Natural Parks as Local Agents of Sustainability: Institutional Perceptions of the Role of Gaia Biological Park in Promoting Sustainable Development

Tiago Ribeiro[1], Telma Cruz[2], Clara Vasconcelos[3]

[1]Science Teaching Unit, Faculty of Sciences (FCUP), University of Porto, Portugal & Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), Portugal
[2]Science Teaching Unit, Faculty of Sciences (FCUP), University of Porto, Portugal, Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), Portugal, Parque Biológico de Gaia, Portugal
[3] Science Teaching Unit, Faculty of Sciences (FCUP), University of Porto, Portugal & Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), Portugal

Abstract

In the context of the 2030 Agenda, natural parks are increasingly recognized as spaces that mediate between science, society, and nature, contributing to the promotion of Sustainable Development (SD). This study focused on analysing institutional perceptions regarding the contribution of the Gaia Biological Park (PBG) to the promotion of SD, specifically examining interview results obtained from directors of the Department of Environment and Urban Parks of the Municipality of Vila Nova de Gaia. The research followed a qualitative case study approach, using semi-structured interviews conducted with directors directly involved in the management of the PBG. The sample comprised three directors (n=3), corresponding to 60.0% of the department's leadership. Results reveal institutional consensus concerning the role of the PBG as a space promoting sustainable development, with all interviewees (n=3; 100.0%) stating that the park's activities predominantly align with this domain. All participants (n=3; 100.0%) also demonstrated familiarity with the Sustainable Development Goals (SDGs) and identified SDGs 4 (Quality Education), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), and 15 (Life on Land) as the most represented within park activities, indicated by two interviewees (n=2; 66.6%), while one director (n=1; 33.3%) explicitly added SDG 13 (Climate Action). In terms of institutional governance, all interviewees (n=3; 100.0%) stressed the importance of strengthening collaboration between municipal departments and developing partnerships with universities, companies, and the local community, also recognizing the need for strategic instruments ensuring continuity of activities. An optimistic perception regarding the continuity of park initiatives despite political changes also prevails among all participants (n=3; 100.0%). The findings indicate that the PBG is institutionally recognized as a relevant agent for local sustainability promotion, contributing to environmental literacy, visitor diversification, and reinforcement of territorial identity associated with conservation and environmental education. These results reinforce the role of natural parks as strategic instruments of local governance for sustainability and highlight the importance of Science Communication in consolidating environmental citizenship practices.

Keywords: *Science Communication; Case study; Natural Parks; Sustainable Development; Environmental Literacy; Institutional Perceptions.*

1. Introduction

The implementation of the 2030 Agenda and the Sustainable Development Goals (SDGs) has reinforced the urgency of promoting pro-environmental behaviours capable of reducing environmental impacts and supporting more sustainable development pathways. The 2030 Agenda establishes a broad and ambitious framework that integrates multiple dimensions of Sustainable Development (SD), while encouraging social responsibility, justice, and effective citizenship practices. Achieving these goals depends not only on political and institutional action but also on the active participation of citizens and changes in individual behaviour patterns [1].
Voluntary Local Reviews (VLRs), supported by the *European Handbook for SDGs Voluntary Local Reviews* [2], have improved local monitoring capacities and strengthened cities' abilities to assess their progress towards the SDGs while supporting governance and long-term planning processes. Nevertheless, the transition towards sustainability largely depends on public engagement and

behavioural transformation. Current anthropogenic systems continue to encourage unsustainable lifestyles characterised by excessive consumption and environmentally harmful practices, particularly in industrialised societies. Citizens therefore require adequate knowledge and awareness to address contemporary environmental challenges such as climate change, biodiversity loss, excessive resource exploitation, plastic pollution, and emerging environmental risks.

Education for Sustainable Development (ESD) and Science Communication (SC) have been recognised as essential tools for promoting environmental literacy and encouraging more sustainable practices [3]. Previous studies suggest that although individuals frequently demonstrate positive attitudes and knowledge regarding environmental issues, these do not necessarily translate into behavioural change [4]. Human behaviour often remains resistant to change, even when environmental risks are widely recognised. Moreover, modern urban and industrial lifestyles may weaken the individual's connection with the natural world, reducing opportunities for developing stronger environmental awareness.

