

CHALLENGES AND POTENTIAL OF ENVIRONMENTAL EDUCATION IN THE PMVA: A SOCIAL NETWORK APPROACH

DESAFIOS E POTENCIALIDADES DA EDUCAÇÃO AMBIENTAL NO PMVA: UMA ABORDAGEM POR REDES SOCIAIS

DESAFÍOS Y POTENCIALIDADES DE LA EDUCACIÓN AMBIENTAL EN EL PMVA: UN ENFOQUE DE REDES SOCIALES



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ABSTRACT

Population growth and the advancement of civilization intensify pressure on natural resources, demanding public policies that ensure survival conditions grounded in intergenerational solidarity. In this scenario, environmental education emerges as an essential instrument for the implementation of policies aimed at sustainable development. The Green-Blue Municipality Program (PMVA) acts as a mediator between the municipalities of São Paulo and the State Secretariat for the Environment, promoting actions aimed at improving the quality of life and local and regional sustainability. This proposal analyzes the exchange of information in environmental education through Social Network Analysis (SNA), using the Netdraw® and Ucinet® software to map interactions between municipalities participating in the PMVA. The methodology adopted, of an exploratory and descriptive nature, considers indices and benefits associated with the program, relating them to the UN Sustainable Development Goals (SDGs). The results indicate that the application of SNA in the environmental education sector makes it possible to understand information flows and verify compliance with the program's criteria. Furthermore, it allows the creation of structural indicators capable of assisting municipalities in increasing their scores, as well as strengthening their capacity to plan, execute, and evaluate educational actions in a continuous and integrated manner, involving schools, the community, and public management. The graphical analysis of the networks reveals a significant disparity between the best-evaluated municipalities and those with lower performance, highlighting challenges in the equity of the implementation of environmental policies. Although the PMVA (Green-Blue Municipality Program) represents a relevant public policy for fostering municipal participation in favor of sustainable development, the results demonstrate that there are still necessary advances to fully achieve the proposed objectives.

Keywords: Social Network Analysis. SNA. Information. Environmental Education. Green-Blue Municipality Program.

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RESUMO

O crescimento populacional e o avanço da civilização intensificam a pressão sobre os recursos naturais, exigindo políticas públicas que assegurem condições de sobrevivência fundamentadas na solidariedade intergeracional. Nesse cenário, a educação ambiental emerge como instrumento essencial para a implementação de políticas voltadas ao desenvolvimento sustentável. O Programa Município Verde-Azul (PMVA) configura-se como mediador entre os municípios paulistas e a Secretaria de Estado do Meio Ambiente, promovendo ações que visam à melhoria da qualidade de vida e à sustentabilidade local e regional. A presente proposta analisa a troca de informações em educação ambiental por meio da Análise de Redes Sociais (ARS), utilizando os softwares Netdraw® e Ucinet® para mapear interações entre municípios participantes do PMVA. A metodologia adotada, de caráter exploratório e descritivo, considera índices e benefícios associados ao programa, relacionando-os aos Objetivos de Desenvolvimento Sustentável (ODS) da ONU. Os resultados indicam que a aplicação da ARS no setor de educação ambiental possibilita compreender fluxos de informação e verificar o atendimento aos critérios do programa. Além disso, permite a criação de indicadores estruturais capazes de auxiliar municípios na ampliação de suas pontuações, bem como no fortalecimento da capacidade de planejar, executar e avaliar ações educativas de forma contínua e integrada, envolvendo escolas, comunidade e gestão pública. A análise gráfica das redes evidencia significativa disparidade entre municípios mais bem avaliados e aqueles com desempenho inferior, revelando desafios na equidade da implementação das políticas ambientais. Embora o PMVA represente uma política pública relevante para fomentar a participação municipal em prol do desenvolvimento sustentável, os resultados demonstram que ainda há avanços necessários para alcançar plenamente os objetivos propostos.

Palavras-chave: Análise de Redes Sociais. ARS. Informações. Educação Ambiental. Programa Município Verde-Azul.

RESUMEN

El crecimiento poblacional y el avance de la civilización intensifican la presión sobre los recursos naturales, lo que exige políticas públicas que garanticen condiciones de supervivencia basadas en la solidaridad intergeneracional. En este escenario, la educación ambiental emerge como un instrumento esencial para la implementación de políticas orientadas al desarrollo sostenible. El Programa Municipio Verde-Azul (PMVA) actúa como mediador entre los municipios de São Paulo y la Secretaría de Estado de Medio Ambiente, promoviendo acciones destinadas a mejorar la calidad de vida y la sostenibilidad local y regional. Esta propuesta analiza el intercambio de información en educación ambiental mediante el Análisis de Redes Sociales (ARS), utilizando los software Netdraw® y Ucinet® para mapear las interacciones entre los municipios participantes en el PMVA. La metodología adoptada, de carácter exploratorio y descriptivo, considera los índices y beneficios asociados al programa, relacionándolos con los Objetivos de Desarrollo Sostenible (ODS) de la ONU. Los resultados indican que la aplicación del ARS en el sector de la educación ambiental permite comprender los flujos de información y verificar el cumplimiento de los criterios del programa. Además, permite la creación de indicadores estructurales capaces de ayudar a los municipios a mejorar sus puntuaciones, así como a fortalecer su capacidad para planificar, ejecutar y evaluar acciones educativas de forma continua e integrada, involucrando a las escuelas, la comunidad y la gestión pública. El análisis gráfico de las redes revela una disparidad significativa entre los municipios mejor evaluados y aquellos con menor desempeño, lo que pone de relieve los desafíos en la equidad de la implementación de las políticas ambientales. Si bien el PMVA (Programa Municipio Verde-Azul) representa una política pública relevante para fomentar la participación municipal en favor del desarrollo sostenible, los resultados demuestran que aún se requieren avances para alcanzar plenamente los objetivos propuestos.



Palabras clave: Análisis de Redes Sociales. SNA. Información. Educación Ambiental. Programa Municipio Verde-Azul.

