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Application of a Methodology for Modeling the Influence of Environmental Factors on the Work of the Public Sector in the Context of Sustainable Development

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ABSTRACT

In recent decades, increased awareness of environmental issues has led to significant attention to sustainable development, especially in the public sector, where the need for a balanced combination of economic growth, social justice and environmental protection has become increasingly apparent. The main purpose of the article is to present a methodical approach to assessing the impact of environmental factors on the public sector in the context of sustainable development. The object of research is the sustainable development of the public administration system. The scientific task is to evaluate the environmental factors in such a way as to reveal the most significant in the action of the sustainable development of the public sector. The proposed approach to modelling the influence of environmental factors on the work of the sustainable development of the public sector is based on the method of multicriteria selection of alternatives based on a fuzzy advantage ratio. The multi-criteria alternative selection method relies on a comprehensive assessment of various factors to ensure an objective selection of strategies, while the fuzzy balance of advantages reduces the impact of ambiguity and uncertainty, providing more accurate and reliable analysis results. As a result of the conducted research, an approach to the assessment of environmental factors on the activity of the public sector was presented. By applying the method of multi-criteria selection of alternatives on the basis of a fuzzy ratio of advantages, the modelling of factors for the public sector in the context of sustainable development was carried out, which contributed to the creation of the necessary informational basis for improving their activities. One limitation of this study is the lack of analysis of the health and environmental impacts of agrochemicals, changes in biodiversity due to anthropogenic activities, and the socioeconomic impacts of environmental changes on communities. Future research will carefully analyze these factors to provide a more complete picture of the environmental challenges facing the public sector in the context of sustainable development.

1. INTRODUCTION

Today, the public day plays a key role in accelerating and optimizing sustainable development. In times of increasing levels of environmental challenges and threats, both at the global level and at the level of an individual state, a separate important task is to understand how certain environmental factors affect the work of public authorities and how their activities can be optimized in accordance with modern ones. environmental trends.

Thus, understanding the direct and indirect relationships between the activities of the public sector and environmental factors will allow us to fully formulate an effective strategy and policy for public activities, aimed not only at achieving the efficiency of the economic and other systems, but also at achieving sustainable development goals. In developed countries, where similar policies are already in place, their measures are aimed at reducing the negative impact on the environment, supporting the rational use of natural resources and stimulating innovation related to environmentally friendly production.

A separate important area in this matter is the coordination of the activities of the public sector with the activities of international organizations, as well as the formation of interstate agreements. This is due to the fact that a large number of environmental problems and challenges are often

transnational in nature and require the implementation of cooperative activities of several states. Thus, in this context, it is important to promote the implementation of environmental international agreements and cooperation, as well as proactive participation in solving global environmental issues. By concentrating its activities at this level, the public sector will automatically solve some of the environmental problems and challenges at the national and regional levels, stimulating the pace of sustainable development.

Considering the practice of countries around the world, we can say that a significant part is already actively adapting modern strategies and methods of work of the public sector in the direction of optimizing environmental factors and stimulating sustainable development. This activity concerns the formation and implementation of policies for reducing emissions, developing renewable energy sources, rational management of natural resources and minimizing negative anthropogenic impacts. In addition, an important direction of the public sector in this matter is the promotion of social justice and economic sustainability through the formation of local communities and the creation of so-called “green” jobs.

In conclusion, environmental factors significantly influence the work of the public sector today, driven by legislative mandates, investment priorities, emergency management needs, public opinion, and the global nature of environmental challenges. The integration of environmental considerations into public sector operations is not only relevant but essential for promoting sustainable development, ensuring public well-being, and addressing the pressing environmental challenges of our time. This approach demonstrates a commitment to stewardship of the planet that will benefit current and future generations.

The main purpose of the article is to present a methodical approach to assessing the impact of environmental factors on the public sector in the context of sustainable development. The object of research is the sustainable development of the public administration system.

The structure of the article consists of a literature review, methodology, presentation of results, discussion and conclusions.