In this context, natural parks and SC centres may play a relevant role by creating opportunities for reconnecting individuals with nature and fostering experiences that encourage environmental learning and behavioural transformation. The Gaia Biological Park (Parque Biológico de Gaia – PBG), the first permanent environmental education centre established in Portugal, appears to have evolved into a space promoting ESD and implementing SC activities designed to increase environmental awareness and encourage pro-environmental actions.

Considering the potential role of natural parks as agents of sustainability promotion, this study aims to explore institutional perceptions regarding the contribution of the Gaia Biological Park (PBG) to SD. Specifically, it seeks to understand how institutional actors perceive the role of SC activities in promoting sustainability practices and environmental citizenship.

1.1. Environmental Education and Education for Sustainable Development

The discussion surrounding the relationship between environmental limits and human development has evolved considerably over the past decades. Early concerns regarding the capacity of Earth's finite resources to sustain continuous population growth emerged with the Malthusian population theory, which suggested that population growth could eventually exceed the availability of natural resources [5,6]. Subsequently, global environmental concerns intensified during the twentieth century, particularly following the publication of *The Limits to Growth* by the Club of Rome in 1972, which highlighted the potential consequences of unrestricted economic and demographic expansion.

The same year, the United Nations Conference on the Human Environment held in Stockholm represented a turning point in international environmental policy, promoting a closer relationship between environmental concerns and development processes [7]. However, the concept of Sustainable Development (SD) only gained broader international recognition through the report *Our Common Future*, published by the World Commission on Environment and Development (WCED), where SD was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (CMMAD, [8], p. 46).

This understanding of SD was further strengthened through international initiatives such as Agenda 21, the Millennium Development Goals (MDGs), and later the SDGs integrated into the 2030 Agenda (United Nations, 2015). The SDGs introduced an integrated framework addressing environmental, social, and economic dimensions while promoting collective responsibility towards a more sustainable future.

Within this context, education has increasingly been recognised as a fundamental mechanism for achieving sustainability. Initially, Environmental Education (EE) focused primarily on ecological issues and environmental awareness. Over time, however, broader perspectives emerged, incorporating social, economic, and cultural dimensions into educational approaches. This evolution led to the development of ESD, formally introduced through international discussions promoted by UNESCO [3].

The emergence of ESD generated considerable debate among researchers and educators. Some scholars argued that ESD represented a continuation and expansion of EE, while others questioned the replacement of EE terminology, arguing that EE had already incorporated social and environmental dimensions [9,10,11,12]. Despite these discussions, ESD gradually became established as a broader educational paradigm, aiming to equip individuals with the knowledge, competencies, values, and critical thinking skills necessary to address complex sustainability challenges.

According to UNESCO [3], ESD is characterised by an interdisciplinary perspective, lifelong learning principles, contextual relevance, and participatory educational practices. Furthermore, ESD seeks to empower individuals and communities to make informed decisions and adopt sustainable lifestyles capable of contributing to long-term societal transformation.

Current perspectives increasingly consider ESD as an evolutionary stage of EE rather than a replacement of it [13]. Consequently, education plays a central role in developing sustainability competencies and fostering active citizenship, becoming an essential pathway towards achieving the SDGs and promoting societal change.

1.2. Science Communication and the Promotion of Pro-environmental Behaviours

SC has progressively evolved from traditional deficit-based models, centred primarily on the transmission of scientific information, towards more participatory and interactive approaches that emphasise dialogue and public engagement. Earlier perspectives such as *Public Understanding of Science* (PUS) focused mainly on increasing scientific knowledge among citizens, assuming that higher levels of knowledge would naturally lead to more informed decisions and behavioural change. More recent approaches, including *Public Engagement with Science and Technology* (PEST), recognise that communication processes should involve interaction, participation, and co-construction of knowledge between scientific institutions and society [14,15].

