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# DIFFICULTIES IN ACHIEVING SOCIAL SUSTAINABILITY IN A BIOSPHERE RESERVE

Alexandru-Ionut PETRISOR[1,2*], Raluca PETRE[2], Vasile MEIȚĂ[2]

[1] Ion Mincu University of Architecture and Urban Planning, Str. Academiei nr. 18-20, sector 1, 010014, Bucharest, Romania

[2] National Institute for Research and Development in Constructions, Urban Planning and Sustainable Spatial Development URBAN-INCERC, Sos Pantelimon no. 266, sector 2, 021652, Bucharest, Romania

***Abstract***

*In the management of resources, the cost of opportunity plays an important role decision making when resources are finite and their use restricted. In natural protected areas restrictions can lead to social issues when the local economy suffers: the displacement of people, unsupportive attitude towards conservation or illegal activities. This situation is important in biosphere reserves, which should be learning laboratories for an integrated economic, societal, cultural and environmental sustainability. This paper analyzes the example of Danube Delta Biosphere Reserve in Romania, aiming to find correlations between social and environmental issues. The results indicate that urbanization, deforestations and abandonment of agriculture are the leading transitional dynamics of environmental degradation, and ageing and migration of population (especially from rural areas) to better job opportunities are the main societal challenges; they seem to be inversely correlated, although not statistically significant. Rural communities, with a better environmental status, experience social issues, and urban areas, with a better socio-demographic status, face environmental impacts. Spatial analyses show that isolation, essential condition for safeguarding the pristine environmental status, is a major obstacle for development. The solution consists of needs-based policies aimed at preserving traditional values and increasing environmental awareness through education.*

***Keywords:*** *Conflict; Conservation; Development; Demography; Society; Biosphere reserve; Danube Delta; Sustainability.*

## Introduction

When dealing with the quantitative assessment of natural resources, including ecosystem services, a key concept is the cost of opportunity, which measures the impact of assigning a certain resource to a specific economic activity; this procedure allows for choosing the most cost-effective use [1-2]. When resources are finite or the impact of assigning them to a certain use is irreversible (*e.g.*, different possible land uses of the same parcel [3] or conflicting uses of neighboring parcels [4], the importance of finding the optimal cost of opportunity becomes crucial. This is also the case of natural protected sites, where the conservation status limits the possible uses of most natural resources [5, 6]. On the other hand, according to many authors, the benefits of conservation include ecosystem services [7-10], tourism revenues [8, 11], and an improved infrastructure [8, 11].

* Corresponding author: alexandru_petrisor@yahoo.com

The conflict between conservation and economic development becomes pregnant in developing countries or in developed countries during economic crises [12]. Many authors consider that environmental issues associated with the lack of environmental awareness are a consequence of poverty or at least connected to it [10, 13-15], particularly in developing countries [16, 17], or when natural resources are not seen as solutions for reducing poverty through their sustainable use [18].

Generally, there is a controversial debate between conservation and its effects on humans [8, 19]. Some authors believe that conservation can reduce poverty [7-11, 20, 21], while others believe that in fact conservation induces poverty [22], that is not aimed at its reduction [8] or the socio-economic and environmental management objectives are conflicting [23]. When looking at the roots of the conflict, some authors point to the temporal and spatial scale; conservation is aimed at future generations and, for this reason, it is locally unfair for the current generation [24]. Moreover, its scope is more general and expands over the local borders [25]. Furthermore, Upton *et al*. [26] believe that the relationship might differ with the scale and that the conflicts can be local, but not national.

Among the causes of conflicts, economic activities are the dominant ones [27]; in particular, agriculture seems to be a source of conflicts [8, 23, 27]. Generally conflicts appear due to restricting access to resources [7, 8, 11, 23, 24, 28-32], reducing the rights derived from ownership [7, 19, 30], ignoring the particularities of local cultures [33] or from an unfair distribution of revenues [19, 21, 24]. The economic causes generate social issues [32]. Some authors also mention conflicts between humans and the wildlife [7, 23]. Other causes are political; they include the local opposition to top-down approaches [7, 23, 34-36], especially to restrictions imposed by international acts [37] and lack of or reduced involvement of local communities in the management of protected areas [21, 39-41]. Moreover, low accessibility [8], lack of funding [32, 42], lack of planning and design [43] and the pressure of tourism [42] are possible sources of conflict.