1 INTRODUCTION

The issue of sustainable use of the environment demands urgent attention because it is a necessity for the preservation of life, because "(...) the guarantee of survival, current and future, is expressed by sustainability – which is desired and is the objective to be achieved" (SILVA, 2012, p. 36).

In the face of the advance of civilization and the increase in population, the lifestyle that uses natural resources to satisfy people's needs and interests requires the analysis of public policies so that present and future populations can have conditions for survival, based on the principle of intergenerational solidarity. In this context, for the solution of problems related to the socio-environmental scenario, environmental education is essential as an instrument to promote the implementation of public policies that promote sustainable development (SOUSA et al., 2024).

Considering the context of globalization, it seems quite tempting to establish a global-local binomial and cross the intermediate scales encompassing national states. However, political relations are established on different scales. In addition, still in relation to global scales, the results are punctual, such as rains, tsunamis and hurricanes as a result of global warming (ORSI, 2016 apud UN, 2023).

The notion of environment comprises a special way of seeing, living, and interacting in the world. More than a scientific concept, the environment is a challenge for all researchers, managers and social participants. Its analysis requires interaction and flows that go beyond the reductionism of positivist science (BERTRAND, 2007, p. 302).

"For Smith, Ricardo, Mithus and Mill, "the idea that economies could grow indefinitely was unthinkable because the economy was tied to a finite base of resources". (MURPHY JR, MURPHY, LOVE, LEHEW, MCCALL, 2021, p. 5. Authors' translation)³.

The interrelationship between natural and anthropic spaces must be considered at the local, state, national and global levels, considering the ecological awareness of the universality of the environment on Planet Earth. The concern and global demand for sustainable development require decisions and actions to be developed by the Government, private initiative and civil society, in view of the recognition, on the one hand, of everyone's right to an ecologically balanced environment, and on the other, of everyone's duty on environmental responsibility.

In Brazil, environmental legislation is based on major premises guaranteed in the Federal Constitution of 1988 and complemented by infra-constitutional laws, in addition to

³ "(...) the idea that economies could grow indefinitely was unthinkable because the economy was tied to a finite resource base (Smith, Ricardo, Mithus and Mill, apud (MURPHY JR, MURPHY, LOVE, LEHEW, MCCALL, 2021, p. 5.)

ordinances, resolutions and other regulations in accordance with federal, state and municipal competence.

The Federal Constitution of 1988 establishes, in its article 225, that a balanced environment is a right of all and a collective patrimony, indispensable to the quality of life. This provision imposes on both the State and society the responsibility to ensure its protection and conservation, in order to ensure that present and future generations enjoy this common good (BRASIL, 1988).

The Federal Constitution of 1988 elevated the environment to a fundamental right by providing in its article 225 as a duty and a right of all. On the other hand, it divides the competences for local, regional and national tasks of action in the policy capable of solving environmental problems. In this sense, the phrase defended by environmentalists that it is necessary to "Think globally and act locally" stands out. The effect of the slogan summarizes the importance of defending articulation at different territorial scales, such as municipalities, states and the nation, in political discussion. (ORSI, 2016).

Thus, the Green-Blue Municipality Program (PMVA) emerges as an interlocutor between the Municipality and the State Secretariat for the Environment (SEMA, 2022) to achieve the benefits of sustainable development and the quality of life of the population directly and indirectly achieved.

The PMVA program presents some elements as parameters for measuring the local environmental agenda, involving the themes of Sustainable Municipality, Structure and Environmental Education, Environmental Council, Biodiversity, Water Management, Air Quality, Land Use, Urban Forestation, Treated Sewage and Solid Waste (SEMA, 2022).

The analysis of the adoption of the program and its effects goes through the application of environmental education. Even the social and scientific activities related to the production of senses and meanings would be obedient and conditioned to rationalized and market parameters, and follow the logics of economic and industrial production" (REIGOTA, 507).

The PMVA coordinates efforts between the state and municipal spheres, assisting in the construction of balanced environments, managing negative impacts on everyday spaces. The database generated by the PMVA makes it possible to monitor the environmental performance of the Municipalities in the State of São Paulo and verify the desired development for the country and the quality of life of its people (DANTAS, 2023), in accordance with sustainable development.

Thus, the adhesion of the Municipalities to the Green-Blue Program of the State of São Paulo can help in the implementation of the Verde-Azul Program of the State of São Paulo.

To measure the results, the State of São Paulo developed in 2007, through the Secretariat of the Environment (SMA), the Green-Blue Municipality Program (PMVA), through which it seeks to encourage the Municipalities of São Paulo to adopt a minimum agenda on ten environmental themes, called environmental directives, established as follows: (1) treated sewage (ET); (2) solid waste (RS); (3) biodiversity (Bio); (4) urban afforestation (AU); (5) environmental education (EE); (6) sustainable city (CS); (7) water management (GA); (8) air quality (AQ); (9) environmental structure (EM); and (10) environmental council (CA), assigning scores from 10 to 100 points per item (SMA, 2016).

It is, therefore, a public policy that evaluates the performance of the Municipalities based on the evaluations made through the results obtained in each attribute classified by the Environmental Assessment Index (IAA), whose indicators present a final score that awards the best classified municipalities a certification of the "Green-Blue" seal (SEMA) (SÃO PAULO, 2021).

Those who obtain scores above 80 points will have access to a benefit consisting of a budget amount resulting from the release of resources from the State Pollution Control Fund (FECOP). Thus, the municipality obtains funds to continue investing in projects and public policies for the sustainability of the city (BRASIL, 2018).

In this connection, "the change in the agenda depends on the combination of problems, solutions and political conditions. The existence of a problem does not determine the adoption of a specific solution and does not in itself create a favorable political environment for change" (KINGTON apud CAPELLA, 2006).

A study by ESCOBAR and SIQUETE (2021), researchers at the University of São Paulo (USP) shows that most municipalities in the State of São Paulo are not prepared for climate change.

The survey shows that most of the municipalities in São Paulo have a low capacity to adapt to climate change: approximately two-thirds (66%) are in this condition. Only ten municipalities, corresponding to about 1.5% of the total, achieved a score close to the maximum index, an indicator of greater preparedness to face the impacts resulting from extreme weather events.