Within the context of SD, SC has become increasingly relevant as a mechanism for enhancing environmental literacy and encouraging active citizenship practices. Beyond merely disseminating information, SC may contribute to the development of critical thinking skills, environmental awareness, and greater public participation in sustainability-related issues. Effective communication strategies can therefore support individuals in understanding complex environmental challenges and motivate them to adopt behaviours that contribute to sustainability goals.

However, previous research suggests that increasing scientific knowledge alone does not necessarily result in behavioural transformation. Knowledge and positive attitudes towards environmental issues frequently coexist with limited behavioural action, highlighting the existence of a gap between awareness and actual practice [4]. Consequently, SC initiatives increasingly seek to provide more experiential, participatory, and contextualised learning opportunities capable of influencing both cognitive and affective dimensions associated with environmental action.

Natural parks and non-formal educational environments may offer particularly favourable conditions for these approaches because they facilitate direct contact with nature and allow visitors to engage with real-world environmental contexts. Such spaces can create meaningful experiences that strengthen emotional connections with the environment while simultaneously fostering scientific understanding and promoting sustainable behaviours. Research has demonstrated that direct interaction with natural environments may positively influence environmental attitudes and strengthen individuals' willingness to engage in conservation practices [16].

In this regard, the PBG represents a relevant example of a SC environment that combines EE, biodiversity conservation, and non-formal learning experiences. Through activities specifically designed to engage diverse audiences, the Park creates opportunities for visitors to develop knowledge and awareness regarding sustainability issues while encouraging reflection about everyday environmental practices.

Considering the growing recognition of SC as a potential catalyst for behavioural change, the present study examines the role of PBG activities in promoting pro-environmental behaviours for SD. Specifically, the study seeks to understand whether SC initiatives implemented within a natural park context can contribute to influencing visitors' knowledge, attitudes, and behavioural intentions towards sustainability.

2. Methodology

This study adopted a qualitative case study approach to explore institutional perceptions regarding the contribution of the PBG to the promotion of Sustainable Development (SD). The case study design was considered appropriate as it enables an in-depth understanding of a contemporary phenomenon within its real-life context and facilitates the examination of participants' experiences and perspectives.

Data collection was conducted through semi-structured interviews with directors from the Department of Environment and Urban Parks (DAPU) of the Municipality of Vila Nova de Gaia. Semi-structured interviews were selected because they allow flexibility during data collection while ensuring that predefined themes relevant to the research objectives are addressed. The interview script included questions focusing on participants' perceptions of the Park's role in promoting SD, its contribution to the SDGs, institutional articulation and governance, and the potential impact of SC activities on environmental awareness and citizenship practices.

The study sample comprised three directors (n = 3), corresponding to 60.0% of the department's leadership positions. Participants were selected based on their direct involvement in the management, planning, and implementation of activities developed within the Gaia Biological Park, ensuring that they possessed relevant institutional knowledge and decision-making experience.
Data analysis followed a qualitative content analysis approach. Interview responses were transcribed, coded, and organised into thematic categories previously established according to the study objectives and interview structure. The analysis process aimed to identify recurrent patterns, shared perspectives, and institutional understandings concerning the role of the Park as a local sustainability agent.
This methodological approach enabled a detailed examination of institutional viewpoints and provided insights into how SC activities developed within a natural park context may contribute to strengthening environmental literacy and promoting SD practices.

2.1. Sample Characterisation

The study sample comprised three directors (n=3) from the Department of Environment and Urban Parks (DAPU) of the Municipality of Vila Nova de Gaia (Portugal), representing 60.0% of the department's leadership structure. Participants were selected through purposive sampling based on their direct involvement in the management, planning, and implementation of activities developed within the Gaia Biological Park (PBG).
The inclusion of participants occupying leadership positions was considered particularly relevant because of their institutional responsibilities and strategic roles in decision-making processes associated with environmental management, educational initiatives, and sustainability-related activities. Their professional experience and organisational responsibilities provided a comprehensive institutional perspective regarding the role of the Park in promoting SD and implementing SC initiatives.
The sample aimed to ensure access to informed perspectives concerning the Park's educational, environmental, and governance dimensions, allowing an in-depth exploration of institutional perceptions regarding the contribution of PBG to sustainability promotion and environmental citizenship practices.

