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ECOSYSTEM SERVICES EVALUATION OF THE DANUBE DELTA: AN ANALYSIS USING HIERARCHICAL MULTIFACTOR REGRESSION

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Abstract:

The present study aims to assess the ecosystem services of the Danube Delta through a complex multi-factor hierarchical regression analysis. Using three different regression models, the research addresses multiple dimensions of human-nature interaction in this area of major ecological and cultural importance. First, the attractiveness of ecosystem services (VF1) was investigated, identifying a positive impact of improved infrastructure and tourism service provision on the local economy and visitor experience. It was also found that this attractiveness needs to be weighed with specific demographic and social needs. Secondly, the current perception and potential for conservation and tourism (VF2) was examined, revealing the link between effective resource management and the region's tourism value. Thus, positive perceptions of conservation practices were found to be determinant in establishing the value of the Delta as a tourist destination. Finally, the impact of obstacles to Delta development (VF3) was considered, highlighting the importance of an integrated approach to development planning in the region. The recognised obstacles involve environmental, economic and social factors, and indicate the need for balanced management of natural resources. The results of the study highlight the need for multidisciplinary collaboration for effective management of the Danube Delta, emphasising the need to protect this unique habitat while promoting sustainable and inclusive development for the benefit of current and future generations.

Key words: *ecosystem services, multifactorial hierarchical regression, sustainable development, Danube Delta*

1. Introduction

In the current context of climate change and increasing anthropogenic pressures on natural ecosystems, understanding and valuing the services they provide to humanity becomes a necessity (Celac & Vadineanu, 2018). The Danube Delta, the largest and best preserved of the European deltas, is a unique natural laboratory for analysing the interaction between ecological processes and the benefits they bring to human society.

This study aims to explore and quantify the broad spectrum of ecosystem services provided by the Danube Delta, from recreational and leisure to vital services such as regulating the local climate and maintaining biodiversity (Munteanu *et al.*, 2020).

From this perspective, the Danube Delta is an emblematic case, providing a wide range of ecosystem services that support the economic, social and spiritual well-being of local populations as well as that of wider communities. Whether we are talking about traditional fisheries, ecological tourism, or the inestimable value of landscapes that enrich cultural and historical heritage, all of these contribute to the complexity and undeniable value of the delta (Herciu *et al.*, 2011).

The present study, using hierarchical multifactorial regression, allows the observed variation to be decomposed into multiple services to identify interactions between them and to determine the relative contributions of each factor to service provision. This statistical method has proven to be very useful in complex ecological systems, such as the Danube delta, where multiple interconnected processes coexist and influence each other.

The methodological approach starts with the presentation of the conceptual and theoretical frameworks underlying the study.

First, it is important to understand the concept of ecosystem services. These are the tangible and intangible benefits that humans obtain from ecosystems, essential for human survival and quality of life. Ecosystem services can be classified into four main categories: provisioning, regulating, cultural and supporting. The Danube Delta contributes to all these categories, providing food and raw material resources, controlling climate and water quality, and providing cultural and spiritual value through its landscapes and biodiversity (Serman, 2000, p.981).

Given this framework, the study will focus on identifying and assessing three main dimensions: direct utility value, non-utility value and supporting value. Direct utilitarian value refers to material benefits, such as food and raw materials, while non-utilitarian value encompasses cultural, aesthetic and recreational aspects (Grigorescu *et al.*, 2023). Supporting value includes the services needed to produce all other ecosystem services, such as nutrient cycling and soil formation.

Methodologically, the study will adopt a two-step approach. The first stage involves collecting empirical data through field observations based on a questionnaire and describing the variables used. The second stage consists of applying hierarchical multifactor regression to shape the relationships between the independent variables - demographic factors, ataractivity (VF1), perception of sustainability (VF2) and barriers (VF3) - and ecosystem services as the dependent variable (DV).

In the context of statistical modelling, independent variables were selected based on literature and local knowledge, including aspects such as species diversity, intensity of human activities and climate variables. In this way, the model will be able to identify the key factors influencing the delta's ability to provide essential services and assess the interdependence between these services.

This study highlights the researchers' commitment to provide a significant contribution to understanding the complexity and interdependence of ecosystem services provided by the Danube Delta. The results are expected to contribute to the development of conservation and sustainable management policies, improve regional development

strategies and increase awareness and appreciation of the inestimable value of this unique ecosystem.