2. LITERATURE REVIEW

2.1 Interaction between environmental factors and the public sector

The intersection of environmental factors and the public sector in the context of sustainable development has garnered significant attention within academic and professional circles, as evidenced by a diverse range of studies focusing on the institutional pressures, environmental strategies, environmental governance, and the role of knowledge and policy in shaping sustainable outcomes. This chapter reviews pertinent literature that informs the methodology for modelling the influence of environmental factors on the work of the public sector, drawing on recent empirical and theoretical research. Li and Ji [1] provide a foundational understanding of how institutional pressures and environmental strategies correlate with corporate environmental performance. Their empirical analysis highlights the direct and mediated effects these factors have on improving sustainability within organizations, offering insights into the broader implications for public sector entities seeking to enhance their environmental governance. In a similar vein, Fuzi et al. [2] delve into the relationship between environmental costs, organizational performance, and the implementation of environmental management systems. Through structural equation modelling, their study elucidates the positive impacts that proactive environmental management can have on organizational efficacy, suggesting a pathway for public sector organizations to integrate environmental considerations into their operational frameworks.

2.2 The development of modern environmental governance in the context sustainable development

The question of whether environmental governance is substantive or symbolic is critically examined by Rodrigue et al. [3]. Their empirical investigation into corporate practices reveals a complex landscape where governance mechanisms can vary widely in their effectiveness and sincerity, offering a cautionary perspective that is relevant to public sector efforts in environmental governance. O’byrne et al. [4] and Alinski's [5] researches highlight the importance of the public sector in driving sustainable development, particularly through the integration of sustainability principles into strategic planning and operations. The authors identify how government agencies can promote environmental sustainability, economic development, and social justice, making this study relevant to my analysis of the impact of environmental factors on public sector performance. These findings provide a basis for assessing and developing effective public sector management strategies to meet the challenges of sustainable development and help formulate specific recommendations for improving environmental responsibility and sustainable management. Kryshtanovych et al. [6] addressed the socio-ecological effects of public management in green development, presenting a philosophical and practical framework for understanding the ecological impacts of public sector actions. Their analysis points to the significance of adopting a holistic approach to environmental management, aligning with the principles of modern ecology to enhance sustainable development outcomes.

Khaled et al. [7] examined the relationship between sustainability goals and corporate sustainability, exploring how companies integrate sustainability goals into their operations and how this impacts sustainability performance. This analysis is important to my research because it provides insights into the mechanisms for implementing sustainability at the corporate level and helps identify how the public sector can facilitate or regulate this process to achieve broader environmental goals.

Further contributions by Singh et al. [8], Vagiona [9] and Paiders [10], they expand the discourse on sustainable development, environmental sustainability indices, and the financial implications of environmental protection for regional economic development. These studies collectively highlight the multifaceted relationships between environmental performance, sustainable development goals, and economic and social indices, providing a comprehensive backdrop for understanding the environmental dimensions of public sector work [8-10]. Muafi [11], Singh et al. [12], and Ovchynnykova et al. [13] offer insights into the roles of green culture, strategy, and the impact of environmental regulation implementation. By examining the moderating effects of green intellectual capital and the outcomes of environmental regulation, these studies contribute to a nuanced understanding of how green

initiatives and regulations influence public sector operations and sustainability efforts [11-13].

In summary, the reviewed literature presents a diverse and complex picture of how environmental factors influence the public sector. From institutional pressures and environmental strategies to governance, knowledge, policy, and legal frameworks, these studies provide a rich tapestry of insights and empirical evidence that inform the development of methodologies for modelling environmental influences on public sector work. This body of work not only highlights the challenges faced but also points to the opportunities for integrating environmental considerations into the fabric of public sector operations, ultimately contributing to more sustainable and effective governance.

The scientific task is to evaluate the environmental factors in such a way as to reveal the most significant in the action of the sustainable development of the public sector.

3. METHODOLOGY

The method of multicriteria selection of alternatives based on a fuzzy ratio of advantages is an innovative method that is based on the principles of fuzzy logic and is implemented by multicriteria decision-making (MCDM) methods. This method is useful in situations where the inputs are multi-component decision-making scenarios in which the set of criteria is numerous, subjective or contradictory to each other. This description is typical for the process of assessing the impact of environmental factors on the activities of the public sector in the context of sustainable development.