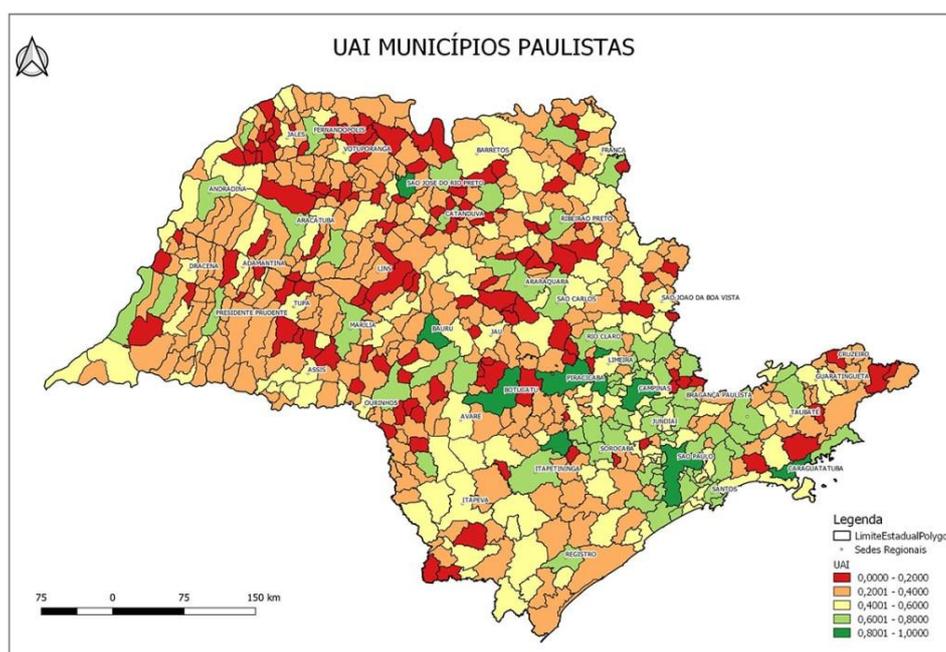
In this context, Pedro Jacobi, coordinator of the thematic project Environmental Governance of the São Paulo Macrometropolis in the face of Climate Change, developed with the support of the São Paulo Research Foundation (Fapesp), points out that the national reality requires greater structuring of local administrations. According to the author, the recurrence of extreme events requires not only investments in technology and infrastructure, but also the strengthening of intersectoral and transversal practices. Such practices should

value society's role in decision-making processes and consider social inequalities and the vulnerability of urban populations (JACOBI, 2021).

Thus, the PMVA emerged with the intention of making efforts between the state and municipal spheres in order to strengthen the environmental agenda according to the competencies and abilities of each entity, given its ability to identify particular problems and needs according to each location. The map in Figure 1 illustrates the result of the research that adds other indices in addition to those ten of the PMVA, as it has 26 indicators related to the environmental theme, highlighting the Urban Adaptation Index (UAI) that was applied to the 645 municipalities of the State of São Paulo, evaluating five central dimensions of public policies: housing, urban mobility, sustainable agriculture, environmental management and responsiveness to climatic events. The scale of the indicator ranges from 0 to 1, with values closer to 1 — graphically represented in dark green — reflecting a higher level of preparedness and resilience of municipalities in the face of socio-environmental challenges.

Figure 1

Map showing the Urban Adaptation Index (UAI) of the 645 municipalities of the State of São Paulo



Source: Neder, E. et al., 2021. "Urban adaptation index: assessing cities' readiness to deal with climate change" (Source: ESCOBAR and SIQUETE, 2021).

The Green-Blue Municipality Program (PMVA) establishes ten guidelines considered fundamental to guide environmental management in the municipalities of São Paulo. These guidelines, defined and updated annually by the State Secretariat for the Environment, are incorporated by the municipalities through the signing of a term of adhesion by the mayors.

In this document, each municipal administration designates a person in charge and an alternate, in charge of preparing an action plan that details the initiatives planned to meet the environmental guidelines. Performance evaluation takes place at the end of each annual cycle, through the Environmental Assessment Index (IAA), which assigns up to 100 points to the actions implemented. To obtain certification, the municipality must achieve at least 80 points, considering the deduction of any environmental liabilities. Municipal entities that reach this level receive not only official recognition, but also priority in accessing financial resources from state programs, such as the State Fund for Water Resources (FEHIDRO) and the State Fund for Pollution Prevention and Control (FECOP) (SECRETARIA DO MEIO AMBIENTE, 2013, p.4).

In this sense, despite the limitations of the program in delimiting the municipal environment, it is denoted that it is irradiated to cover other dimensions, such as financial, social, cultural and educational, which can be used in the evaluation indexes of the directives for the elaboration of other related public policies. (PERES, 2021, p. 121).

The adoption of environmental indicators is an essential requirement for public management, as it allows for an accurate representation of the socio-environmental reality. These instruments should reflect attributes such as completeness, consistency, stability, and relevance to environmental policy priorities. In addition, they need to ensure clarity in communication, efficiency, effectiveness, relevance and measurability, in order to guide decisions and strengthen management processes (REZENDE; DALMÁCIO; SANT'ANNA, p.396).

It is interesting to note that based on the difficulties in implementing the PMVA in several municipalities, other criteria may improve the validation of the classification of the municipalities that are part of the program and reflect a more effective performance regarding their contribution to sustainable development.

An example would be the maintenance or expansion of environmental preservation areas, as shown in the map in FIGURE 2, which illustrates the totality of conservation units in the State of São Paulo. This is because historically the areas of natural environment have been significantly devastated for human occupation, so it would be important to make efforts to recover the green environment and its conservation to the extent possible of each location.

The importance of the PMVA lies in the municipality's potential to build local sustainability and its impact on the environment, as well as its ability to manage the impacts on spaces in order to implement the effectiveness of the environmental management of municipalities on the environment. The result of the evaluation allows the evaluation of

"Art. 225 (...).

