Revista Nacional de
Gerenciamento de Cidades
ISSN eletrônico 2318-8472, volume 11, número 84, 2023

Reflections on the contribution of Environmental Education to Sustainability in the Applicability of Green Infrastructures

Fernanda Alves Góis Meneses
Master Professor, PhD student in Development and Environment, UFS, Brazil.
fernanda_gois@academico.ufs.br

Liana Siqueira do Nascimento Marreiro
Master Professor, PhD student in Development and Environment, UFPI, Brazil.
liana.marreiro@ufpi.edu.br

Elica de Aguiar Martins
Master Professor, PhD student in Development and Environment, UFPI, Brazil.
elicamartins@hotmail.com

Jailton de Jesus Costa
PhD Professor, Graduate Program in Development and Environment, UFS, Brazil.
jailton@academico.ufs.br

Rozana Rivas de Araújo
PhD Professor, Department of Architecture and Urbanism, UFS, Brazil.
rozanarivas@academico.ufs.br

Revista Nacional de
Gerenciamento de Cidades
ISSN eletrônico 2318-8472, volume 11, número 84, 2023

ABSTRACT
The contemporary world has been marked by the permanent degradation of the environment and its ecosystem, and reflecting on social practices is necessary to articulate means of production in environmental education, in order to seek sustainability through green infrastructure. The objective is to present reflections on the contribution of environmental education along with the potential of green strategies in urban drainage, focusing on urban green infrastructures, which serve as a contribution to the formulation of public policies for the promotion of the population's quality of life and the better use of natural resources. The adopted methodology was the development of an Interaction Matrix, using the Leopold Matrix, constructed based on the grouping of typologies by the scale of application - regional, local, and specific, based on the potential these typologies have for environmental, social, and economic benefits for maintaining the quality of life in cities. It is observed that the green infrastructure options that best suit their potentials are urban green areas at the regional scale, linear parks at the local scale, and vertical gardens at the specific scale, which scored the highest potential. Among green infrastructures, the greatest benefits are found in maintaining water flow, which significantly contributes to improvements in urban drainage. The use of public policies aiming at the conservation and creation of urban green areas is essential, and the implementation of Infrastructure Planning Policies in cities will bring benefits from a social, environmental, and economic perspective.

KEYWORDS: Environmental Education. Urban Sustainability. Green Infrastructure.

1 INTRODUCTION

The disorderly manner in which many urban centers have organized themselves has caused numerous environmental problems that affect the well-being of their population, with problems mainly related to urban waters, specifically rainwater, requiring the urgent application of more sustainable strategies that combine water, vegetation, and urbanization aspects.

Cities face challenges related to access to water and basic sanitation, irregular urban settlements, solid waste management, and air pollution. These issues are also part of the Brazilian urban reality, revealing a process of unplanned urbanization that puts pressure on ecosystems. Hurley (2009) states that the function of cities, especially in new growth areas, must change in order to achieve urban sustainability.

Environmental education is a pedagogical approach aimed at promoting awareness and understanding of environmental issues, as well as encouraging individual and collective actions for environmental protection and conservation. It encompasses various aspects, from the transmission of scientific knowledge about ecology and sustainability to promoting behavioral changes and citizen participation in seeking environmental solutions.

In this sense, green infrastructure emerges as a strategy for using natural elements in urban areas to provide ecosystem services, improve people's quality of life, and promote sustainability. As seen, this infrastructure can include parks, gardens, green corridors, recreational areas, green roofs, natural drainage systems, among others.

With American roots dating back to 1990, the term green infrastructure emerged with architectural and landscaping references to refer to "[...] urban and regional planning" with the inclusion of "natural areas and natural ecosystems and their functions as sources, environmental control, climate regulation, recreation and leisure, providing a wide range of benefits to society" (CORMIER; PELLEGRINO, 2008, p. 128).

Therefore, an intrinsic relationship between green infrastructure and the promotion of sustainability is identified, as incorporating green areas in urban areas preserves local fauna and flora habitats, contributes to air quality, helps reduce pollution, and promotes ecosystem balance and the maintenance of ecosystem services. Regarding the concept of sustainability, Jacobi (1999, p. 44) states: "[...]