The benefits of this method are its ability to address the challenges of ambiguity and uncertainty that are inherent in environmental factors and public sector decision-making processes, given that the approach is based on the concept of "fuzzy sets" to represent uncertain or imprecise information. Unlike traditional binary logic where variables may only take on true or false values, fuzzy logic permits a continuum of possible values between 0 and 1, representing the degree of truth. In the context of evaluating environmental impacts on the public sector, this means that the significance of factors such as air quality, water availability, or biodiversity loss can be expressed in terms of fuzzy numbers that reflect their relative importance and uncertainty. This flexibility is crucial for capturing the nuanced impacts of environmental factors on public sector activities.

The method proceeds by establishing a set of criteria (environmental factors in this case) and alternatives (public sector responses or strategies) and then assessing the performance of each alternative against each criterion using fuzzy numbers. The "fuzzy advantage ratio" is then calculated for each alternative, which involves determining the degree to which one alternative is preferable to another across all criteria, taking into account the fuzziness of the data. This is achieved through a series of mathematical operations that aggregate the fuzzy values, ultimately yielding a ranking of alternatives based on their overall advantage or suitability in addressing the environmental factors under consideration. This modeling approach is particularly relevant and appropriate in today's context where environmental challenges present complex and uncertain impacts on public sector operations. It offers a systematic and flexible framework for decision-making that can accommodate the inherent uncertainties of environmental factors, allowing public sector managers to make more informed, nuanced, and resilient decisions. By employing the fuzzy advantage ratio method, public sector entities can better assess the multifaceted influences of environmental factors on their work and identify strategies that are not only effective but also adaptable to changing environmental conditions. This approach underscores the growing importance of incorporating advanced decision-making tools in public sector planning and management, particularly in the face of global environmental challenges in the context of sustainable development.

The principle of this method is to define and analyze several criteria simultaneously in order to find the most suitable alternative or to rank alternatives according to their degree of attractiveness. In the first stage, evaluation criteria and alternatives that should be compared are determined. Next, data is collected and analyzed for each criterion for each alternative. An important step is to assign weights to the criteria that reflect their importance in the decision-making context. The final stage is to synthesize the information obtained and determine the advantages of alternatives using the selected mathematical model.

The process of calculating the coefficient of fuzzy advantages deserves special attention in the multicriteria selection method, which allows you to effectively work with ambiguities and subjectivity of assessments. Fuzzy advantage ratio is based on fuzzy set theory, where each criterion is assigned a fuzzy value according to its importance or influence on decisions. The key is to turn subjective assessments into fuzzy numbers that represent the degree to which alternatives belong to each criterion. Next, using fuzzy logic operators, the obtained estimates are aggregated, which makes it possible to calculate the overall preference coefficient for each alternative. This process provides the opportunity to take into account not only quantitative, but also qualitative characteristics of the solution, contributing to the formation of an objective and balanced conclusion.

4. RESULTS OF RESEARCH

Based on the data analysis, we will compile into two tables (Table 1) the environmental factors that influence the work of the public sector in Ukraine in the context of sustainable development. Essentially, this involves defining a set of factors (feasible alternatives) that, from the perspective of their emergence, require changes in the public administration system – x_i, $i = 1, n$.

These environmental factors have a complex impact on sustainable development, requiring in-depth analysis and adaptive measures from the public sector. Changing climate conditions with extreme weather events and fluctuating temperatures threaten infrastructure, health care and the effectiveness of emergency services, highlighting the need to strengthen resilience to climate challenges. Deteriorating air quality requires immediate action to reduce emissions from industrial and vehicular sources, as it has a direct impact on public health and quality of life. Limited access to clean water affects health, agriculture and industry, requiring the development and implementation of comprehensive programs for the management and storage of water resources.

The loss of biodiversity and ecosystems leads to a decline in natural resources and services such as pollination and water purification, requiring government conservation measures. Finally, urban sprawl and land degradation require the public

sector to undertake careful spatial planning and conservation measures to ensure environmental sustainability and promote sustainable development initiatives.