Paragraph 1 - To ensure the effectiveness of this right, it is incumbent upon the Public Authority:

(...)

VI – to promote environmental education at all levels of education and public awareness for the preservation of the environment;

(...)"

As environmental education still does not find a practical correspondence at the same level as the importance conferred in the Federal Constitution, as a right, duty and fundamental principle, there is no ideal relationship in the budget agenda of the municipalities, as there is no mandatory minimum value or percentage as occurs with health and education. Thus, investments in environmental programs show a trend of instability and insufficiency (BORJETTI, et. Al., 2018).

"Environmental education is analyzed as an emerging field; which is faced with the hegemonic neoliberal, competitive and productivist conception of science, and, therefore, antagonistic to the ecologist ideology that originated and identifies environmental education" (BARCHI apud REIGOTA, 2012, p. 499).

The difficulty in understanding the need for budgetary investment in public and private environmental policies results in a fluctuation of efforts that aggravates the environmental crisis. Meanwhile, the environmental crisis can amplify the economic and social crisis, whose relationship is not yet felt by all entities. From the correlation between investments and actions, it will be possible to advance in the results (DANTAS; PASSADOR, 2021).

Thus, the intention of the PMVA to promote the decentralization of socio-environmental responsibility through the sharing of a minimum agenda, the level of adherence and the grades assigned demonstrate a lack of planning at the municipal level, which also varies according to different realities in relation to social, cultural, economic and political aspects in municipal management (DANTAS; PASSADOR, 2021).

Thus, the analysis of the PMVA and its results through verification of the results obtained in the grades attributed to the evaluation criteria and the relations between the municipalities and SEMA reveal the possibility of better results and lead to mitigating actions to achieve better environmental classifications and results with the support of environmental education in future evaluations.

The State of São Paulo has 645 municipalities, and all of them are open to join the PMVA. It happens that environmental concern does not always override other economic interests. In addition to the public manager and the private sector, civil society also appears as an important actor in the execution of actions that project a better quality of life related to an ecologically balanced environment.

To understand the theme, it is suggested to observe the use of local tools in the global era. The dynamic connection between local, regional and global explains the network inherent to the new reality of complex society for the search for conflict management and proposals for solutions. Different actors and interests and different powers influence situations and demand national, regional or local policies according to the demands that arise (CASTELLS, 1999).

"Social network analysis (SNA) can provide an x-ray of the internal and external workings of an organization – a powerful means to make visible the invisible patterns of information flow and collaboration in important groups of strategic value actors" (MOLLO; WAKER, 2023, p. 71).

The application of social network analysis (SRA), through qualitative and quantitative analysis of the exchange of information about environmental education, in view of meeting the UN Sustainable Development Goals (SDGs), especially goal 4 (quality education) and goal 11 (sustainable cities and communities), Goal 13 (Action against global climate change), goal 16 (Peace, justice and effective institutions) and goal 17 (Partnerships and means of implementation), seeks to identify the levels of relationships and the results obtained individually and collectively, directly and indirectly, with a view to sustainable development (UN, 2023).

According to Hanneman (2001), there are no right or wrong ways or indicators in the approach to social networks, and a set of analytical tools should be selected for each case according to the objective of the analysis and the dynamics of the intended network (FERREIRA, 2011, p. 220).

The parameter used in the unidirectional relationships identifies the higher or lower frequency and the proximity to the guidance of the Secretariat of the Environment (SMA) for the score assigned to each evaluation criterion.

"The importance of a node in a given network is measured by the centrality of its eigenvector, which also gives weight to other nodes. The centrality of the eigenvector measures the influence of a node in a given network" (AZAD; DEVI, 2020, p. 3).

The existence of common objectives is responsible for the alignment and direction of the actors of a network, but collective strategies will hardly bring substantial gains if an intense process of connectivity between them is carried out. Therefore, understanding the relationship process between the actors is crucial to understand its dynamics and to obtain efficiency in its operational results (MOLLO, WAKER, p. 74).

This research is justified based on the need to solve the problem related to the effects of human intervention on the environment and the need to meet the UN sustainable development goals.

As a general objective of the research, it is intended to demonstrate how the networks of exchange of environmental education information regarding the adequacy of the Green-Blue Municipality Program of the State of São Paulo can benefit the Municipalities and promote sustainable development.

The present work specifically aims to:

- Explore and seek understanding of the rules for joining the Green and Blue Municipality Program of the State of São Paulo and its benefits;
- To carry out a quantitative and descriptive analysis of the participation of some of the municipalities of São Paulo in the PMVA with the use of ARS;
- Identify the network of relationships for the exchange of information between the entities and the Green and Blue Municipality Program that allow the evaluation of education actions and reduction of environmental impact;
- Verify the relationship between the implementation of the program and sustainable development, especially regarding the improvement of the quality of life of the population directly achieved.

2 METHODOLOGY

This study presents a quantitative and descriptive analysis of the participation of São Paulo municipalities in the PMVA, an exclusive program of the State of São Paulo. Considering that there are 645 Municipalities and not all of them are participants in the program, and that there is an annual evaluation, initially, a cut was made of the first five classified, the five intermediate, and the last five classified in the year 2021, for a comparison between the grades assigned and the distance between the entities in relation to the criteria by environmental directive verified by SEMA (SÃO PAULO, 2021).

Based on the verification of the participation and performance of the best-evaluated, intermediate, and worst-evaluated municipalities, the Environmental Assessment Index – IAA collected on the SMA website in the 2021 ranking, is intended to demonstrate the correlation between the environmental, economic, and social spheres in each agent for the pursuit of sustainable development.

"It is important to emphasize that for this specific case not all actors in the organizational structure (...) are necessary" (MOLLO NETO, WAKER, p. 74).

The study will use the method of Social Network Analysis (SNA) as a paradigm for research on social structure. "Structure is concretely apprehended as a network of relationships and limitations that weighs on the choices, orientations, behaviors, opinions of individuals" (MARTELETO, 2001, p. 72, apud FERREIRA, 2011, p. 214).