2.2. Data Collection Instrument

Data were collected using a semi-structured interview guide specifically designed according to the objectives of the study. Semi-structured interviews were selected because they provide a balance between consistency across participants and flexibility for exploring emerging topics and obtaining deeper insights into participants' perspectives.
The interview guide included open-ended questions organised into thematic dimensions related to the role of the Gaia Biological Park (PBG) in promoting SD. Specifically, the questions explored: (i) participants' perceptions regarding the contribution of PBG activities to Sustainable Development; (ii) the relationship between park activities and the SDGs; (iii) the contribution of the Park to environmental awareness and environmental literacy; (iv) institutional articulation and governance processes; and (v) perspectives regarding the continuity and future development of sustainability-related initiatives.
The structure of the interview guide aimed to ensure that all participants addressed the same central themes while allowing opportunities for clarification, additional explanations, and the emergence of new relevant issues throughout the interview process. This approach facilitated the collection of rich qualitative data and enabled a more comprehensive understanding of institutional perceptions regarding the Park's contribution to sustainability promotion.

2.3. Procedure and Ethical Considerations

The interviews were conducted individually with the selected participants at previously agreed times and locations, ensuring suitable conditions for discussion and minimising external influences on the interview process. Prior to data collection, participants received information regarding the aims and procedures of the study and were informed about the intended use of the collected data.
Ethical principles guiding research involving human participants were strictly followed throughout the study. Participation was entirely voluntary, and informed consent was obtained from all participants before the interviews were conducted. Participants were informed of their right to withdraw from the study at any stage without any consequences. To ensure privacy and protect participants' identities, anonymity and confidentiality procedures were implemented during all stages of the research process. Personal identifiers were removed from interview transcripts and participants were assigned codes during data analysis and reporting procedures. All collected information was treated confidentially and

used exclusively for research purposes. Following participants' consent, interviews were recorded to ensure the accuracy and completeness of the collected information. The recordings were subsequently transcribed and prepared for content analysis through coding and categorisation procedures aligned with the research objectives.

2.4. Data Analysis

The interview data were analysed using qualitative content analysis, allowing for the systematic identification, organisation, and interpretation of recurring themes emerging from participants' responses. This approach was selected because it enables the examination of meanings, perceptions, and patterns within textual data while preserving the contextual richness of participants' narratives.
Following the interviews, audio recordings were transcribed verbatim to ensure an accurate representation of participants' statements. The transcribed material was then subjected to a coding process based on predefined analytical categories established according to the study objectives and the thematic dimensions included in the interview guide. These categories addressed aspects such as perceptions of SD, the contribution of the Gaia Biological Park (PBG) to the SDGs, environmental literacy, institutional governance, and future perspectives regarding park activities.
Subsequently, responses were grouped into thematic units and analysed to identify common patterns, similarities, and differences across participants' perspectives. Frequency analysis of recurring themes was also considered to support the interpretation of institutional perceptions and provide a clearer understanding of the relevance attributed to different dimensions of sustainability promotion.
The analytical process aimed to ensure consistency and coherence in data interpretation, enabling a comprehensive understanding of the institutional role of the Gaia Biological Park as a local agent contributing to SD and environmental citizenship practices.