2. Theoretical background

The Danube Delta is one of Europe's most valuable natural assets, providing a variety of ecosystem services essential for human sustainability and prosperity (Collste *et al.*, 2017). Assessing the multifunctionality of this region and its impact on well-being requires a thorough understanding of its diverse contributions. In this context, we explored four key areas.

First, we explored Ecosystem Services, the foundation of the functioning of the Delta, which support biodiversity and provide vital resources for human and non-human life. The next aspect, Attractiveness, refers to the extent to which the Danube Delta presents itself as a tourist destination, with its natural beauty, recreational opportunities and cultural offerings. With a growing interest in sustainable practices, the Perception of Sustainability and Tourism Potential of the Danube Delta will guide us in understanding how visitors and local communities see the balance between ecosystem conservation and economic development Gastescu, P. (2021). Finally, the acknowledged Obstacles will confront us with the realities of the challenges involved in maintaining the delicate balance of this unique ecosystem. These barriers, ranging from environmental to socio-economic issues, need to be identified and addressed to ensure a future in which the Danube Delta can maintain its multifunctionality and continue to contribute to human well-being (Danube Delta Local Action Group, 2021).

Each of these sub-chapters brings into discussion elements vital to understanding and appreciating the Danube Delta, not only as a vital habitat for wildlife, but also as a source of inspiration, recreation and livelihood for human communities. These four analysed areas, with the multitude of variables that define them, represent the methodological foundation of our research. Through this holistic approach, we aim to highlight the complexity of human-nature relationships in this unique area of the world (Petrisor *et al.*, 2020, p. 275).

2.1. Ecosystem services

Natural ecosystems, such as the Danube delta, provide a diverse range of ecosystem services essential for human well-being and environmental health. These services, often underestimated, are fundamental to the balance and dynamics of life on Earth; they form a complex, vital network of interactions between humans and nature (Giosan *et al.*, 2012).

Recreation and recreational services are among the most visible benefits provided by ecosystems. These include relaxation and leisure activities, such as walks through green areas, fishing and bird watching, contributing to improve mood and reduce daily stress (Cretescu *et al.*, 2021). Alongside these recreational and leisure services, tourism services support the local economy, providing business and employment opportunities that allow people to connect with nature and cultural heritage.

Playing sports in natural ecosystems contributes to maintaining and improving health, providing diverse opportunities for movement and physical and mental recovery. The educational importance of these services is also important, with ecosystems serving as outdoor 'classrooms' where valuable lessons about biodiversity and natural processes can be learned (ICPDR, 2021, p. 290). Cultural, historical and spiritual services offer a deep connection to the past, with events bearing the imprint of cultural diversity that enrich the spiritual life of communities. Whether historic sites surrounded by nature or natural landscapes that have inspired myths and traditions, these ecosystem services strengthen collective identity and bring meaning to individual lives (Lazar *et al*, 2022).

Esthetic services, such as the beauty and inspiration of natural landscapes, bring intangible benefits, but of immense value to creativity and artistic appreciation. On the other hand, ecosystems function as resources for industry and energy, providing materials and services essential to the functioning of the modern economy (Tucker *et al*, 2010).

In terms of provisioning services, ecosystems such as the Danube delta are vital sources of food and clean water, while regulating local and global climate by reducing carbon emissions and controlling weather phenomena are fundamental regulating services. These systems contribute to maintaining biodiversity, which not only ensures the stability and resilience of nature, but also provides an essential genetic pool for adaptation to future changes.

Regulating services also include noise reduction, where vegetation acts as a natural screen, and carbon storage, a key component in combating climate change. Ecosystems, through their complexity and variety, absorb carbon dioxide, contributing significantly to the atmospheric balance.

As can be seen, ecosystem services are invaluable resources that require protection and careful management (Herciu & Ogrean, 2018). Awareness and appreciation of these services must be at the centre of any sustainable development and environmental policy efforts.

2.2. Attractiveness

The Danube Delta is an ecosystem of rare biodiversity and beauty, representing one of Europe's most valuable natural heritages. Its tourism potential is huge, but in order to transform this natural treasure into a world-class ecotourism destination, a multi-dimensional and systematic approach is needed (Guittard *et al.*, 2022). The question underlying the sustainable development of tourism in this region is: to what extent are interventions such as promotion, infrastructure upgrading and conservation needed to increase the attractiveness of the delta for visitors?