"To summarize, we can affirm that the ARS maps and investigates the relationship patterns of social actors based on their interactions and seeks to identify, through indicators, the effects of these interactions on the actors themselves and on the organizations in which they are inserted" (FERREIRA, 2011, p. 215).

The research will use a qualitative and quantitative approach, following an exploratory and descriptive character, analyzing the criteria for adherence to the program, the results obtained and a network map using a .vna text file and the NETDRAW® and UCINET® software for social network analysis with a focus on the effects of environmental education reach. The use of the tool allows us to conclude that the software can be an indicator of the performance of the municipalities participating in the PMVA and the generation of eventual metrics (indicators) for other proposals that allow for better results.

The methodology used is based on a state program, but emphasizes the importance of research and other programs that study the attributes and relationships between the entities of the Government and society as a whole for the incessant search for ecosystem balance.

3 RESULTS

The VerdeAzul Municipality Program (PMVA), created by the Government of the State of São Paulo, is a public policy aimed at encouraging and evaluating environmental management in the municipalities of São Paulo.

Adherence to the program occurs through the official indication of an interlocutor and an alternate with the Secretariat of Environment, Infrastructure and Logistics (SEMIL), formalized by letter. Once integrated, the municipalities are evaluated annually based on ten environmental directives: treated sewage, solid waste, biodiversity, environmental education, urban forestation, water management, air quality, environmental structure, environmental council and territorial planning. Each directive has technical criteria that allow for the objective measurement of municipal performance. The final score is assigned according to the fulfillment of the planned actions, and municipalities that reach 80 points or more receive the VerdeAzul Municipality Certificate, which guarantees priority in access to state resources for environmental projects.

The benefits of the program are manifested in different dimensions. From an environmental point of view, there is a reduction in water and air pollution, greater efficiency in solid waste management and biodiversity conservation. Socially, the PMVA promotes healthier urban environments, strengthens ecological awareness through environmental education and encourages community participation in environmental councils. Economically, certified municipalities have privileged access to state financing and transfers, in addition to reducing public costs related to health and sanitation by implementing sustainable practices. Scientifically, the program stands out for adopting a management logic based on environmental indicators, similar to international methodologies of urban sustainability, allowing comparability between municipalities, objective measurement of results and stimulation of continuous improvement.

In this way, the PMVA not only fosters local environmental policies, but also creates a governance system that integrates science, society, and economics in favor of sustainability.

The implementation of the VerdeAzul Municipality Program (PMVA) is directly related to the concept of sustainable development, as it articulates environmental, social and economic dimensions in local public policies. By requiring municipalities to meet goals related to sanitation, solid waste, biodiversity, afforestation and environmental education, the program promotes practices that reduce environmental impacts and ensure the conservation of natural resources. This strengthens ecological sustainability, ensuring that the use of current resources does not compromise future generations.

From a social point of view, the PMVA contributes to improving the quality of life of the population by encouraging cleaner, healthier and more organized urban environments. The expansion of urban forestation, for example, reduces heat islands and improves thermal comfort; Proper waste management reduces risks to public health; and environmental education expands collective awareness about sustainable practices. These factors translate into direct benefits for citizens, such as a lower incidence of pollution-related diseases and greater well-being in urban spaces.

In the economic aspect, the program generates financial and institutional incentives by rewarding municipalities that achieve high levels of environmental performance with priority in access to state resources. This creates a virtuous cycle: the more the municipality invests in sustainability, the more benefits it receives to expand its actions. In scientific terms, the PMVA applies a management logic based on indicators, allowing objective measurement of advances and stimulating continuous improvement, which is in line with international practices for assessing urban sustainability.

Thus, it can be said that the PMVA works as an instrument of environmental governance that integrates science, politics and society. It not only fosters environmental preservation, but also promotes social justice and economic efficiency, which are central elements of sustainable development. Ultimately, the directly reached population experiences concrete gains in health, well-being and citizen participation, consolidating the idea that sustainability is also synonymous with quality of life.

Taking into account the Environmental Ranking of São Paulo Municipalities – 2021 Cycle (São Paulo, 2021), some actors have several prominent roles, which are the cases of the five best-ranked municipalities, Bragança Paulista (1st), Penápolis (2nd), São Pedro do Turvo (3rd), Guararema (4th) and Lençóis Paulista (5th). As there were 577 participating municipalities, the intermediate classified are around position 289 to 293. Thus, the cut of the intermediate municipalities of the classification points to: Gália (289th), Ipeúna (290th), Itaberá (291st), Mirandópolis (292nd) and Piquete (293rd). Other actors have less prominence in the network under evaluation and greater distance from the attributes, which is the case of the worst ranked municipalities, Irapuru (573rd), Santa Cruz da Esperança (574th), Zacarias (575th), Arco-Íris (576th) and Ribeira (577th).

The classification considers the final score obtained in the ranking: Bragança Paulista (97.52), Penápolis (96.89), São Pedro do Turvo (95.77), Guararema (94.63), Lençóis Paulista (93.85), Gália (55.00), Ipeúna (54.80), Itaberá (54.60), Mirandópolis (54.40), Piquete (54.20), Irapuru (10.00), Santa Cruz da Esperança (10.00), Zacarias (10.00), Arco-Íris (10.00) and Ribeira (10.00).

The top municipalities scored practically the highest in all directives, with small variations in the "Air Quality" directive, which has more specific technical criteria.

The municipalities with intermediate evaluation have a medium and balanced score, indicating actions in all areas, but with less depth or scope.

The reason why the five worst-ranked municipalities in the 2021 cycle of the Green-Blue Municipality Program (PMVA) received exactly 10.00 points is related to the minimum evaluation model adopted by the Secretariat of Infrastructure and Environment (SEMA), as they did not present valid documentation or minimum actions in any directive.

Table 1 presents a comparative PMVA 2021 – of the Scores by Environmental Directive analyzed.