Table 1. Environmental factors affecting the work of the public sector

x_i	Factor
x_1	Changes in climate patterns can lead to severe weather events, sea-level rise, and temperature fluctuations, impacting infrastructure, public health, and emergency services
x_2	Poor air quality can result in health crises, necessitating public health interventions and policies to reduce pollution from industrial and vehicular sources
x_3	limited access to clean water affects public health, agriculture, and industry, requiring effective water management and conservation policies
x_4	The loss of species and ecosystems can impact natural resources and services, like pollination and water purification, necessitating conservation efforts and habitat protection
x_5	Increased frequency and intensity of disasters such as floods, hurricanes, and wildfires require robust emergency preparedness, response plans, and infrastructure resilience
x_6	The growing problem of waste, including plastic pollution and electronic waste, demands sustainable waste management and recycling policies
x_7	The need for sustainable energy sources is crucial to reduce dependency on fossil fuels and mitigate climate change, influencing public sector investments in renewable energy projects
x_8	Urban sprawl and land degradation affect environmental sustainability, requiring careful planning, green spaces preservation, and sustainable development initiatives

The next step was to define the criteria by which the selection among the identified factors (feasible alternatives) gj, j = 1, m (Table 2).

Table 2. The criteria by which the selection among the identified factors

g_i	Criteria
g_1	The appearance of one or another of the above factors
g_2	A combination of several factors at the same time
g_3	Repeatability of occurrence of a factor (several factors) over a certain period of time

In the process of implementing the task, it is important to identify key factors according to the selected criteria. This means that it is necessary to effectively solve the problem of choosing the optimal option from a set X, while taking into account the established fuzzy ratio of advantages g1, g2,... gm with given membership functions μ_{gj}: $X \times X \rightarrow [0, 1]$.

Therefore, further, for each of the criteria gj, we evenly compare environmental factors that can have a significant impact on public administration. The results were assessed as follows (1):

$$\mu_{g1}(x_i, x_j) = \begin{cases} 1, if\ xi \succ xj \\ 0, if\ xi \prec xj \end{cases} \quad (1)$$

For g1 we have the following (2):

$$x_1 \succ x_2, x_1 \succ x_3, x_1 \succ x_4, x_1 \prec x_5, x_1 \prec x_6, x_1 \succ x_7, x_1 \prec x_8, \\ x_2 \approx x_3, x_2 \succ x_4, x_2 \prec x_5, x_2 \prec x_6, x_2 \approx x_7, x_2 \prec x_8, \\ x_3 \approx x_4, x_3 \prec x_5, x_3 \prec x_6, x_3 \approx x_7, x_3 \prec x_8, \\ x_4 \prec x_5, x_4 \prec x_6, x_4 \approx x_7, x_4 \prec x_8, \\ x_5 \approx x_6, x_5 \succ x_7, x_5 \approx x_8, \\ x_6 \succ x_7, x_6 \approx x_8, \\ x_7 \prec x_8. \quad (2)$$

For g2 we have the following (3):

$$x_1 \approx x_2, x_1 \succ x_3, x_1 \succ x_4, x_1 \approx x_5, x_1 \prec x_6, x_1 \approx x_7, x_1 \prec x_8, \\ x_2 \succ x_3, x_2 \succ x_4, x_2 \prec x_5, x_2 \prec x_6, x_2 \approx x_7, x_2 \prec x_8, \\ x_3 \succ x_4, x_3 \prec x_5, x_3 \prec x_6, x_3 \approx x_7, x_3 \prec x_8, \\ x_4 \approx x_5, x_4 \prec x_6, x_4 \prec x_7, x_4 \prec x_8, \\ x_5 \succ x_6, x_5 \succ x_7, x_5 \prec x_8, \\ x_6 \succ x_7, x_6 \approx x_8, \\ x_7 \prec x_8. \quad (3)$$

