no. 730222)

Author/s and affiliations: Adina Dumitru[1], Catalina Young[2], Irina Macsinga[2]

[1] *Universitry of A Coruña, Spain*

[2] *West University of Timisoara, Romania*

Pro-environmental behaviour	**Knowledge and Social Capacity Building**
Description and justification	Pro-environmental behavior (PEB) represents another dimension of interest in the evaluation of NBS' impact and foreseeable sustainability. Narrowly defined as "behavior which has a significant impact on the environment" (Krajhanzl, 2010, p. 252), PEB has been central to both theoretical and empirical endeavors aimed at shedding light on the factors that foster accountability in relation with nature. Evidently, the behavior addressed in PEB can be encountered in various unintentional forms (e.g., purchase of soya products). Moreover, environmental theory employs a variety of terms to capture different nuances of the pro-environmental manifestation, like "ecological behavior" (Kaiser, 1998), "sustainable behavior" (Tapia-Fonllem, Coral-Verdugo, Fraijo-Sing, & Duron-Ramos, 2013), "environment-protective behavior", "environment-

preserving behavior", "environmentally responsible behavior" (Krajhanzl, 2010). For instance, Tapia-Fonllem et al. (2013) emphasize that "although sustainable behavior is, in practical terms, synonymous with pro-environmental behavior, the latter has been used to emphasize efforts to protect the natural environment, while the former specifies actions aimed at protecting *both* the natural and the human (social) environments" (p. 712).

Pro-environmental behavior has been investigated in relation with numerous other variables pertinent to NBS research, such as environmental stewardship (Dresner, Handelman, Steven Braun, & Rollwagen-Bollens, 2014; Whitburn, Milfont, & Linklater, 2018), place attachment (Ramkissoon, Weiler, & Smith, 2012; Takahashi & Selfa, 2015), connectedness to nature (Whitburn et al, 2018), environmental identity (Brick, Sherman, & Kim, 2017; Brick & Lai, 2018), or education (Kudryavtsev, Krasny, & Stedman, 2012; Meyer, 2015).

Whitburn et al. (2018) explored the relationship between pro-environmental behaviors and personal relationship with nature in a quasi-experimental research with 423 participants from 20 neighborhoods varying with respect to their vegetation. The authors measured past PEB as participants' active involvement in a tree-planting action and reported results that indicate a strong association between connectedness to nature and engagement in PEB. Moreover, participants' involvement in tree-planting and the level of neighborhood greenness explained 46% of the variance in PEB, where connectedness to nature, environmental attitudes, and use of nature for psychological restoration acted as mediators.

Dresner et al. (2014) surveyed and interviewed 172 adults participating in 18 urban volunteer events in area parks across Portland, Oregon between February and June 2012. Based on the annual frequency of participation in such events, the stewards were differentiated as first-time volunteers, mid-level volunteers (3-10 events/year), and frequent volunteers (>10 events/year). Pro-environmental behavior, environmental identity, and civic engagement were positively correlated with the frequency of volunteer participation in park area events, with frequent volunteers scoring the highest degree of attention to environmental issues, environmental identity, and self-reported pro-environmental behaviors (Dresner et al., 2014).

Brick et al. (2017) built on the significance of identity signalling (i.e., the visibility of our behaviour to others) and its

	role in shaping our social identity to propose that "the most important identity for expressing and signalling pro-environmental behavior is identifying with environmentalists" (p. 227) and showed that *environmentalist identity* predicts pro-environmental behavior more strongly for self-reported high-visibility behaviors than even political orientation. Brick and Lay (2018) replicated this finding and reported that explicit identity strongly and uniquely predicted pro-environmental behaviors and policy preferences.
Definition	Pro-environmental behavior is such behavior which is generally (or according to knowledge of environmental science) judged in the context of the considered society as a protective way of environmental behavior or a tribute to the healthy environment (Krajhanzl, 2010, p. 252). Larson, Stedman, Cooper, and Decker (2015, p. 113) summarized the theoretical evidence for PEB's multidimensionality: • Some behaviors are inherently more difficult to carry out than others, and participation levels are influenced by a wide array of social and structural factors. • Participation in PEB is influenced by both hedonic, gain, and normative goals and intent. These drastically different motives not only result in different rates of behavioral expression; they may also affect the ways in which people perceive actions and their environmental impacts. • PEB varies substantially when it comes to type of impacts (e.g., direct vs. indirect), and scope of influence or specificity (e.g., local to global)
Strengths and weaknesses	+ indicator of participation, pro-activeness and tenacity in the pursuit of environmentally responsible goals -self-reported measures are susceptible to the effects of social desirability on respondents' answers -complex, multidimensional construct, highly dependent on social and cultural variables making it difficult to effectively measure the full range of potential pro-environmental behaviors in a single study (Larson et al., 2015) -generalizable PEB measurement scales based on behaviors that transcend place/location may not capture the reality of implemented actions playing a role in local environmental quality (Larson et al., 2015); *Local land stewardship activities* (i.e., efforts to physically enhance local environments) may represent a particularly relevant component of PEB when "place" matters (Larson et al., 2015, p. 114).