3. Results and Discussion

The interview findings revealed a strong institutional consensus regarding the role of the Gaia Biological Park (PBG) as a strategic space for promoting Sustainable Development (SD). All participants (n = 3; 100.0%) considered that the activities developed by the PBG are predominantly associated with SC, recognising its role in making scientific knowledge accessible and meaningful for different audiences. Although participants acknowledged characteristics associated with both formal and non-formal educational approaches, they identified SC as the dimension that most strongly characterises the Park's initiatives.
One participant emphasised this perspective by stating that the Park seeks to "reach the public with the more complex aspects of science and make science simple" (P1). This statement suggests an understanding of SC as a process extending beyond the transmission of information and involving the adaptation of scientific knowledge to different audiences and contexts. Contemporary approaches to SC increasingly emphasise participation, accessibility, and dialogue rather than one-directional dissemination models. Within this perspective, natural parks may act as mediating environments where individuals engage directly with scientific knowledge through experiential and contextualised activities.
The findings also indicate that participants perceive PBG as a space capable of fostering environmental awareness and promoting more meaningful interactions between society and environmental issues. Previous research suggests that direct contact with natural environments may strengthen emotional attachment to nature and contribute positively to the development of pro-environmental attitudes and behaviours. Consequently, SC activities implemented in natural settings may provide opportunities not only for increasing knowledge but also for encouraging behavioural reflection and environmental responsibility.
Regarding the contribution of PBG activities to the SDGs, results indicate that all interviewees (n = 3; 100.0%) demonstrated familiarity with the SDGs and recognised their integration within the Park's activities. Participants identified SDG 4 (*Quality Education*), SDG 11 (*Sustainable Cities and Communities*), SDG 12 (*Responsible Consumption and Production*), and SDG 15 (*Life on Land*) as the goals most strongly represented within educational and environmental initiatives developed at the Park, mentioned by two participants (n = 2; 66.6%). One participant (n = 1; 33.3%) additionally highlighted SDG 13 (*Climate Action*) as an important dimension associated with Park activities.
These findings suggest that institutional actors perceive the Park as contributing to sustainability through an integrated and multidimensional perspective, extending beyond traditional biodiversity conservation practices. Rather than focusing exclusively on ecological preservation, participants recognised educational, social, and behavioural dimensions associated with sustainability promotion. Such

perceptions align with ESD principles, which advocate interdisciplinary approaches capable of integrating environmental, social, and economic dimensions while promoting active citizenship and critical thinking.

The interviews also highlighted the relevance of governance and institutional collaboration mechanisms for ensuring the effectiveness and continuity of sustainability initiatives. Results reveal that all participants (n = 3; 100.0%) stressed the importance of strengthening cooperation among municipal departments and establishing partnerships involving universities, private organisations, and local communities. Participants additionally emphasised the importance of implementing strategic planning instruments capable of ensuring the long-term continuity and development of Park activities.

The emphasis placed on collaboration suggests that participants recognise sustainability promotion as a multidimensional process requiring coordinated actions across different institutional actors. Previous studies have identified collaborative governance structures as important mechanisms for improving the effectiveness and societal impact of educational and environmental programmes. The present findings therefore indicate that the perceived impact of the PBG does not rely solely on activities conducted within the Park itself but also on broader institutional networks capable of strengthening its educational and social role.

Participants also demonstrated optimistic perceptions regarding the continuity of Park activities despite possible political or administrative changes. All interviewees (n = 3; 100.0%) considered that the PBG possesses a sufficiently established institutional identity to maintain its mission and activities over time. This perception may indicate that the Park is viewed not simply as an isolated municipal initiative but rather as an institution with a recognised educational and environmental identity embedded within the local community.

The data indicate that the Gaia Biological Park is institutionally recognised as a relevant local agent for sustainability promotion, contributing to environmental literacy, visitor diversification, and the reinforcement of territorial identity associated with environmental conservation and educational practices. Furthermore, the results reinforce the potential of natural parks as strategic instruments for local governance and support the role of SC as a mechanism capable of promoting environmental awareness and strengthening sustainability-oriented citizenship practices. The prominence of SDG 4 is unsurprising considering the educational mission of PBG. However, the simultaneous identification of SDGs related to urban sustainability, responsible consumption, and biodiversity conservation suggests that participants perceive the Park as contributing to sustainability through interconnected dimensions rather than isolated environmental actions.

4. Conclusion

This study explored institutional perceptions regarding the role of the Gaia Biological Park (PBG) in promoting Sustainable Development (SD), focusing on the perspectives of directors from the Department of Environment and Urban Parks of the Municipality of Vila Nova de Gaia. The findings revealed a strong consensus among participants concerning the relevance of the Park as a local agent for sustainability promotion and as a space capable of connecting EE, SC, and active citizenship practices.