For g3 we have the following (4):

$$x_1 \prec x_2, x_1 \approx x_3, x_1 \succ x_4, x_1 \prec x_5, x_1 \prec x_6, x_1 \approx x_7, \\ x_1 \prec x_8, \\ x_2 \approx x_3, x_2 \approx x_4, x_2 \prec x_5, x_2 \prec x_6, x_2 \approx x_7, x_2 \prec x_8, \\ x_3 \approx x_4, x_3 \prec x_5, x_3 \prec x_6, x_3 \approx x_7, x_3 \prec x_8, \\ x_4 \prec x_5, x_4 \prec x_6, x_4 \prec x_7, x_4 \prec x_8, \\ x_5 \prec x_6, x_5 \succ x_7, x_5 \prec x_8, \\ x_6 \succ x_7, x_6 \prec x_8, \\ x_7 \prec x_8.. \quad (4)$$

The process of generating a matrix of fuzzy relations in the context of the multicriteria selection of alternatives method using fuzzy logic consists of turning qualitative assessments and expert judgments into quantitative membership values measured on a scale from 0 to 1. This scale represents the degree to which an element (for example, an alternative criterion) corresponds to a specific property or category. The process is based on turning subjective judgments about the importance, priority, or influence of various factors into precise numerical values, allowing mathematical analysis to be performed.

After all qualitative assessments are converted into numerical membership values, a matrix of fuzzy relations is formed, where each element of the matrix represents the degree of membership between pairs of criteria or alternatives. Such a matrix allows further analysis to determine optimal decisions or rank alternatives taking into account all criteria, which contributes to an objective and comprehensive approach to decision making in complex conditions of unclear information.

Next, based on a relation (2-4), membership functions of the given preference relations μgj(xi, xj) were constructed (Table 3).

The data were presented in the form of matrices μg1(xi, xj), μg2(xi, xj), μg3(xi, xj), meeting the criteria gj.

Now we construct the convolution of the relations g1, g2, g3 in the form of a section Q1 = g1 ∩ g2 ∩ g3 with a membership function (5):

$$\mu_{Q1}(x_i, x_j) = \min\{\mu_{g1}(x_i, x_j), \mu_{g2}(x_i, x_j), \mu_{g3}(x_i, x_j)\} \quad (5)$$

The result of the calculation using the formula for the environmental factors we identified is presented in Table 4.

Table 3. The relation matrix for g1-g3

	x_i/x_j	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8
	x_1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 0	Value: 0	Value: 1	Value: 0
	x_2	Value: 0	Value: 1	Value: 1	Value: 1	Value: 0	Value: 0	Value: 1	Value: 0
	x_3	Value: 0	Value: 0	Value: 1	Value: 1	Value: 0	Value: 0	Value: 1	Value: 0
$\mu_{g1}(x_i, x_j)$ =	x_4	Value: 0	Value: 0	Value: 0	Value: 1	Value: 0	Value: 0	Value: 1	Value: 0
	x_5	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1
	x_6	Value: 1	Value: 1	Value: 1	Value: 1	Value: 0	Value: 1	Value: 1	Value: 1
	x_7	Value: 0	Value: 0	Value: 0	Value: 0	Value: 0	Value: 0	Value: 1	Value: 0
	x_8	Value: 1	Value: 1	Value: 1	Value: 1	Value: 0	Value: 0	Value: 1	Value: 1
	x_i/x_j	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8
	x_1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 0	Value: 1	Value: 0
	x_2	Value: 0	Value: 1	Value: 1	Value: 1	Value: 0	Value: 0	Value: 1	Value: 0
	x_3	Value: 0	Value: 0	Value: 1	Value: 1	Value: 0	Value: 0	Value: 1	Value: 0
$\mu_{g2}(x_i, x_j)$ =	x_4	Value: 0	Value: 0	Value: 0	Value: 1	Value: 1	Value: 0	Value: 0	Value: 0
	x_5	Value: 0	Value: 1	Value: 1	Value: 0	Value: 1	Value: 0	Value: 1	Value: 0
	x_6	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1
	x_7	Value: 0	Value: 0	Value: 0	Value: 1	Value: 0	Value: 0	Value: 1	Value: 0
	x_8	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 0	Value: 1	Value: 1
	x_i/x_j	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8
	x_1	Value: 1	Value: 0	Value: 1	Value: 1	Value: 0	Value: 0	Value: 1	Value: 0
	x_2	Value: 1	Value: 1	Value: 1	Value: 1	Value: 0	Value: 0	Value: 1	Value: 0
	x_3	Value: 0	Value: 0	Value: 1	Value: 1	Value: 0	Value: 0	Value: 1	Value: 0
$\mu_{g3}(x_i, x_j)$ =	x_4	Value: 0	Value: 0	Value: 0	Value: 1	Value: 0	Value: 0	Value: 0	Value: 0
	x_5	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 0	Value: 1	Value: 0
	x_6	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 0
	x_7	Value: 0	Value: 0	Value: 0	Value: 1	Value: 0	Value: 0	Value: 1	Value: 0
	x_8	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1	Value: 1