Promotion is essential to draw global attention to the inestimable values of the delta, but it must be done with respect for the fragility of the ecosystem. A well-targeted marketing strategy can educate potential visitors about the unique way of life of the inhabitants and the rare species of fauna and flora that make their home here, thus inspiring responsible and informed tourism.

Hotel modernisation, on the other hand, must strictly align with environmental standards, offering hospitality that complements rather than devalues the authentic delta

experience. Modern hotels must not only offer comfort, but also integrate harmoniously into the landscape, contributing to its conservation. The protection and conservation of ecosystems is also fundamental, not only to maintain biodiversity, but also to ensure The protection and conservation of ecosystems is also fundamental, not only to maintain biodiversity, but also to ensure the continuation of this natural refuge for future generations.

Access infrastructure, such as paths and refuges, requires special attention, as it must allow responsible visiting of natural sights without disturbing the habitat. This includes not only the restoration of existing trails, but also the development of new trails that enhance the delta landscapes, maximising the tourism experience and minimising environmental impact.

Public utilities and waste management in delta communities need to be upgraded to support local communities and provide adequate conditions for visitors (Van den Belt, 2004, p. 328). This is vital to maintain a balanced relationship between economic activities and nature protection. In addition, cleaning and maintenance of canals is essential to ensure accessibility and navigability, which are key elements in promoting ecotourism.

Last but not least, it is imperative to set up information points and develop information materials to raise awareness of the importance of conserving the delta and the role that each tourist plays in this process. In an age when mass tourism can have devastating consequences, the Danube Delta needs a careful and dedicated approach to reveal its potential. In an era when mass tourism can have devastating consequences, the Danube Delta requires a careful and dedicated approach to unlock its tourism potential in a sustainable and responsible way.

2.3. Perception of Sustainability and Tourism Potential of the Danube Delta

Recognised as a biosphere reserve and UNESCO World Heritage Site, the Danube Delta is not only a sanctuary for biodiversity, but also a potential hub for European tourism. In this context, a key question arises: to what extent is the Danube Delta ready to embrace its role as a major tourist destination, while respecting the principles of sustainability and conservation?

Maintaining and caring for the Danube Delta is imperative for maintaining its ecological health. Trails must not only be maintained but also carefully designed so as not to disturb the delicate habitat. In addition, the safety of tourists is critical. Without a sense of security, visitors will not be able to enjoy the splendour and tranquillity of this landscape.

Cleanliness is another issue; litter not only destroys the natural beauty but is also harmful to wildlife. Easy access to points of interest and ease of visiting are essential for an enjoyable tourist experience. Recreational infrastructure, when planned and implemented responsibly, can significantly improve the attractiveness of the Danube Delta, making it a magnet for ecotourism.

Although the Danube Delta is already a tourist attraction, there is a general consensus that it could become one of Europe's most important tourist attractions. But to achieve this potential, concrete action must be taken to protect and enhance its natural and cultural heritage. Traditions and landscapes, which make up the intangible heritage of

the delta, need to be promoted in a measured way, maintaining a balance between exploitation and conservation.

Opinions are divided on how to achieve the tourism potential of the Danube Delta. Some argue that it has reached its capacity and should not aspire to attract more tourists, while others believe there is room for growth (Vaidianu *et al.*, 2015). There is also debate about economic exploitation, whether in tourism or food resources. In all of these discussions, the underlying principle should be sustainability, ensuring that the exploitation of the delta's natural resources is done in a way that does not compromise the long-term viability of the ecosystem (Tiller *et al.*, 2021).

2.4. Barriers

The tourist development of the Danube Delta is often constrained by a number of factors, the impacts of which can vary in magnitude.

The first and most obvious factor is the negative impact of motor boats. They not only disturb the natural habitat of aquatic species and birds, but also contribute to shore erosion, leading to the alteration of natural landscapes. It is essential to regulate the use of motorboats to minimise environmental impact.

Poaching is another serious threat. By illegally catching wildlife, the delicate balance of biodiversity is disturbed. Moreover, this illegal practice undermines the ecotourism potential of the Delta, reducing the chances of tourists seeing species in their natural habitat.

An often neglected factor is the high density of tourists in certain areas of the Delta, which can lead to the degradation of natural resources. A more sustainable approach could include the development of responsible and controlled tourism, allowing the Delta to be explored without damaging the environment.