Measurement procedure (P) and tool (T)	☒ *Quantitative P*: Scale inventory/Questionnaire (survey procedure, paper-and-pencil administration, computer-based administration) ○ T: *Pro-environmental Behavior (Brick and Lay, 2018)* – 6 items adapted from the Recurring Environmental Behavior Scale (Brick et al., 2017) measuring the self-reported frequency of PEB assessed on a 5-point Likert scale - 1 (never), 3 (sometimes), 5(always) ○ T: *Recurring Environmental Behavior Scale* (Brick et al., 2017) – 21 items measuring the self-reported frequency of PEB assessed on a 5-point Likert scale - 1 (never), 3 (sometimes), 5(always) ○ T: *General Ecological Behaviour Scale* (Kaiser, Wolfing, & Fuhrer, 1999) – established as a Rasch-scale that assesses behavior by considering the tendency to behave ecologically and the difficulties in carrying out the behaviors, which depend on influences beyond people's actual behavior control; consists of 38 items representing different types of ecological behavior and some nonenvironmental, prosocial behaviors as well; a yes/no response format for these items is used. Negatively formulated items are reversed in coding. ☒ *Qualitative P*: ▪ *Qualitative methodologies can be used in mixed-methods research designs to explore the dimensions of PEB, as defined by community members (i.e., participant-driven approach, Larson et al., 2015)* ○ T: case study methodology – structured interviews, case study analysis, phenomenological analysis ○ T: participatory data collections methods, such as collaborative participatory data collection,
Scale of measurement	▪ *Pro-environmental Behavior (Brick and Lay, 2018)* – 6 items *1 (never), 3 (sometimes), 5(always)* 1. When you visit the grocery store, how often do you use reusable bags? 2. How often do you conserve water when showering, cleaning clothes, washing dishes, watering plants, or during other activities? 3. How often do you discuss environmental topics, either in person or with online posts (Facebook, Twitter, etc.)?

4. When you buy clothing, how often is it from environmentally friendly brands?

5. How often do you engage in political action or activism related to protecting the environment?

6. How often do you educate yourself about the environment?

- *Recurring Environmental Behavior Scale* (Brick et al., 2017) – 21 items

1 (never), 3 (sometimes), 5(always)

1. When you visit the grocery store, how often do you use reusable bags?

2. How often do you walk, bicycle, carpool, or take public transportation instead of driving a vehicle by yourself?

3. How often do you drive slower than 60mph on the highway?

4. How often do you go on personal (non-business) air travel?

5. How often do you compost your household food garbage?

6. How often do you eat meat?

7. How often do you eat dairy products such as milk, cheese, eggs, or yogurt?

8. How often do you eat organic food?

9. How often do you eat local food (produced within 100 miles)?

10. How often do you eat from a home vegetable garden (during the growing season)?

11. How often do you turn your personal electronics off or in low-power mode when not in use?

12. When you buy light bulbs, how often do you buy high efficiency compact fluorescent (CFL) or LED bulbs?

13. How often do you act to conserve water, when showering, cleaning clothes, dishes, watering plants, or other uses?

14. How often do you use aerosol products?

15. When you are in PUBLIC, how often do you sort trash into the recycling?

16. When you are in PRIVATE, how often do you sort trash into the recycling?

17. How often do you discuss environmental topics, either in person or with online posts (Facebook, Twitter, etc.)?

18. When you buy clothing, how often is it from environmentally friendly brands?

19. How often do you carry a reusable water bottle?

20. How often do you engage in political action or activism related to protecting the

environment?

21. How often do you educate yourself about the environment?

- *General Ecological Behaviour Scale* (Kaiser, Wolfing, & Fuhrer, 1999) – 38 items

YES/NO

Prosocial behaviour items:

1. Sometimes I give change to panhandlers.
2. From time to time I contribute money to charity.
3. If an elderly or disabled person enters a crowded bus or subway, I offer him or her my seat.
4. If I were an employer I would consider hiring a person previously convicted of a crime.
5. In fast food restaurants, I usually leave the tray on the table.*
6. If a friend or relative had to stay in hospital for a week or two for minor surgery _e.g., appendix, broken leg., I would visit him or her.
7. Sometimes I ride public transportation without paying a fare.*
8. I would feel uncomfortable if Turks lived in the apartment next door.*

Ecological behaviour items:

1. I put dead batteries in the garbage.*
2. After meals, I dispose of leftovers in the toilet.*
3. I bring unused medicine back to the pharmacy.
4. I collect and recycle used paper.
5. I bring empty bottles to a recycling bin.
6. I prefer to shower rather than to take a bath.
7. In the winter, I keep the heat on so that I do not have to wear a sweater.*
8. I wait until I have a full load before doing my laundry.
9. In the winter, I leave the windows open for long periods of time to let in fresh air.*
10. I wash dirty clothes without prewashing.
11. I use fabric softener with my laundry.*
12. I use an oven-cleaning spray to clean my oven.*
13. If there are insects in my apartment I kill them with a chemical insecticide.*
14. I use a chemical air freshener in my bathroom.*
15. I use chemical toilet cleaners.*
16. I use a cleaner made especially for bathrooms rather than an all-purpose cleaner.*

	17. I use phosphate-free laundry detergent. 18. Sometimes I buy beverages in cans.* 19. In supermarkets, I usually buy fruits and vegetables from the open bins.* 20. If I am offered a plastic bag in a store I will always take it.* 21. For shopping, I prefer paper bags to plastic ones. 22. I usually buy milk in returnable bottles. 23. I often talk with friends about problems related to the environment. 24. I am a member of an environmental organization. 25. In the past, I have pointed out to someone his or her unecological behaviour. 26. I sometimes contribute financially to environmental organizations. 27. I do not know whether I may use leaded gas in my automobile.* 28. Usually I do not drive my automobile in the city. 29. I usually drive on freeways at speeds under 100 k.p.h. _62.5 m.p.h.. 30. When possible in nearby areas waround 30 km, _18.75 miles.x, I use public transportation or ride a bike. **** Negatively formulated items.***
Data source	
Required data	✓ Essential: NBS characteristics for each city/site, more specifically objectives (long-term) and challenges ✓ Desirable: evaluations of *"local land stewardship activities" (Larson et al., 2015), i.e., conservation-oriented actions that improve the ecological features of the neighborhood/city (e.g., tree planting) – actions specific to each NBS*
Data input type	Quantitative (quantitative and qualitative, if participatory data collection methods are opted for)
Data collection frequency	Aligned with NBS implementation and timing of targeted objectives
Level of expertise required	☒ Methodology and data analysis requires high expertise in psycho-social research ☒ Quantitative data collection requires no expertise ☒ Qualitative data collection (case study, for example) requires high expertise in psycho-social research ○ Basic training needed if participatory data collection is opted for
Synergies with other indicators	P1 Type of interaction with NBS

	P2 Frequency of interaction with NBS P3 Duration of interaction with NBS P4 Perceived Quality of Green Spaces HW 12 Restoration-Recreation: Enhanced physical activity and meaningful leisure SC6 Place attachment (Sense of Place): Place Identity SC10 Environmental Education Opportunities SC11.1 Positive environmental attitudes motivated by contact with NBS SC11.2 Environmental Identity
Connection with SDGs	Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture Goal 3. Ensure healthy lives and promote well-being for all at all ages Goal 6. Ensure availability and sustainable management of water and sanitation for all Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all Goal 10. Reduce inequality within and among countries Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable Goal 12. Ensure sustainable consumption and production patterns Goal 13. Take urgent action to combat climate change and its impacts Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Opportunities for participatory data collection	Participatory methods can be used in mixed-methods research designs to explore the dimensions of PEB, as defined by community members (i.e., participant-driven approach, Larson et al., 2015)
Additional information	
References	Brick, C., Sherman, D. K., & Kim, H. S. (2017). "Green to be seen" and "brown to keep down": Visibility moderates the effect of identity on pro-environmental behavior. *Journal of Environmental Psychology*, *51*, 226-238. doi: 10.1016/j.jenvp.2017.04.004 Brick, C., & Lai, C. K. (2018). Explicit (but not implicit) environmentalist identity predicts pro-environmental behavior

and policy preferences. *Journal of Environmental Psychology*, *58*, 8-17. doi: 10.1016/j.jenvp.2018.07.003

Kaiser, F. G. (1998). A general measure of ecological behavior 1. *Journal of Applied Social Psychology*, *28*(5), 395-422.

Kaiser, F. G. (1996). Environmental attitude and ecological behavior. *Journal of Environmental Psychology*, 19, 1-19. Retrieved from https://pdfs.semanticscholar.org/e83f/34516e1e3bbc079904cb77bb74d6a52e7ca8.pdf

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior?. *Environmental education research*, *8*(3), 239-260. doi: 10.1080/13504620220145401

Krajhanzl, J. (2010). Environmental and proenvironmental behavior. *School and Health*, *21*(1), 251-274. Retrieved from https://www.researchgate.net/profile/Jan_Krajhanzl/publication/265508352_Environmental_and_Pro-environmental_Behavior/links/54106d600cf2f2b29a410a78/Environmental-and-Pro-environmental-Behavior.pdf