As it has been mentioned above, tourism generates conflicts due to the behavior of tourists [44], particularly through cultural differences and their lack of interaction with the locals [45], which ultimately determine an erosion of the local traditions [41], but also due to an uneven return of benefits [41]. Tourism attracts jobseekers [44] and even immigration to protected areas [46]. Nevertheless, Walpole and Goodwin [41] found out that a positive attitude towards tourism may be likely to determine a local supportive attitude towards conservation. The number of tourists visiting protected areas is conditioned by infrastructure [47]. While the remoteness of these places usually prevents massive tourism [8], the development of infrastructure resulting from the protection status [8, 11] can generate potential threats.

The effects of the conflict between conservation and local people are discussed by Cernea and Schmidt-Soltau [30], who identified eight possible consequences: “landlessness, joblessness, homelessness, marginalization, food insecurity, increased morbidity and mortality, loss of access to common property, and social disarticulation”. As a consequence, people move away [7, 22, 48- 49], are less supportive to conservation [21] (although Dolnicar [50] suggests that regional identity is a decisive factor determining the support), react against it [34, 51, 52] or simply ignore the conservation status. The last situation leads to environmental degradation through illegal activities (poaching and harvesting of resources) despite the conservation status [32, 53-56]. Due to the population shifts, many protected areas face depopulation and ageing due to maintaining a rural economy [57-58], or ageing and unemployment [59].

While the challenge of reconciling economy, society and the environment is a core requirement of sustainable development [60], this issue becomes prominent in biosphere reserves, seen as sustainability-learning sites [35, 61]; that is, human settlements situated within biosphere reserves must be managed such that they achieve equally social, economic and environmental sustainability and make up a successful case study.

The economy – society – conservation nexus resulted from the literature review presented before is summarized in the conceptual model presented in Fig. 1.

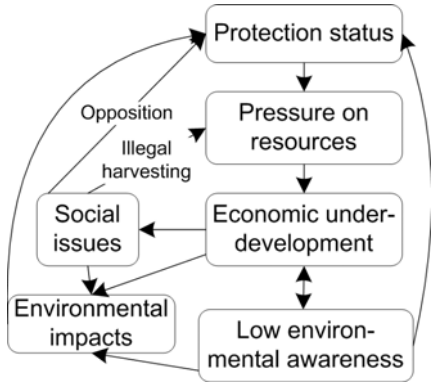


**Fig. 1**. The economy – society – conservation nexus

Nevertheless, this paper is focused on the relationship between society and the environment in a biosphere reserve, choosing the Danube Delta Reserve of Biosphere as a case study. The reserve, situated in southeastern Romania (Fig. 2), covers two level 2 units of the Nomenclature of Units for Territorial Statistics – NUTS (countries) and 30 NUTS level 5 units (cities and communes), summing 58 km$^2$; due to the surface, the area is ranked as second largest wetland and largest biosphere reserve [62-63].