The possibility of encountering wild animals, while a draw for nature fans, can be a safety concern for tourists. It is crucial to educate visitors on how to behave in the presence of wildlife and to take steps to prevent unwanted incidents.

Overfishing also threatens the Delta's fish habitats, directly impacting the food chain and local communities that depend on fishing for their livelihoods. Implementing fishing limits and a monitoring system can help conserve these vital resources.

The condition of the infrastructure is another determining factor in the development of tourism. Unpaved roads, poor public transport and limited accommodation and food facilities can discourage tourism. Investment in infrastructure is essential to ensure the accessibility and convenience needed for a quality tourism experience.

Hunting, even when regulated, can be perceived negatively by those who travel to the Danube Delta to enjoy nature and wildlife watching.

Education and strict regulation of this activity are essential to maintain a balance between the interests of hunters and ecotourism. Other obstacles, which may include climate change, pollution and uncontrolled development, must also be seriously addressed. An integrated strategy that takes all these factors into account is needed to ensure the sustainable development of tourism in the Danube Delta, one that respects and protects this natural treasure for future generations.

3. Research methodology

3.1. Methodology design

The analysis conducted involved a hierarchical multiple regression method, which examines how multiple independent variables influence a dependent variable. This technique highlights the relevance and added contribution of different groups of variables by including them in a predetermined order in the analysis model. Hierarchical regression operates by progressively adding variables to the model, assessing the impact of each group of variables on the dependent variable, which allows researchers to observe changes in the dependent variable when new predictors are introduced.

In our study, we applied this methodology to independently analyze the influence of three groups of variables on a specific outcome - in this case, Ecosystem Services. Using this approach, we assessed the influence of Demographic factors, Attractiveness, Perceptions of sustainability and Barriers.

A key benefit of hierarchical regression is the ability to test theories or hypotheses about the sequence in which variables should affect the dependent variable. Hierarchical multiple regression is useful in a variety of fields, from organizational psychology to economics and public policy, facilitating the separation and understanding of the complexity of interactions between variables and their effects on the outcomes of interest. The method not only reveals the interactions between variables, but also allows the gradual construction of predictive models. Before applying this technique, we conducted a detailed statistical analysis of the variables involved and checked their reliability using the Cronbach alpha test.

3.2. Sample description

Table 1 shows the distribution of survey respondents by gender, age, education and employment status. Of the total of 318 respondents, 66 (20.8%) are male and 252 (79.2%) are female. In terms of the age of the participants, 100 (31.4%) are in the 16-24 age group, 56 (17.6%) are in the 25-34 age group, 84 (26.4%) are between 35-44, 46 (14.5%) are between 45-54, and 32 (10.1%) are over 55.

Regarding the level of education completed, 2 persons (0.6%) have completed partial high school or School of Arts and Crafts (grades IX-X), 78 (24.5%) have completed full high school (grades IX-XII/XIII), 4 (1.3%) have post-secondary education, 124 (39.0%) have completed university education, and 110 (34.6%) have post-graduate education (Master's, PhD).

Regarding the current employment status, 170 people (53.5%) are employed full time, 6 (1.9%) are employed part time, 16 (5.0%) are self-employed, 2 (0.6%) are unemployed looking for a job, 10 (3.1%) are homemakers, 8 (2.5%) are retired, 66 (20.8%) are pupils/students or in full-time education, 34 (10.7%) are employers/entrepreneurs, and 6 people (1.9%) prefer not to answer the question about their professional status.

Table 1. Demographic profile of respondents

	N	%
<i>Gender</i>		
Male	66	20.8
Female	252	79.2
<i>Age</i>		
16 - 24	100	31.4
25 - 34	56	17.6
35 - 44	84	26.4
45 - 54	46	14.5
Peste 55 ani	32	10.1
<i>Level of education</i>		
Partial high school or School of Arts and Crafts (grades IX-X)	2	0.6
Full high school (grades IX-XII/XIII)	78	24.5
Post-secondary education	4	1.3
University education	124	39.0
Post-graduate education (Master's, PhD)	110	34.6
<i>Current employment status</i>		
Employed full time	170	53.5
Employed part time	6	1.9
Self-employed	16	5.0
Unemployed looking for a job	2	0.6
Homemakers	10	3.1
Retired	8	2.5
Pupils/students or in full-time education	66	20.8
Employers/entrepreneurs	34	10.7
Prefer not to answer	6	1.9

3.3. Instruments

For the application of the hierarchical multifactor regression method we developed 4 scales: 1) Ecosystem services, 2) Attractiveness, 3) Perception of sustainability, 4) Barriers.