Kudryavtsev, A., Krasny, M. E., & Stedman, R. C. (2012). The impact of environmental education on sense of place among urban youth. *Ecosphere*, *3*(4), 1-15. doi: 10.1890/ES11-00318.1

Larson, L. R., Stedman, R. C., Cooper, C. B., & Decker, D. J. (2015). Understanding the multi-dimensional structure of pro-environmental behavior. *Journal of Environmental Psychology*, *43*, 112-124. doi: 10.1016/j.jenvp.2015.06.004

Meyer, A. (2015). Does education increase pro-environmental behavior? Evidence from Europe. *Ecological economics*, *116*, 108-121. Retrieved from https://epublications.marquette.edu/cgi/viewcontent.cgi?article=1530&context=econ_fac

Ramkissoon, H., Weiler, B., & Smith, L. D. G. (2012). Place attachment and pro-environmental behaviour in national parks: The development of a conceptual framework. *Journal of Sustainable Tourism*, *20*(2), 257-276. doi: 10.1080/09669582.2011.602194

Takahashi, B., & Selfa, T. (2015). Predictors of pro-environmental behavior in rural American communities. *Environment and Behavior*, *47*(8), 856-876. doi: 10.1177/0013916514521208

Tapia-Fonllem, C., Corral-Verdugo, V., Fraijo-Sing, B., & Durón-Ramos, M. F. (2013). Assessing sustainable behavior and its correlates: A measure of pro-ecological, frugal, altruistic and equitable actions. *Sustainability*, *5*(2), 711-723. doi:10.3390/su5020711

Whitburn, J., Linklater, W. L., & Milfont, T. L. (2019). Exposure to urban nature and tree planting are related to pro-environmental behavior via connection to nature, the use of nature for psychological restoration, and environmental attitudes. *Environment and Behavior*, *51*(7), 787-810. doi: 10.1177/0013916517751009

Whitmarsh, L., & O'Neill, S. (2010). Green identity, green living? The role of pro-environmental self-identity in determining consistency

across diverse pro-environmental behaviours. *Journal of environmental psychology*, *30*(3), 305-314. doi: 10.1016/j.jenvp.2010.01.003

Getting in touch with the EU

IN PERSON

All over the European Union there are hundreds of Europe Direct information centres.
You can find the address of the centre nearest you at:
https://europa.eu/european-union/contact_en

ON THE PHONE OR BY EMAIL

Europe Direct is a service that answers your questions about the European Union.
You can contact this service:

– by freephone: **00 800 6 7 8 9 10 11** (certain operators may charge for these calls),

– at the following standard number: **+32 22999696**, or

– by email via: **https://europa.eu/european-union/contact_en**

Finding information about the EU

ONLINE

Information about the European Union in all the official languages of the EU is available on the Europa website at: **https://europa.eu/european-union/index_en**

EU PUBLICATIONS

You can download or order free and priced EU publications from:
https://op.europa.eu/en/publications. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see **https://europa.eu/european-union/contact_en**)

EU LAW AND RELATED DOCUMENTS

For access to legal information from the EU, including all EU law since 1952 in all the official language versions, go to EUR-Lex at: **http://eur-lex.europa.eu**

OPEN DATA FROM THE EU

The EU Open Data Portal (**http://data.europa.eu/euodp/en**) provides access to datasets from the EU. Data can be downloaded and reused for free, for both commercial and non-commercial purposes.

This *Evaluating the Impact of Nature-based Solutions: Appendix of Methods accompanies the Handbook* for Practitioners for evaluating the impact of nature-based solutions (NBS). The overarching objective of the *Handbook* and this accompanying *Appendix of Methods* is to provide standardised guidance and methods to aid the selection and implementation of indicators to assess impacts of NBS, and, over time, establish a robust European evidence base on NBS performance and impact. In order to compare impacts of different types of NBS, implemented in different contexts, and to draw valid, evidence-based conclusions regarding NBS impact, similar indicators, methods, and types of measurement are needed. The *Evaluating the Impact of Nature-based Solutions: Handbook for Practitioners* and accompanying *Appendix of Methods* identifies indicators and briefly details methodologies to assess impacts of nature-based solutions across 12 societal challenge areas: Climate Resilience; Water Management; Natural and Climate Hazards; Green Space Management; Biodiversity; Air Quality; Place Regeneration; Knowledge and Social Capacity Building for Sustainable Urban Transformation; Participatory Planning and Governance; Social Justice and Social Cohesion; Health and Well-being; and, New Economic Opportunities and Green Jobs.

Evaluating the Impact of Nature-based Solutions: Appendix of Methods provides a brief description of each indicator and recommends appropriate methods to measure specific impacts, along with guidance for end-users about the appropriateness, advantages and drawbacks of each method in different local contexts. As such, it is intended to guide the implementation of selected indicators to assess NBS performance and impact.

Studies and reports

Publications Office
of the European Union