> The notion of sustainability implies a necessary interplay between social justice, quality of life, environmental balance, and the need for development with support capacity. But it is also associated with a premise of ensuring economic-financial and institutional support. In our view, the emphasis is on practices guided by a development of social policies that are articulated with the need for recovery, conservation, improvement of the environment, and quality of life."

Green infrastructure aims at urban planning considering the conservation of natural resources and the search for innovative solutions that allow economic, social, and environmental development, meeting the needs of current generations without compromising the subsistence of future generations. It is in this context that the relevance of environmental education for the applicability of green infrastructure stands out. After all, only with knowledge is it possible to plan and implement this strategy. Thus, environmental education plays a fundamental role in raising awareness and understanding of environmental issues, such as the importance of nature preservation and conservation, and disseminates information about the benefits and impacts of green infrastructure, creating a foundation for its implementation and maintenance. Furthermore, individuals need to be trained to actively participate in decision-making related to the design and execution of green infrastructure.

In addition, the aspect of connecting with nature, whose importance attributed by environmental education allows the appreciation of green spaces, encourages their exploration, the understanding of their importance, and the influence on their care and preservation. Therefore, environmental education enables the dissemination of knowledge that contributes to the planning of green infrastructure. In this regard, Santos and Enoribaka (2021) discuss how the concept of green infrastructure transcends the fields of Architecture, Urban Planning and Landscaping and enters the areas of Geography, Law, Biological Sciences, Civil Engineering, Environmental Engineering, Environmental Management and Analysis, Forestry Engineering, and Advertising, where each one constitutes a potential field of development and application of the theme. Thus, environmental education plays a cross-cutting and essential role in the approach to green infrastructure by various academic and professional areas. It provides fundamental knowledge about environmental conservation, natural resources, and sustainability, allowing professionals from various fields to understand the importance of its application in their respective disciplines.

Through environmental education, these professionals acquire the necessary foundation to analyze, plan, and implement sustainable solutions, considering aspects such as biodiversity conservation, mitigation of environmental impacts, efficient use of natural resources, and promotion of human well-being. Moreover, environmental education plays a fundamental role in training professionals capable of effectively contributing to the implementation of green infrastructure and the construction of a more sustainable future.

Urbanization in the contemporary world is causing a concentration of people in cities to the point of influencing and compromising the quality of life of these people, and consequently, urban sustainability. Rodrigues et al. (2015) affirm that there was rapid growth of cities in the 20th century and attribute this phenomenon to capitalism. Therefore, the study of ways to promote sustainability within the urban environment is urgent since there is currently great complexity in relation to the growth and maintenance of cities. Urban sustainability is directly linked to the quality of life of the population that inhabits the city, and this quality

varies according to the needs of each environment, having in common the need to meet the needs of its inhabitants. Wu (2010) considers urbanization as a spatial expansion of the built environment promoted by societies and states that this may be the reason for many environmental problems such as biodiversity loss, ecosystem degradation, climate change, and the fragmentation of landscapes from the past.

According to the UN-Habitat's Cities Report 2022, currently, 56% of the world's population lives in urban areas, and this proportion is expected to increase to 68% by 2050, as a result of various demographic, environmental, economic, social, and spatial changes that cities have been facing in recent years. It is estimated that by 2030, there will be 41 megacities with a population of over 10 million inhabitants. In Brazil, according to data from the National Household Sample Survey of 2015, 84.72% of the population lives in urban areas. By 2050, 38.5 million people may be internally displaced as a result of climate change.

It is a fact that the urban population has grown significantly, and consequently, cities will face numerous challenges to meet the needs of their inhabitants. It is of paramount importance that cities are planned, integrating their various natural and built elements, always aiming for the better quality of life of their citizens and the more efficient use of natural resources. Green and permeable areas must be incorporated into the urban context, allowing for the existence of a city with a higher quality of life.

The green spaces of cities, such as urban parks, squares, and tree-lined streets, are examples of green infrastructure that provide environmental services in the urban environment, related to the well-being of the population, environmental balance, protection of water and soil resources, and biodiversity conservation.

In this sense, green infrastructures can ensure multiple functions and benefits in the same space. The functions can be environmental (e.g., biodiversity conservation or adaptation to climate change), social (e.g., water drainage and green spaces), and economic (e.g., job creation and property value appreciation).