From the data presented in Table 2, related to ecosystem services, it can be observed that tourism and recreation and leisure aspects are the most appreciated, with averages of 4.53 and 4.42 respectively, suggesting a high degree of satisfaction or importance attributed by respondents. In contrast, resource use for industry and energy and carbon storage have the lowest averages, 3.37 and 3.21, indicating lower appreciation or importance.

Of particular note is the relatively high standard deviation for most categories, such as playing sports (1,165) and maintaining and improving health (1,231), showing significant variation in people's responses. This suggests that there are differences of opinion or experience between participants on these categories.

These statistics can be used to understand which aspects of a region are most valued by the community and where there may be opportunities for improvement or development. For example, more can be invested in tourism and recreation, while looking at ways to improve public perception of the region's role in carbon storage and industry.

Table 2. Ecosystem services

	Mean	N	SD
Recreational and leisure	4.42	274	0.871
Tourism	4.53	274	0.83
Sports	3.93	270	1.165
Maintaining and improving health	4.02	274	1.231
Educational	4.02	276	1.16
Cultural	3.93	270	1.099
Historical	3.92	270	1.201
Spiritual	3.99	274	1.148
Aesthetic	4.03	274	1.142
Resource for industry and energy	3.37	272	1.256
Food resource	3.91	274	1.122
Local climate regulation	3.82	274	1.175
Maintaining biodiversity	4.33	274	1.014
Carbon storage	3.21	268	1.313

The data presented in Table 3 on Attractiveness suggests an assessment of the various initiatives or services proposed to improve tourism and infrastructure in the Danube Delta.

The aspect with the highest rating is "Better protection and conservation", with an average of 4.59, indicating a high priority given by respondents to environmental conservation. This is closely followed by initiatives such as cleaning and dredging of main channels, reflecting a concern for accessibility and navigability in the area, with a mean of 4.55 and the lowest standard deviation (0.732), showing a fairly high consensus among respondents.

Promotion of the region also receives a high rating, with a mean of 4.48, highlighting the importance of marketing to attract visitors. Interestingly, there is relatively low demand for "More modern hotels" with a mean of only 3.4, and with the highest standard deviation (1.315), suggesting divided opinions among respondents.

All other initiatives, including the development of access trails, ecotourism refuges, lookout points, and upgrading utility infrastructure, receive averages between 4.3 and 4.45, indicating strong support for improving tourism infrastructure and services.

These values suggest a strong preference for environmental conservation and protection, improving existing infrastructure, and increasing tourism information and promotion, rather than developing new accommodation facilities. This provides an insight into which development directions might be priorities for the region's planners and respondents' interests.

Tabelul 3. Attractiveness

	Mean	N	SD
More promotion	4.48	268	0.837
More modern hotels	3.4	262	1.315
Better protection and conservation	4.59	266	0.652
Rehabilitation / improvement of access paths to natural tourist attractions	4.41	266	0.787
Rehabilitation and development of networks of refuges (shelters) for ecotourism	4.3	268	0.803
Development of observation / filming / photographing points (gazebos)	4.4	268	0.755
Marking of boundaries and restoration of signs and markers for strictly protected areas, areas of special importance and buffer zones	4.44	266	0.741
Construction/upgrading of public utility networks (water, sewerage, wastewater treatment plants, ecological waste transfer points) in the localities of the Danube Delta	4.45	266	0.81
Cleaning, dredging and maintenance of main access channels and those related to tourist routes	4.55	266	0.732
Setting up ecotourism information and documentation points	4.44	268	0.75
Production of information and promotional material (maps, leaflets with the main tourist attractions, documentary films, information and orientation panels)	4.4	264	0.835

Table 4 focuses on current perceptions and the tourism and conservation potential of the Danube Delta and its resource management. Current perceptions of maintenance and protection are relatively low, with averages below 3 for "It is maintained/cared for" (2.64) and "It is sufficiently protected" (2.54), suggesting that respondents feel these aspects need improvement. Also, the fact that the Delta is "cleaned of litter" receives a low rating (2.59), indicating concerns about keeping the area clean.