Table 4. Matrix μQ1(xi, xj) of minimal elements xi, xj among matrices μgj(xi, xj)

	x_i/x_j	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8
	x_1	Value: 1	Value: 0	Value: 1	Value: 1	Value: 0	Value: 0	Value: 1	Value: 0
	x_2	Value: 0	Value: 1	Value: 1	Value: 1	Value: 0	Value: 0	Value: 1	Value: 0
	x_3	Value: 0	Value: 0	Value: 1	Value: 1	Value: 0	Value: 0	Value: 1	Value: 0
$\mu_{Q1}(x_i, x_j)$ =	x_4	Value: 0	Value: 0	Value: 0	Value: 1	Value: 0	Value: 0	Value: 0	Value: 0
	x_5	Value: 0	Value: 1	Value: 1	Value: 0	Value: 1	Value: 0	Value: 1	Value: 0
	x_6	Value: 1	Value: 1	Value: 1	Value: 1	Value: 0	Value: 1	Value: 1	Value: 0
	x_7	Value: 0	Value: 0	Value: 0	Value: 0	Value: 0	Value: 0	Value: 1	Value: 0
	x_8	Value: 1	Value: 1	Value: 1	Value: 1	Value: 0	Value: 0	Value: 1	Value: 1

After identifying the precise advantage ratio through the initial convolution, we proceed to establish the membership function as indicated in Eq. (6):

$$\mu_{Q_1}^{s}(x_i, x_j) = max\{0; \mu_{Q_1}(x_i, x_j) - \mu_{Q_1}(x_j, x_i)\} \quad (6)$$

Subsequently, we specify the collection of non-dominated options Q1nd within the set (X, Q1) and develop a corresponding membership function. In this instance, it is presented as follows in Eq. (7):

$$\mu_{Q1}(X)=[0;0;0;0;1;1;0;1] \quad \mu_{Q2}(X)=[0,51;0;0;0,21;0,21;73;1] \quad (7)$$

Thus, we determine the non-dominated environmental factor (alternatives) from both convolutions (Table 5).

The results obtained demonstrate that for the public sector of Ukraine, the most important external factor is x8 – Urban sprawl and land degradation affect environmental sustainability, requiring careful planning, green space preservation, and sustainable development initiatives. The degree of non-dominance of this factor is equal to one, that is, this is a true non-dominated alternative.

In Ukraine, a country with diverse geographic and climatic conditions ranging from rainforests in the north to steppes and semi-deserts in the south, the problem of land degradation and urban sprawl is particularly pressing. This is due to intensive agricultural use of land, which leads to soil erosion, a decrease in soil fertility and loss of natural biodiversity. In addition, urbanization and urban expansion lead to overuse of land resources, pollution and reduction of green spaces, which are critical to ensure ecological balance and sustainability of ecosystems. Given these conditions, the importance of careful planning, conservation and sustainable development initiatives is clear to help conserve natural resources, maintain biodiversity and adapt to climate change.