The conservation and restoration of natural landscapes, such as forests, wetlands, and floodplains, are essential components of the so-called green infrastructure. When these sensitive areas are protected or implemented, there is an improvement in water quality and wildlife habitat conditions, as well as the generation of recreational opportunities, increasing the quality of life of citizens - the so-called environmental services. Thus, green infrastructure can be an alternative to mitigate urban landscape degradation and provide essential environmental services for the sustainability of cities.

2 OBJECTIVE

The objective of our work is to present reflections on the contribution of environmental education together with the potential of green strategies in urban drainage, focusing on urban green infrastructures, which serve as a contribution to the formulation of public policies for the promotion of the population's quality of life and the better use of natural resources.

To do this, we will discuss the applicability of environmental education and the effects of green strategies and correlate them with the potential of green infrastructure in

environmental, social, and economic benefits, through Strategic Environmental Analysis by applying an Interaction Matrix.

3 METHODOLOGY

For the exception of the research, a survey was conducted in scientific articles in databases such as SciELO, Science Direct, CAPES Periodicals Portal, Google Scholar, books, and websites covering the theme of environmental education from 2017 to 2022. In the search for articles, the terms "environmental education," "urban sustainability," "green infrastructure," and "urban drainage" were used. After the search, a screening was carried out, and the choice was made from those articles that presented the necessary information to compose the research. Environmental education should be seen as a process of continuous learning that values diverse forms of knowledge and forms conscious citizens.

Green infrastructure is a tool that aims to improve human well-being through its environmental, social, and economic values, based on the multifunctional use of ecosystems (VALLECILLO et al., 2018). The term is defined as a combination of vegetation (green) and bodies of water (blue) belonging to networks that associate natural and designed landscape components, such as forest reserves, urban parks, bodies of water, green roofs, and canals (GHOFRANI; SPOSITO; FAGGIAN, 2017). Green infrastructure can help promote compact cities, providing a better quality of life, while its reduction as a result of urban occupation leads to the loss of existing environmental services in the city (ARTMANN; BASTIAN; GRUNEWALD, 2017). This happens because most green infrastructure typologies provide solutions for the prevention and recovery of urban degradation processes, resulting in the provision of various environmental services. For Rossetto (2003), there is a need for integrated action that combines dynamics of social promotion and reduction of impacts in urban environments, given the complexity of existing structures.

Urban sustainability is a theme that permeates attitudes regarding the development of cities, seeking ways to develop without compromising natural spaces and allowing for the construction of urban space to absorb the population and its demands.

Bremer (2004) emphasizes the need to think about urban sustainability from the inclusion and interrelation of various topics, all treated in a systemic way. Acselrad (2009b) clarifies that the main concerns about sustainability in the urban context are expressed through uncertainty about the future, concerning the conditions and quality of the duration of cities.

The infrastructures used in accordance with their scale of application are listed in Table 1, according to IPT (2020) and Comier and Pellegrino (2008):"

Revista Nacional de
Gerenciamento de Cidades
ISSN eletrônico 2318-8472, volume 11, número 84, 2023

Table 1- Types of Green Infrastructures at different scales of application.

Scale	Infrastructure	Concepts
Regional	Urban Green Areas	Set of intra-urban areas with native and introduced tree cover, shrub or creeping contributing to the quality of life and environmental balance in cities.
	Green Corridor	Linear free spaces serving as a connection between fragments and integrating equipment and other areas with important functions for the city.
Local	Linear Parks	Continuous system of green areas along valley bottoms, with objectives of preservation and recovery of the natural environment and natural drainage and retention of water, in addition to configuring a space for public use for leisure and active mobility.
	Rainfall Construction Site	Compacted rain gardens for small spaces assisting in the process of evaporation, evapotranspiration and infiltration.
	Rain Gardens	Existing topographic depressions or re-affected to receive the runoff of rainwater from roofs and other bordering impermeable areas.
	Infiltration Wells	Considered a localized compensatory technique, infiltration wells are vertical reservoirs, of reduced surface area, excavated in the ground in order to receive and infiltrate the waters coming from the surface runoff.
	Ditches and ditches of detention and infiltration	Linear compensatory techniques for the reception and temporary storage of rainwater, which may or may not promote its infiltration into the soil.
	Biovaleta	Linear depressions filled with vegetation, soil and filter elements to promote the filtration of pollutants and water infiltration, and may or may not direct the water to another system such as the rain garden.
Particular	Vertical Garden	All forms of growth and development of vegetation on a vertical surface, can be planted directly in the soil, in gardeners or in other support structures.
	Green Roofs	Structure that can replace the natural area of water infiltration altered by the building, and can be extensive or light (small plants - shallow soil) and intensive systems (large plants - deep soil).
	Cistern	Structure used to collect rainwater for reuse such as human or animal consumption, crop irrigation, cleaning or sanitary purposes.
	Urban Garden	Community or private gardens where crops are grown, ideally without pesticides, in residual spaces, unoccupied areas, facades and green ceilings that can be of different sizes.