Interestingly, respondents believe in the potential of the Danube Delta to become one of Europe's most important tourist attractions, with an average of 4.33 for future potential, in contrast to an average of only 3.28 for the current situation. This suggests that respondents see great value in the region's untapped possibilities.

Safety for tourists receives a moderate average of 3.63, indicating some degree of concern, but overall a positive perception. Accessibility of points of interest and ease of visiting have averages below 3 (2.91 and 3.19, respectively), which may suggest that improvements in access infrastructure are needed.

Intangible heritage is highly valued, with an average score of 4.34, underlining the cultural and traditional value that people associate with the Danube Delta. There is also a view that the Delta should be more exploited economically as a tourist resource (3.91), although this is a more divided perception, as suggested by the relatively high standard deviation (1.164).

The survey shows that there is a strong belief that the Danube Delta has not reached its tourism potential (2.38), which can be interpreted as a call for action to increase tourist numbers and tourism development. Finally, the sustainability of the holding

is rated very low (2.49), suggesting significant concerns about current resource management practices.

These data reflect a mixed picture, where there is a clear appreciation of the cultural value and potential seen for tourism, but also serious concerns about maintenance, protection and sustainability. These perceptions can guide decision making on development and conservation strategies for the Danube Delta.

Table 4. Perception on sustainability

	Mean	N	SD
It is maintained/cared for	2.64	274	0.928
Is sufficiently protected	2.54	272	0.932
Has maintained trails	2.74	272	1.031
Is (now) one of Europe's most important tourist attractions	3.28	270	1.061
Could be one of Europe's most important sights	4.33	272	0.885
Is safe for tourists	3.63	270	0.966
Is clean of rubbish	2.59	274	0.852
Easy to reach points of interest	2.91	274	1.016
Easy to visit	3.19	272	1.027
Has recreational infrastructure	3.01	272	1.11
The Danube Delta has reached its tourist potential and does not need more tourists	2.38	274	1.223
It has an invaluable intangible heritage (customs / traditions / landscapes, etc)	4.34	272	0.835
Should be exploited economically more as a tourist resource	3.91	274	1.164
Should be exploited economically more as a food resource	2.84	272	1.115
Is exploited sustainably	2.49	270	0.928

Table 5 presents data on *Barriers* encountered in protected areas or natural tourist destinations in the Danube Delta.

Poaching is seen as a major concern, having the highest mean (4.23) with a standard deviation indicating some variation in responses, but still a general recognition of the problem. The state of infrastructure is also a concern, with a mean of 4.00, signalling that participants see room for improvement. Overfishing and hunting are also seen as problems (with averages of 3.94 and 3.53 respectively), and the variation in responses is reflected in standard deviations that are above 1. This suggests different experiences or opinions on the severity of these problems.

Too high tourist density and the possibility of encountering wildlife are rated less severely (with means of 2.85 and 2.77, respectively), indicating that these are concerns, but perhaps not as pressing as the others mentioned. However, the standard deviations are still relatively high, suggesting diverse opinions among respondents. People with powerboats are a moderate issue in terms of level of concern, with an average of 3.47, which may reflect a perceived impact on quietness, environment or safety.

Overall, the survey results reflect a variety of concerns related to conservation and human impact on nature, with a clear focus on the need for poaching management and

infrastructure improvements. The mixed views on tourist density and wildlife interaction also suggest the need for a balance between nature conservation and the promotion of sustainable tourism.

Table 5. Barriers

	Mean	N	SD
Persons with motor boats	3.47	264	1.147
Poaching	4.23	266	1.068
Too high density of tourists	2.85	266	1.188
Possible encounter with wild animals	2.77	266	1.125
Overfishing	3.94	266	1.111
State of infrastructure	4	264	1.046
Hunting	3.53	262	1.144

Table 6 provides an overview of the Cronbach's Alpha coefficient values for each of the study scales, along with additional statistical information such as the number of items in each scale, sample size (N), minimum and maximum scores per scale, mean scores, variance and calculated Cronbach's Alpha coefficient. Cronbach's Alpha is a measure of internal consistency reliability that assesses the extent to which items in a scale measure the same underlying construct. Overall, Table 6 demonstrates that all four scales in the study exhibit high reliability, as indicated by Cronbach Alpha coefficients ranging from .719 to .907.