Table 1

Scores by Environmental Directive obtained by the municipalities in the Environmental Ranking of the Municipalities of São Paulo – 2021 Cycle

Município	Esgoto	Resíduos	Biodiversidade	Arborização	Educação	Sustentável	Águas	Ar	Estrutura	Conselho	Total IAA
Bragança Paulista	10,00	10,00	10,00	10,00	10,00	10,00	10,00	7,52	10,00	10,00	97,52
Penápolis	10,00	10,00	10,00	10,00	10,00	10,00	10,00	6,89	10,00	10,00	96,89
São Pedro do Turvo	10,00	10,00	10,00	10,00	10,00	10,00	10,00	5,77	10,00	10,00	95,77
Guararema	10,00	10,00	10,00	10,00	10,00	10,00	10,00	4,63	10,00	10,00	94,63
Lençóis Paulista	10,00	10,00	10,00	10,00	10,00	10,00	10,00	3,85	10,00	10,00	93,85
Gália	6,00	6,00	6,00	6,00	6,00	6,00	6,00	3,00	5,00	5,00	55
Ipeúna	6,00	6,00	6,00	6,00	6,00	6,00	6,00	2,80	5,00	5,00	54,8
Itaberá	6,00	6,00	6,00	6,00	6,00	6,00	6,00	2,60	5,00	5,00	54,6
Mirandópolis	6,00	6,00	6,00	6,00	6,00	6,00	6,00	2,40	5,00	5,00	54,4
Piquete	6,00	6,00	6,00	6,00	6,00	6,00	6,00	2,20	5,00	5,00	54,2
Irapuru	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	10,00
Santa Cruz da Esperança	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	10,00
Zacarias	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	10,00
Arco-Íris	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	10,00
Ribeira	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	10,00

Source: Adapted by the authors of Environmental Ranking of São Paulo Municipalities – 2021 Cycle (São Paulo, 2021)

Thus, based on the studies and data previously described, it was possible to build, with the help of a text file in .vna format standard input of the NETDRAW® software, the network that comprises the municipalities that participate in the PMVA, considering the indicators related to the environmental theme as being the weights of the relationships between the actors of the network.

In Figure 3 we have a cutout of the .vna file produced and its structure. The complete original archive has a total of 182 rows of data.

Figure 3

Clipping of the .vna file produced for data entry in the NETDRAW software

```

Arquivo  Editar  Exibir  H1  B  I  G  ...
*NODE DATA
MUNICIPIO      COR
Braganca_Paulista  Vermelho
Penapolis      Vermelho
Sao_Pedro_do_Turvo  Vermelho
Guararema     Vermelho
Lencois_Paulista  Vermelho
Galia  Vermelho
Ipeuna  Vermelho
Itabera  Vermelho
Mirandopolis  Vermelho
Piquete  Vermelho
Irapuru  Vermelho
Santa_Cruz_da_Esperanca  Vermelho
Zacarias     Vermelho
Arco_Iris    Vermelho
Ribeira  Vermelho
Esgoto  Verde
Residuos     Verde
Biodiversidade  Verde
Arborizacao  Verde
Educacao     Verde
Sustentavel  Verde
Aguas  Verde
Ar  Verde
Estrutura    Verde
Conselho     Verde
LEGENDA Branco
MUNICIPIO      Vermelho
DIRETIVA_AMBIENTAL  Verde

*TIE DATA
FROM  TO  RELATION
Braganca_Paulista  Esgoto  10,00
Braganca_Paulista  Residuos  10,00
Braganca_Paulista  Biodiversidade  10,00
Braganca_Paulista  Arborizacao  10,00
Braganca_Paulista  Educacao  10,00
Braganca_Paulista  Sustentavel  10,00
Braganca_Paulista  Aguas  10,00
Braganca_Paulista  Ar  7,52
Braganca_Paulista  Estrutura  10,00
Braganca_Paulista  Conselho  10,00
Penapolis  Esgoto  10,00

Penapolis  Residuos  10,00
Penapolis  Biodiversidade  10,00
Penapolis  Arborizacao  10,00
Ln 162, Col 24 | 4.511 caracteres | Texto sem formatz | 100% | Windows (CRLF) | UTF-8

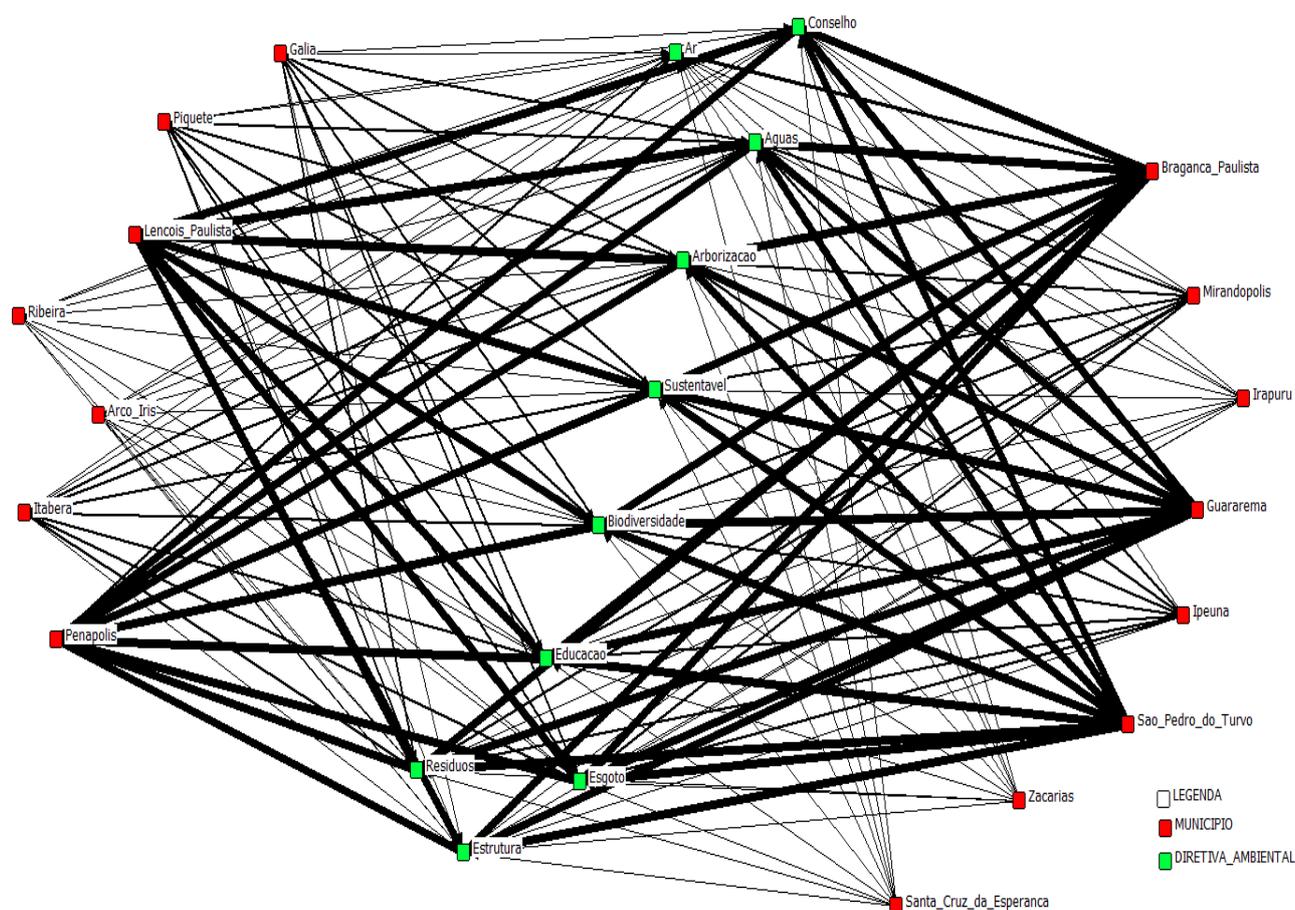
```