Source: Prepared by the authors, 2023.

To assess the effectiveness and impacts of Green Strategies, Strategic Environmental Assessment (SEA) is based on a planning instrument aimed at the assessment of environmental impacts with a strategic vision to support the decision-making process, assisting in environmental integration and the assessment of risks and opportunities of action strategies associated with the formulation of Plans, Programs, and Projects (PPPs) related to sustainable development.

To carry out this assessment, there are various methodologies aimed at collecting, analyzing, evaluating, and presenting information. However, none of these methods are capable, on their own, of fully assessing environmental impacts. Interaction Matrices can have various levels of complexity, where interactions are identified as simple marks or receive a high degree of importance, allowing for a direct assessment of impacts. The most commonly used interaction matrix is known as the Leopold matrix and is one of the most used in socio-environmental studies to identify direct impacts.

To meet the objective of this work, an Interaction Matrix will be elaborated using the Leopold matrix, constructed from the grouping of typologies by the scale of application - regional, local, and specific, based on the potential that these typologies have for

environmental, social, and economic benefits for maintaining the quality of life in cities: environmental benefits and water protection; well-being of the population; economic benefits.

An evaluation scale will be defined and applied to identify the potential of each typology to provide strategic potential, where: (0) means null potential or does not apply; (1) means lower potential, and (2) means higher potential. For this assessment, priority typologies that could meet the needs of managers were considered, seeking to understand the scale of application for real city situations.

The aim is to understand the guiding principles for Green Infrastructure Policies, Plans, and Planning, regarding the characteristics of green infrastructure, as well as the governance process, and also to raise awareness among the population about the benefits of small actions, both locally and individually. We can take action in our homes and bring benefits to everyone!

4 RESULTS

In Table 2, scores from 0 to 2 were assigned according to the level of potential, and the sum will identify which of the green infrastructures have the most strategic potential.

Table 2- Strategic Potential of Green Infrastructure.

Strategic Environmental Potential x Green Infrastructures	**F1 Environmental Benefits and Water Protection**					**F2 Welfare of Human Populations**				**F3 Economic Benefits**		**Total**
	S1. Water Flow Maintenance	S2. Mitigation of Extreme Water Events	S3. Water Quality Improvement	S4. Habitat Maintenance	S5. Maintenance of Genetic Diversity (Gene Flow)	S6. Recreation, Health Physical and Mental	S7. Decreased Social Vulnerability	S8. Reducing the Effect of Heat Islands	S9. Improved Air Quality	S10. Employment and Income Generation	S11. Valorization of space	
Urban Green Areas	2	2	2	2	1	2	1	2	2	2	2	**20**
Green Corridor	2	2	2	2	1	1	1	2	2	2	2	**19**
Linear Parks	2	1	1	1	1	2	2	1	2	2	2	**17**
Rainfall Construction Site	2	1	1	0	0	1	0	1	1	0	1	**8**
Rain Gardens	1	1	1	1	1	0	1	1	1	0	1	**9**
Infiltration Wells	1	1	2	0	0	0	1	1	1	0	1	**8**
Biovaleta	2	1	2	0	0	1	0	1	1	0	1	**9**
Ditches and ditches of detention and infiltration	2	1	1	2	1	1	2	1	1	2	2	**16**

Vertical Garden	2	2	2	2	1	2	2	2	2	2	2	**21**
Green Roofs	2	2	2	1	1	1	2	2	2	1	2	**18**
Cistern	2	2	1	1	1	2	2	1	1	2	2	**17**
Urban Garden	1	1	1	0	1	2	2	1	1	2	1	**13**
TOTAL	**20**	**16**	**17**	**12**	**8**	**13**	**14**	**15**	**16**	**13**	**18**	

Source: Prepared by the authors, 2023.