Table 5. The non-dominated environmental factor (alternatives) from both convolutions

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8
$\mu_{Q1}^{H\partial}(X)$	Value:0.516	Value:0	Value:0	Value:0.210	Value:0.210	Value:0.726	Value:0	Value:1
$\mu_{Q2}^{H\partial}(X)$	Value:0	Value:0	Value:0	Value:0	Value:1	Value:1	Value:0	Value:1
$\mu_{Q}^{H\partial}(X)$	Value:0	Value:0	Value:0	Value:0	Value:0.210	Value:0.726	Value:0	Value:1

The significance of urban sprawl and land degradation as the most critical external factor for Ukraine's public sector, particularly identified as factor x8, stems from its profound impact on sustainability. Urban sprawl refers to the uncontrolled expansion of urban areas into rural lands and natural habitats, leading to a multitude of environmental issues. This expansion often results in land degradation, where the quality and productivity of the land diminish, affecting ecosystems, biodiversity, and the ability to provide for future generations. The reason this factor is paramount, especially for a country like Ukraine, lies in its direct challenge to sustainable development. Sustainable development aims to meet the needs of the present without compromising the ability of future generations to meet their own needs. However, urban sprawl and land degradation counteract these goals by causing irreversible harm to the environment, which includes loss of green spaces, increased pollution, and disruption of natural processes. These changes not only affect the ecological balance but also have social and economic repercussions, such as health issues due to pollution and increased costs for sustainable development in sprawled areas.

5. DISCUSSIONS

In the context of our article research endeavours to carve a methodical pathway for assessing the impact of environmental factors on the public sector. This article underscores the significance of a multicriteria selection method based on a fuzzy advantage ratio, highlighting its efficacy in modelling environmental influences on the public sector's operational dynamics. Comparatively, our research resonates with and builds upon the foundational insights offered in existing literature, notably those outlined in references such as Yildiz and Yercan [14], Kolisnychenko et al. [15], and further discussions by Al Azzam et al. [16], among others. These references collectively emphasize the critical nature of environmental reporting, the role of human capital in environmental performance, and the overarching challenges in ensuring environmental safety, especially in unprecedented times such as the COVID-19 pandemic.

Our study advances the discourse by not only reinforcing the acknowledged importance of environmental considerations in the public sector as evidenced by Alrasheedi et al. [17] and Alazzam et al. [18], but also by offering a novel approach to comprehensively evaluate and model these impacts. The application of a fuzzy advantage ratio for the multicriteria selection of alternatives provides a nuanced tool for decision-making, enhancing the informational basis for strategic improvements in public sector activities. However, it is imperative to acknowledge the limitations inherent in our approach, primarily the non-inclusivity of all conceivable environmental factors. This gap beckons further investigation, as suggested by Blikhar et al. [19], which could enrich the analytical framework by incorporating a broader spectrum of environmental indicators for a more holistic assessment.

The prospective avenues for future research, inspired by the empirical analysis and theoretical underpinnings of works like Kaivo-oja et al. [20] and Nahar et al. [21], entail expanding the list of environmental factors and exploring new methodologies for their assessment. This endeavour is vital for enhancing the resilience and efficacy of the public sector in navigating the intricate web of environmental challenges.

The study by Kopytko and Sylkin [22] examines methods for modelling information support for the fight against corruption in the context of managing the economic security of the state. She contributes to the understanding of the importance of technology solutions for transparency in public administration. In contrast, our study focuses on assessing the impact of environmental factors on the public sector, expanding the scope of analysis to environmental sustainability and sustainable development, which allows for a deeper understanding of the relationship between public management and environmental challenges.

The study by Pilgrimiene et al. [23] examines sustainable consumption patterns in different settings, looking at how consumer behaviour is changing and what economic and environmental impacts this has. This study contributes to understanding the factors shaping sustainable consumption. Our research is distinguished by its focus on the impact of environmental factors on public sector performance, complementing the concept of sustainable consumption with an assessment of sustainable development from a management perspective.

Alazzam et al. [24] develop an information model for e-commerce platforms, considering it in the context of modern socio-economic systems and sustainable development. Their work highlights the importance of proper information modelling to meet digitalization and legal requirements. What makes our study different is its focus on the environmental dimensions of sustainable development, adding a new dimension to the analysis of public sector performance through an environmental lens.

Menton et al. [25] analyze how sustainable development goals interact with environmental justice, identifying synergies and tensions between them. Their research contributes to the understanding of the complex relationships between different aspects of sustainable development. Our study complements this work by proposing a methodological approach to assessing the impact of environmental factors on the public sector, with an emphasis on a multi-criteria selection method based on a fuzzy balance of benefits, which allows us to consider the environmental side of sustainable development in more detail.