Table 6. Cronbach Alpha for the Study's Scales

	Number of Items	N	Min	Max	Mean	Variance	Cronbach Alpha
Ecosystem services(VD)	14	256	3.250	4.523	3.958	.124	.907
Attractiveness (VF1)	11	250	3.384	4.592	4.346	.108	.874
Sustainability(VF2)	15	264	2.379	4.356	3.114	.431	.769
Barriers(VF3)	7	260	2.762	4.231	3.535	.325	.719

4. Findings

The three models predicted in Table 7, which resulted from the regression analysis, show the influence of different predictors (or independent variables) on an unknown dependent variable. The coefficient R² represents the proportion of the variation of the dependent variable explained by the model. The Beta coefficient (β) is the standardised slope of each independent variable, showing the relative importance of each variable in the model. "B" represents the unstandardized slope, "t" is the t-statistic associated with each predictor, and *** indicates a significance level below .001.

Model 1 has an R² of .117, which means that the model explains 11.7% of the variation in the dependent variable. The most significant predictor appears to be "VF1", given the largest t-value and a positive Beta coefficient. Education level also has a positive

impact, while the variables 'gender' and 'age' have a negative impact on the dependent variable, although they are relatively insignificant according to t-values.

Model 2, with an R² of .242, explains 24.2% of the variation in the dependent variable. It includes an additional predictor to Model 1, "VF2", which has the highest Beta value and the highest t-value, indicating a strong influence on the dependent variable. "VF1" remains an important predictor, although its impact is somewhat smaller in this model. Education level retains its positive influence, while 'gender' and 'age' have an even smaller negative impact.

Table 7. Summary of Hierarchical Multiple Regression Results for

	<i>B</i>	β	<i>t</i>	<i>R</i> ²
Model 1				.117
Constant***	25.114		4.013	
Gender	-.855	-.035	-.559	
Age	-.730	-.104	-1.485	
Education level	.892	.108	1.532	
VF1	.496	.318	5.053	
Model 2				.242
Constant***	2.900		.424	
Gender	-.766	-.031	-.539	
Age	.237	.034	.491	
Education level	1.146	.138	2.115	
VF1	.376	.241	4.036	
VF2	.504	.391	6.129	
Model 3				.259
Constant***	-3.241		-.443	
Gender	-.794	-.033	-.564	
Age	.143	.020	.297	
Education level	1.179	.142	2.195	
VF1	.357	.229	3.851	
VF2	.515	.400	6.311	
VF3	.265	.131	2.258	
*** significant at <.001.				

Model 3 slightly increases R² to .259, which means that the model explains 25.9% of the variation in the dependent variable. This model includes one more predictor, "VF3", which adds a slight improvement to the explanatory power of the model. "VF2" remains the most influential predictor, and "VF1" and education level are still important, with positive effects. "Gender" and "age" continue to have a negative but minor impact on the dependent variable.

5. Discussions

Considering that "VF1" represents "Attractiveness", in the context of initiatives or services to improve tourism and infrastructure in the Danube Delta, Model 1 in the regression analysis may have economic, social and sustainability implications.

From an economic point of view, the positive and significant value of the coefficient for "Attractiveness" (VF1) in Model 1 indicates that improving the attractiveness of the Danube Delta can have a direct and positive impact on the local economy. This could mean that investments in tourism services, infrastructure or nature conservation could increase tourism revenues and bring economic opportunities for local communities. However, the relative contribution to variance ($R^2 = .117$) suggests that other variables not included in the model may also influence economic performance, so further analysis is important.

From a social perspective, the negative coefficient for "Gender" could indicate the existence of differences in perception or tourism experience based on gender, which could have implications for social inclusion and service design. Age, also having a negative coefficient, suggests that perceptions may differ across age groups, possibly reflecting different priorities or accessibility (Nguyen, 2017).

From a sustainability perspective, the presence of 'Level of education' as a positive predictor could imply that people with higher levels of education are more aware of the importance of sustainability and may be more likely to support responsible tourism practices that protect the Delta's natural environment. Thus, initiatives to educate tourists and local communities about the importance of conservation can play a crucial role in maintaining the balance between development and conservation.

In conclusion, Model 1 suggests that improving the tourist attractiveness of the Danube Delta should take into account the different needs and preferences of social groups and promote practices that are both economically profitable and sustainable to maintain the unique biodiversity of the region. This implies the need for a balanced approach that incorporates economic development, social cohesion and environmental protection.