It is evident that in light of the objectives that environmental education can provide, green infrastructure acts as potentialities in urban sustainability. In light of the above, the green infrastructure options listed above that best match their anticipated potential are as follows: at the regional scale, urban green areas stand out with the highest potential, linear parks at the local scale, and vertical gardens scored the highest for potential as a green strategy.

This is reinforced by what Peck et al. (2007) mention, that the effect of vertical gardens can be greater than that of green roofs, especially in the case of buildings, due to the larger vertical surface area that is usually greater and covers its entire height and not just the roof. Green facades act as insulating cladding capable of reducing the energy required for both heating and cooling indoor spaces (DUNNETT; KINGSBURY, 2004).

Among green infrastructures, the greatest benefits are seen in the maintenance of water flow, which significantly contributes to improvements in urban drainage, as urban drainage control is one of the major problems, causing flooding and inundation.

Several authors, including Cavalheiro and Del Picchia (1992) and Lima et al. (1994), mention various benefits that green areas can bring to urban living, such as air pollution control, surface stabilization through soil fixation by plant roots, rainwater interception in the subsoil, reducing surface runoff, balancing humidity levels in the air, among others.

With urban growth in Brazil, the population is in favor of public investments in urban green areas, as they improve the quality of life for citizens (HILDEBRAND; GRAÇA; HOEFLICH, 2002). It is essential to use public policies for the conservation and creation of urban green areas, such as public squares, parks, tree-lined streets, gardens, conservation units, and more.

A more just society, with equal public policies, quality of life, and quality education for citizens, is easier to manage, and people who are educated and well-treated by their governments respond better to changes in standards. By achieving all of these goals, the concept of urban sustainability can become applicable and successful. The impacts of changes on urban infrastructure require the development of more sustainable technologies capable of mitigating the problem and increasing resilience (MOURA et al., 2016, p.243).

In practice, this means that if included and implemented in the Infrastructure Planning Policies of cities, it will bring individual and collective benefits from a social, environmental, and economic perspective. The aim is to establish management strategies to improve the quality of life.

5 CONCLUSION

One of the biggest problems faced in urban centers is the lack of planning related to the infrastructure aspects that cities should offer to meet the population's demands related to health and well-being. We are at the same time facing opportunities that could help address these challenges related to cities and their development.

Environmental Education plays a crucial role in promoting urban sustainability and the implementation of infrastructure to make cities greener. Urban sustainability seeks to create socially just, economically viable, and environmentally responsible communities and cities.

To achieve this, it is necessary to adopt some practices of Environmental Education that contribute to a greener city, including: 1.Raising awareness and engaging the population in environmental challenges faced in urban areas and the importance of adopting practices. 2.Formal and non-formal education, where schools can incorporate these topics into their curricula, ensuring that future generations are educated about the importance of environmental protection in urban areas. 3. Sustainable urban planning, integrating sustainability principles and green infrastructure into projects, plans, and planning (PPP). 4. Efficient use of natural resources, such as water conservation practices, energy conservation, and waste reduction, which can be built into green infrastructure, such as water capture systems, energy production, and rainwater management projects.

It reflects that green infrastructures have the potential to improve the quality of life and well-being for all, bringing environmental, social, and economic benefits such as mitigating extreme water events, improving water and air quality, maintaining habitat, genetic diversity, and water flow, reducing social vulnerability, generating income and employment, and enhancing space value, as well as using green spaces for recreation, providing physical and mental health benefits. Therefore, Environmental Education plays a crucial role in raising awareness among people about these benefits and encouraging their involvement in creating and maintaining these infrastructures.

The collaborative participation of all stakeholders: businesses, government, academia, and society - is of paramount importance to create opportunities for small businesses in building more Sustainable, Creative, Resilient, and Intelligent cities.

When we look at all the impact that has already been generated, it may seem like an impossible mission to find ways to mitigate the effects or at least reduce flooding problems. It is necessary to rethink the model of cities in which we want to live and, based on this, guide the formulation of public policies committed to more sustainable urban development.

BIBLIOGRAPHIC REFERENCE

ACSELRAD, H. **Watch and unite:** the urban sustainability agenda? (Preface to the second edition). In: ACSELRAD, H. The duration of cities: sustainability and risk in urban policies. 2 ed. Rio de Janeiro: Lamparina, 2009b.