Thus, highlight its theoretical contributions, in particular through analysis and comparison with existing literature. Differences in approaches to assessing the impact of environmental factors on the public sector in the context of sustainable development indicate significant progress in understanding this complex topic. Comparing our findings with those of other studies shows how newer techniques, such as multi-criteria selection based on fuzzy benefit trade-offs, can provide a deeper and more accurate understanding of the interactions between environmental factors and public sector performance. This comparison also highlights how our study builds on existing theoretical frameworks while expanding them with new analytical tools.

As for the theoretical innovations of our study, they are especially noticeable in the choice of factors and construction of the model. Our approach to identifying and assessing the impact of environmental factors on the public sector is innovative through the use of fuzzy benefit relationships, which allows us to model complex interdependencies with unique precision. This technique not only improves the accuracy of assessing the influence of environmental factors but also allows us to effectively take into account the ambiguity and uncertainty that often accompany environmental information. Consequently, our study makes a

significant contribution to sustainability analysis methodology by offering an approach that is applicable in various contexts to improve strategic planning and informed decision-making in the public sector.

6. CONCLUSIONS

Our article embarks on a crucial exploration aimed at methodically evaluating how environmental factors impact the public sector's operations. Through meticulous research, the study illuminates the environment surrounding the public administration system as its focal point, seeking to identify the most impactful environmental elements affecting the sector's functionality. At the heart of this investigation is the deployment of a sophisticated methodological approach, leveraging the method of multicriteria selection of alternatives. This approach, grounded in the utilization of a fuzzy advantage ratio, stands out for its innovative capacity to model the influence of environmental factors on the public sector's endeavours in the context of sustainable development. The significance of this methodology cannot be overstated, as it provides a nuanced framework for understanding the complex interplay between various environmental factors and the public sector's operations.

The findings of this research are both illuminating and instrumental. By applying the multi-criteria selection method, predicated on a fuzzy ratio of advantages, the study successfully models the environmental factors pertinent to the public sector. This modelling endeavor has culminated in the development of an essential informational foundation, which holds the potential to significantly enhance the operational effectiveness of the public sector. The approach delineated in this article offers a strategic pathway for public administration systems to navigate the challenges posed by environmental factors, thereby enabling more informed decision-making processes.

Based on an analysis of the impact of environmental factors on public sector activities, our recommendations for sustainable development policies in Ukraine include strengthening land use controls, which are critical to preventing overexploitation of natural resources and preventing land degradation. With urban growth and land degradation identified as significant risks to environmental sustainability, the public sector must increase its efforts to regulate development and land use. This may include the development and implementation of strategic plans for the development of urban and rural areas that take into account the need to preserve natural landscapes and prevent soil erosion. In addition, strengthening legislation to limit the use of land for industrial purposes and introducing strict environmental safety criteria for land use can help reduce negative impacts on the environment.

The second important aspect is the implementation of ecological restoration, which aims to restore damaged ecosystems and maintain biodiversity. For Ukraine, with its rich natural resources and diverse ecosystems, this is especially important. Initiatives could include afforestation programs, restoration of water bodies and protected areas, and the creation of green belts around cities to protect natural landscapes and ensure ecological balance. Such restoration programs must be accompanied by scientific research and monitoring to ensure they are effective and adaptable to changing environmental conditions. Implementing these recommendations will require collaboration across levels of government, as well as public and private sector engagement, to achieve sustainable development goals and ensure the country's future prosperity in the face of growing environmental challenges.

However, the study acknowledges its limitations, notably the exclusion of certain environmental factors from its analysis. This recognition of its bounded scope catalyzes future research avenues, highlighting the necessity for comprehensive investigations that incorporate a broader spectrum of environmental factors. The prospective expansion of this research to include new and diverse factors promises to enrich our understanding further and contribute to the refinement of methodologies for assessing environmental impacts on the public sector in the context of sustainable development.

In sum, the article makes a significant contribution to the discourse on public sector management in the context of environmental factors. It presents a robust methodological approach for assessing these influences, offering valuable insights and laying the groundwork for future explorations aimed at enhancing the public sector's resilience and effectiveness in the face of environmental challenges.

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