Interviewees consistently recognised SC as one of the main characteristics of the activities developed within the Park, highlighting its capacity to translate scientific knowledge into accessible experiences for diverse audiences. Participants also demonstrated familiarity with the SDGs and identified several goals associated with Park activities, particularly SDG 4 (*Quality Education*), SDG 11 (*Sustainable Cities and Communities*), SDG 12 (*Responsible Consumption and Production*), and SDG 15 (*Life on Land*). These findings suggest that institutional actors perceive the Park as contributing to sustainability through an integrated and multidimensional perspective.

The results further emphasised the importance of institutional collaboration, strategic planning, and governance mechanisms for ensuring the continuity and effectiveness of sustainability initiatives. Partnerships among municipal departments, educational institutions, and local communities were recognised as essential factors for strengthening the social impact of Park activities and increasing their contribution to local sustainability objectives.

Although the study provides valuable insights into institutional perspectives regarding the contribution of PBG to SD, some limitations should be acknowledged. The reduced sample size and the exclusive focus on institutional actors limit the generalisation of findings. Future studies may expand the analysis by incorporating perspectives from visitors, educators, and other stakeholders involved in Park activities.

The findings reinforce the potential of natural parks as strategic instruments for local sustainability governance and highlight the importance of SC as a mechanism for promoting environmental literacy and encouraging behaviours aligned with SD principles.

REFERENCES

[1] United Nations, *Transforming our World: The 2030 Agenda for Sustainable Development*, United Nations, New York, 2015.
[2] Siragusa, A., Vizcaino, P., Proietti, P., & Lavalle, C., *European Handbook for SDGs Voluntary Local Reviews*, Publications Office of the European Union, Luxembourg, 2020.
[3] UNESCO, *Education for Sustainable Development Goals: Learning Objectives*, UNESCO, Paris, 2017.
[4] Kollmuss, A., & Agyeman, J., "Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior?", *Environmental Education Research*, Vol. 8, No. 3, 2002, pp. 239–260.
[5] Dixon, J. A., & Fallon, L. A., "The concept of sustainability: Origins, extensions and usefulness for policy", *Society and Natural Resources*, Vol. 2, No.1, 1989, pp. 73–84.
[6] Rostow, W. W., & Rostow, E. V., *The World Economy: History and Prospect*, University of Texas Press, Austin, 1978.
[7] Caldwell, L. K., *International Environmental Policy: Emergence and Dimensions*, Duke University Press, Durham, 1973.
[8] CMMAD (World Commission on Environment and Development), *Our Common Future*, Oxford University Press, Oxford, 1987.
[9] Gaudiano, E. G., "Atisbando el desarrollo conceptual de la educación ambiental en México", Vol. 2, No.1, pp. 34–44, 2003.
[10] Meira, P., "Eloxio da Educación Ambiental", *XII Jornadas Pedagógicas da ASPEA: Educação Ambiental no contexto da década das Nações Unidas da Educação para o Desenvolvimento Sustentável*, Lisboa, 2005, pp.14–18.
[11] Meira, P., & Sato, M., "Só os peixes mortos não conseguem nadar contra a correnteza", *Revista de Educação Pública*, Vol.14, No.25, pp.1–19, 2005.
[12] Schmidt, L., *Ambiente e Políticas Ambientais: Escalas e Desajustes*, Imprensa de Ciências Sociais, Lisboa, 2010.
[13] Hesselink, F., Van Kempen, P., & Wals, A., *ESDebate: International Debate on Education for Sustainable Development*, IUCN Commission on Education and Communication, Gland, Switzerland, 2000.
[14] Bauer, M. W., Allum, N., & Miller, S., "What can we learn from 25 years of PUS survey research? Liberating and expanding the agenda", *Public Understanding of Science*, Vol. 16, No. 1, 2007, pp. 79–95.
[15] Oliveira, L. T., & Carvalho, A., "Public engagement with science and technology", *Observatorio (OBS)* Journal, Vol. 9, No. 3, 2015, pp. 155–178.
[16] Otto, S., & Pensini, P., "Nature-based environmental education of children", *Global Environmental Change*, Vol.47, 2017, pp.88–94.