ARTMANN, M.; BASTIAN, O.; GRUNEWALD, K. Using the concepts of green infrastructure and ecosystem services to specify Leitbilder for compact and green cities-the example of the landscape plan of Dresden (Germany). **Sustainability**, v. 9, n. 2, p. 198, 2017.

GENTLEMAN, F.; DEL PICCHIA, P.C.D. Green areas: concepts, objectives and guidelines for planning. **Annals [...]**1st Brazilian Congress on Urban Arborization and 4th National Meeting on Urban Arborization. Vitória, ES, 1992. pp. 29-38.

CORMIER, Nathaniel S.; PELLEGRINO, Paulo Renato Mesquita. Green infrastructure: a landscape strategy for urban water. **Rev. Landscape and Environment**, São Paulo, n.25, pp. 125-142, 2008.

DUNNETT, N. & KINGSBURY, N. **Planting Green Roofs and Living Walls.** Portland: Timber Press, 2004.

GHOFRANI, Z.; SPOSITO, V.; FAGGIAN, R. A comprehensive review of blue-green infrastructure concepts. **International Journal of Environment and Sustainability**, v. 6, n. 1, 2017.

HILDEBRAND, Elizabeth; GRACE, Luis Roberto; HOEFLICH,Vitor Afonso. "Contingent valuation" in the economic evaluation of urban green areas. **Forest,** v. 32, n. 1, 2002.

HURLEY, Joe. Sustainable or Status-quo: investigating sustainability assessment of residential estate development. In**: State of Australian Cities National Conference 2009**. Promaco Conventions, 2009. p. 1-13.

IPT. Institute of Technological Research of the State of São Paulo. **Methodological Guide for the Implementation of Green Infrastructure**. OLERA, Maria Lucia (ed.). Electronic book. São Paulo: IPT, 2020.

JACOBI, Peter. Local Government, Social Policies and Sustainability. **Journal of Health and Society**, 8(1), p. 31-48, 1999. Available at: http://www.scielo.br/pdf/sausoc/v8n1/04 . Accessed 26 Jun. 2023.

MOURA, N. C. B.; PELLEGRINO, P. R. M.; MARTINS, J. R. S. Best management practices as an alternative for flood and urban storm water control in a changing climate. **Journal of Flood Risk Management**, v.9, n.3, p.243-54, 2016.

UNO. 2022. News: **UN-Habitat:** World population will be 68% urban by 2050. Available at: https://brasil.un.org/pt-br/188520-onu-habitat-popula%C3%A7%C3%A3o-mundial-ser%C3%A1-68-urbana-at%C3%A9-2050. Access on: 11 May 2023.

PECK, S.; et al. Greenbacks from Green Roofs: Forging a New Industry in Canadá. In: **Research Highlight** – Technical Series 01-101. Ottawa: Canada Mortgage and Housing Corporation, 2007. Disponível em: acesso em: 7 jan. 2012.

RODRIGUES, Auro Jesus; VIEIRA, Joseph; FONTANA, Rafael Luiz; BARROSO, Rita of Cassia; SILVA, Joseph Adailton. Urbanization in the world and in Brazil under a geographical approach. **Undergraduate Notebook-Human and Social Sciences-UNIT**, v. 3, n. 1, p. 95-106, 2015.

ROSSETTO, Adriana Marques. **Proposal for an integrated Urban Environment Management System (SIGAU) for the sustainable development of cities**. Thesis (PhD in Production Engineering) - Federal University of Santa Catarina (UFSC), Florianópolis, 2003.

SAINTS, M. F. N. dos; ENOKIBARA, M. **Green infrastructure:** concepts, typologies and terminology in Brazil. **Landscape and Environment**, *[S. l.]*, v. 32, n. 47, p. e174804, 2021. doi: 10.11606/issn.2359-5361.paam.2021.174804. Available in: https://www.revistas.usp.br/paam/article/view/174804. Accessed on: 26 Jun. 2023.

VALLECILLO, S. et al. **Spatial alternatives for Green Infrastructure planning across the EU**: An ecosystem servisse perspective. Landscape and Urban Planning, v. 174, p. 41-54, 2018.

WU, Jianguo. **Urban sustainability:** an inevitable goal of landscape research. Landscape ecology. v. 25, n. 1, p. 1-4.