Source: Authors.

Figure 4 presents the graph built in the NETDRAW® software, based on the .vna file presented in Figure 3, presenting the actors (Municipalities of the highlight made), and their relationships with the Program, considering their attributes (Environmental Directive) as weights of relationships or connection ties.

Figure 4

Graph showing the Municipalities and their relations with the environmental directives of the PMVA program



Source: Authors.

In the graph of Figure 4, which has a total of 25 actors and 150 connecting ties, we can observe that the environmental directives are located in the center, in green, and to the right and left of the directives, the municipalities are observed, in red. The lines that connect each of the directives to the corresponding municipalities correspond to the grade assigned to each directive (weight). The finer lines are relative to the lowest scores obtained by the municipalities (lower weight) and the thicker ones are representative of the highest scores attributed to the municipalities with the best performance (higher weight). The intermediate size lines for the cases of the municipalities of the intermediate extract collected for the analysis can be visualized. The graph also allows us to infer that there is a large discrepancy between the municipalities with the highest score versus those with the lowest score. This points to a network that has a lot of potential to be improved, through improved compliance with the environmental directives of the Program by the municipalities.

The smaller number of ties of greater weight connected to the "Ar" directive is noteworthy, since the scores of the municipalities for this directive did not reach, for any of

the municipalities participating in the Program, a score higher than 7.52. The cut made with the 15 municipalities chosen for the analysis allows a more comfortable viewing, because, if we applied the study to the 577 municipalities enrolled in the Program, it would not be possible to visualize the differences in the ties to connect with the guidelines due to the high density.

The execution of the same .vna file in the URINETT® software allowed the determination of structural indicators of this network. Considering the weights of the grades, it was possible to construct the table of centralities of the municipalities (Degrees of exit) and directives (Degrees of entry). Table 2 presents these centralities.

Table 2

Output and input centralities calculated in the UTINET.®

ATOR DA REDE	CENTRALIDADE DE SAÍDA	ATOR DA REDE	CENTRALIDADE DE ENTRADA
Bragança Paulista	97	Esgoto	85
Penápolis	96	Resíduos	85
São Pedro do Turvo	95	Biodiversidade	85
Guararema	94	Arborização	85
Lençóis Paulista	93	Educação	85
Gália	55	Sustentável	85
Ipeúna	54	Águas	85
Itaberá	54	Ar	41
Mirandópolis	54	Estrutura	80
Piquete	54	Conselho	80
Irapuru	10	-	-
Santa Cruz da Esperança	10	-	-
Zacarias	10	-	-
Arco-Íris	10	-	-
Ribeira	10	-	-

Source: Authors.

4 DISCUSSION

In Table 1, the values presented in the column referring to the exit centralities are relative to the sums of points awarded by the program to each of the municipalities and, in the column referring to the entry centralities, we have the sum of the scores that all the municipalities end up forwarding to each of the guidelines.

In this column we can see that the guidelines for Sewage, Waste, Biodiversity, Afforestation, Education, Sustainable and Water, which are parameters or themes of measurement of the local environmental agenda, can bring benefits to the population directly involved, and these municipalities are those that, for having obtained scores above 80, will have access to a benefit consisting of a budget value resulting from the release of resources from the State Pollution Control Fund (FECOP), Funds that will allow them to continue investing in projects and public policies for the sustainability of the respective cities. It is the

municipalities that accumulate the highest values of 85 points, that is, these guidelines are the most met by the selected actors, which indicates that there are more robust environmental agendas.

Those that obtained scores lower than 80 are municipalities in São Paulo that have low adaptability, and should continue to seek to improve their indicators to win funds for greater investments in order to increase the municipality's potential to build local sustainability and its impact on the environment, as well as its ability to manage impacts on spaces in order to implement the effectiveness of environmental management of the municipalities in the environment. Corroborating the information of Borjetti, et. al. (2018) that they will continue to show a trend of instability and insufficiency.

Observing in isolation the centralities of entry referring to the Guidelines, we can highlight that the municipalities have the greatest difficulties in meeting the "Structure" and "Council", which reach 80 points, which still require more efforts to exceed this limit and ensure a better placement in the Program.