In Model 2, the newly introduced variable VF2, representing current perceptions and potential for tourism and conservation, as well as resource management of the Danube Delta, has a Beta coefficient (β) and a large t-value, indicating a significant influence on the dependent variable, suggesting that perceptions related to these aspects are strong factors in the model analysed.

From a tourism perspective, a large and positive value for VF2 suggests that positive perceptions of natural resource conservation and management can improve the tourist attractiveness of the Delta. Responsible and conservation-conscious tourism could attract visitors who value sustainability and authentic experiences. An R^2 coefficient of .242 indicates that these factors explain almost a quarter of the variance in the data, which is quite significant in the social context.

From a conservation perspective, the results could be interpreted as a warrant for conservation policies that positively influence current perceptions. Thus, effective natural resource management and biodiversity protection actions could be essential in promoting a

positive image of the Delta, which in turn contributes to its attractiveness and tourism value (Sbarcea *et al.*, 2019).

From a resource management point of view, we can deduce that effective resource management is crucial not only for biodiversity conservation but also for the economic viability of tourism in the region. Implementing sustainable resource management can help maintain a balance between resource use and long-term conservation of natural habitats (Cociasu *et al.*, 1996).

In conclusion, Model 2 suggests that perceptions of the conservation and management of the Danube Delta are closely linked to its tourism potential. In order to increase the attractiveness of the region as a tourist destination, it is essential not only to improve infrastructure and tourist services, but also to maintain effective and sustainable management of natural resources, which contributes to a positive perception by visitors and local communities. These results can guide decisions on investment and policy priorities in the region.

Model 3 shows that for a comprehensive analysis of the Danube Delta, the identified obstacles need to be considered and addressed. This requires an integrated planning framework incorporating economic, social, environmental and administrative perspectives to overcome these barriers and support a sustainable and comprehensive development of the region (Stan *et al.*, 2021). Strategies that are sensitive to these barriers and that aim to reduce or eliminate them will be crucial to the long-term success of any development initiatives in the Danube Delta.

From an economic perspective, these barriers can limit investment and new business development, which affects local economic growth and income generation (Aivaz & Vancea, 2009). From a social perspective, barriers can influence the quality of life of local communities by restricting access to resources and services or limiting employment opportunities, and in terms of environmental impacts, they can be linked to the challenges of balancing development with the conservation of biodiversity and the unique ecosystems of the Delta (Petrisor, 2016).

Also, politically and administratively, obstacles may flag the need for better coordination between regulatory agencies and local and national authorities in the design and implementation of development policies.

6. Conclusions

The ecosystem services of the Danube Delta are complex, involving economic, social, conservation and sustainability interests. The analysis by hierarchical multifactor regression highlights not only the current values but also the importance of strategic management of the Delta to optimise ecosystem services in the long term. To achieve this goal, close collaboration between government, local communities, the private sector and NGOs is needed to promote responsible tourism and a development model that preserves the unique natural and cultural heritage of the Danube Delta.

Our study revealed that the attractiveness of ecosystem services is a key factor in the perception and use of the Delta, as shown by the importance of "VF1" in Model 1. Improving infrastructure and offering improved tourism services are key to the economic

growth of the region and to enhancing the visitor experience. However, this needs to be balanced with the needs of residents and environmental conservation, as reflected in the coefficients for gender and age, indicating the need to consider a wide range of stakeholders in tourism sector activity.

Model 2 showed us that current perceptions and tourism potential, together with resource management, are fundamental in determining the value of the Danube Delta as an ecotourism destination. "VF2", assessing perceptions related to tourism and conservation potential, highlights that implementing effective and responsible resource management can positively influence the attractiveness of the region for tourists and investment.

Finally, Model 3 highlighted the influence of "VF3", which are obstacles to the development of the Delta. Recognising and addressing these barriers, which include legislative, economic, social and environmental issues, is essential to ensure the sustainable development of the Danube Delta. This model underlines the need for an integrated approach that does not neglect any of these aspects.

This research calls for a concerted effort to overcome existing barriers and support initiatives that add value for both local communities and the natural environment. As the Danube Delta is a UNESCO World Heritage site, the responsibility for its conservation and sustainable development is a global one, and the results of this analysis can provide a basis for developing policies and practices that reflect this shared responsibility.

7. References

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