In the case of the "Air" guideline, there is a major problem, which has already been mentioned earlier, the municipalities at the top scored practically the maximum in all directives, with small variations in the "Air Quality" directive, which has more specific technical criteria, which is not fully met by the municipalities with intermediate evaluation, which have a median and balanced score, indicating actions carried out in all areas, but with less depth or scope. In this regard, the possibility of seeking greater maturity in the service is highlighted: the depth and scope of the actions will lead to an increase in the scores for the next evaluations of the Program. Municipalities classified in the 2021 cycle of the Green-Blue Municipality Program (PMVA) as intermediate were penalized for not presenting complete documentation or for not having carried out actions to fully comply with this directive. In the cases of the five worst-ranked municipalities in the 2021 cycle of the Green-Blue Municipality Program (PMVA), it is observed that they were penalized for not presenting valid documentation or for not having carried out minimum actions in this directive.

In this way, it can be said that there is still a lot of room for improvement, and it is possible to expand the environmental performance of the Municipalities in the State of São Paulo and thus seek the desired development, contributing to the country and the quality of life of its people, as pointed out in his work by researcher Dantas (2023), in accordance with the sustainable development goals highlighted in this work. For these municipalities that did not reach 80 points, the change in the agenda depends on the combination of problems, solutions and political conditions that they need to manipulate so that they take a new leap towards higher scores. This can be done through the adoption of a set of specific solutions

that contribute to the creation of a favorable political environment for change, as indicated by Kington apud Capella (2006).

With regard to environmental education as an instrument to promote the implementation of public policies that promote sustainable development, municipalities should expand the search to ensure that the municipalities of São Paulo, which have not yet reached 80 points, promote continuous and structured actions of awareness, training and participation of society in the environmental agenda, integrating schools, communities and local public policies. In other words, it is not just about one-off activities, but about a municipal policy that strengthens ecological awareness and social engagement for sustainability with greater robustness of environmental education.

As in the PMVA it uses indicators to measure the efficiency of municipal actions, in the Environmental Education guideline, municipalities are evaluated by:

- Existence of permanent environmental education programs.
- Carrying out campaigns and projects aimed at the community (e.g., selective collection, community gardens, preservation of springs).
- Training of teachers and public servants on environmental issues.
- Creation of municipal councils or committees for environmental education.
- Production of educational materials and reports that demonstrate results.

With this in mind, actions are expected aimed at expanding efforts for the development of environmental education projects in municipal schools, such as science fairs and recycling programs, partnerships with universities and NGOs for training and applied research, public campaigns on conscious consumption, water and energy saving, community events (cleaning efforts, tree planting, composting workshops) and new municipal environmental education plans with clear goals and indicators.

This is of great strategic importance, as it promotes the decentralization of the environmental agenda: each municipality takes a leading role in the formation of conscious citizens. Expands long-term sustainability: by educating, a solid basis is created for lasting environmental policies and brings regional integration: where municipalities certified by the PMVA become a reference and strengthen cooperation networks.

The research carried out with the application of the method of analysis of social networks in the environmental education sector allowed us to understand that it is possible to achieve the proposed objectives of verifying the exchange of information and meeting the criteria of the program for the achievement of sustainable development, allowing the creation of structural indicators of the network that can help the municipalities interested in increasing

their scores in the program, to increase their maturity in the ability to plan, execute and evaluate environmental educational actions in a continuous and integrated way, involving schools, the community and public management.

5 CONCLUSION

The diagramming of the network of municipalities in the State of São Paulo graphically demonstrates that there is a very large disparity between the best evaluated municipalities and those worst in the evaluation. Although the PMVA is a public policy designed according to the purpose of encouraging the participation of Municipalities to contribute with their local participation to the global result of sustainable development, there is still much to be done to achieve the expected result. Through the research, the study of the networks applied to the theme of the PMVA demonstrates the dynamics implemented in the State of São Paulo between its Municipalities and the public policies adopted by each of them, as well as the results obtained. However, the absence of a minimum percentage of budget, especially with municipalities that did not reach 80 points, can lead to fluctuation of actions and investments, requiring constant monitoring to verify the maintenance of the structures developed in relation to the preservation of the environment.

The work presents academic contributions of knowledge and analysis of management and public policies on the PMVA and its potential results of environmental preservation and achievement of sustainable development. The results and their variations demonstrate the need to evaluate the possibility of distributing a minimum percentage resulting from the release of resources from the State Pollution Control Fund (FECOP), to municipalities that have low adaptation capacity, with greater difficulties in making investments according to the Municipality's budget, and, even more, the importance of dialogue between agents for the conciliation of agendas in favor of the common good of sustainable development.

The WASP, when analyzed from the perspective of the SDGs, addresses the growing pressure on natural resources and the need for public policies based on intergenerational solidarity. In this context, environmental education is highlighted as an essential instrument for the implementation of policies aimed at sustainable development, which is directly connected to SDG 4 (Quality Education). The VerdeAzul Municipality Program (PMVA), by mediating actions between municipalities in São Paulo and the State Secretariat for the Environment, contributes to local and regional sustainability, aligning with SDG 11 (Sustainable cities and communities) and SDG 13 (Action against global climate change), especially by emphasizing practices that strengthen resilience in the face of extreme events.

The use of Social Network Analysis (SNA) to map interactions between municipalities highlights the importance of cooperation and the exchange of information, which is related to SDG 17 (Partnerships and means of implementation). In addition, by strengthening the institutional capacity to plan, execute and evaluate educational actions in a continuous and integrated manner, the program contributes to SDG 16 (Peace, justice and effective institutions), as it promotes environmental governance and social participation. The results that point to disparities between municipalities with better evaluations and those with lower performance reveal challenges related to equity in the implementation of environmental policies, reinforcing the need to move forward so that the objectives are fully achieved.

For this, it is concluded that the phrase of Baldassarini and Nunes (2016), "The dichotomous view between society and nature no longer exists, and the human being must be considered as part of nature. The environment is the whole that encompasses nature and each social entity, in an inseparable symbiosis, which requires a punctual action of each entity to achieve the common good of sustainable development", is very important and success lies in the good punctual actions carried out based on solid environmental education.

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