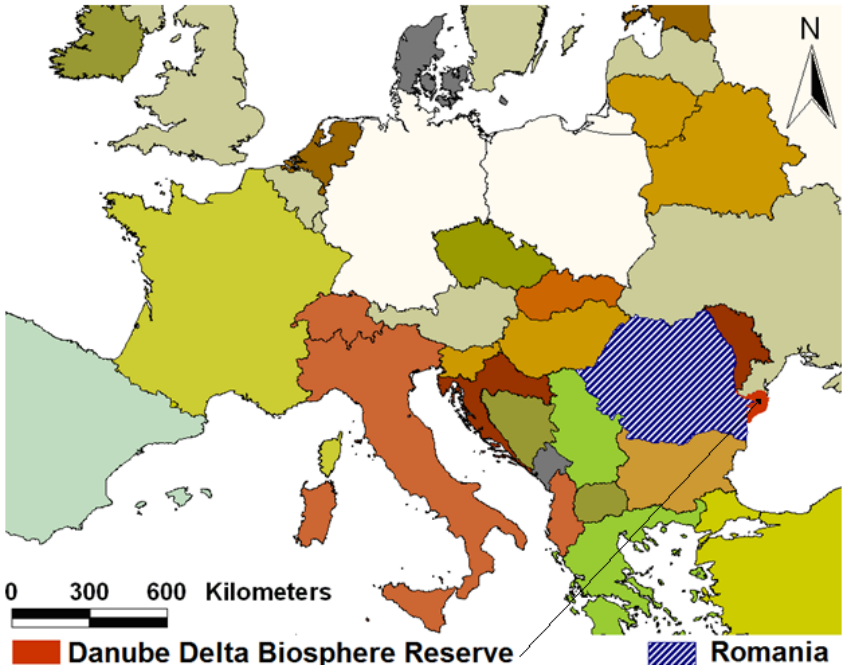


**Fig. 2**. Position of Danube Delta Biosphere Reserve in Romania and Europe (Meiţă *et al*., 2014, with changes)

The study aimed to test whether there is a relationship between the long-term societal and environmental challenges experienced by the human settlements within the territory of the reserve.

## Data and methods

The methodology used in this study was a geostatistical analysis carried out at the level of territorial units (NUTS level 5) looking at the dynamic of their demographic and social profile in relationship with the environmental changes. Geographical Information Systems (GIS) were chosen due to their ability to provide a superior modeling of spatial reality [64].

Environmental impacts were assessed through the long term changes of land cover and by using CORINE data. These data are effective in assessing long term transitional dynamics, especially those determined by economic changes [65]. In this particular case, areas were summed up by transitional dynamics (using positive values for positive impacts and negative values for negative impacts) for each administrative unit separately, and a ranking of settlements was produced for the two periods covered by CORINE data – 1990-2000 and 2000-2006. Among the impacts identified, the regeneration of forests (by afforestation or reforestation) was the only positive one, while the negative ones included urbanization, deforestation, desertification, floods and abandonment of agricultural land.

Demographic and social analyses used raw 2002-2011 data on births, deaths, migration, people moving permanently in and out, and structure of population by age and gender; the indicators were chosen due to their relevance in the planning process [66]. These data were aggregated into complex indexes, sometimes requiring complex computations:

(a) Trend analysis: the method is a variation of the approach developed by Petrişor *et al*. [67], consisting of assessing trends at the level of each unit (in this case, administrative units), and then summarize the results using a statistical test. The difference is that the original paper assessed trends based on the slope of the regression line; here, the coefficient of determination (square root of the coefficient of correlation) is used instead. The regression parameters were computed for particular indicators (global ageing index, percentage of elderly people – people aged 65 and over) against time.

(b) Other analyses were carried out for separate periods or years, based on the availability of data: 2007 and 2011 for density, 2004-2005 and 2008-2009 for migration, 2004 and 2011 for the ageing index.

(c) All values were ranked for the administrative units. When trends were analyzed (ageing index, percentage of elderly people), values were ranked based on the quintiles using the values of the coefficient of determination. In other situations, particular classes were used for density (1 – less than 10/km$^2$, 2 – 10.1 - 20/km$^2$, 3 – 20.1 - 40/km$^2$, 4 – 40.1 - 70/km$^2$, 5 – over 70/km$^2$), net migration rate (1 – increase over 10%, 2 – increase by 2.1% - 10%, 3 – stagnation – (–2)% - 2%, 4 – decrease by (–2.1)% - (–10)%, 5 – decrease more than (–10)%), dynamics of population (1 – increase over 10%, 2 – increase between 2.1 and ten, 3 – stagnation between (–2)% and (+2)%, 4 – decrease between (-2)% and (-10)%, 5 – decrease over (-10)%), and ageing index for each period (1 – young: <40%, 2 – mature: 40.1%-50%, 3 – old: 50.1%-60%, 4 – very old: 60.1%-100%, 5 – extremely old: >100.1%).

(d) Overall ranking – the values of ranks were computed such that high values indicate a "bad" situation. The overall rank resulted from ranking the weighted sums of ranks (*e.g*., the share of population over 65, global ageing index and ageing indices for the two periods formed a group), including mortality and natality in addition to the indices discussed above, and using the quintiles of the resulting distributions.

(e) To test whether the socio-demographic and environmental issues are correlated, rankings for the land cover and use changes occurred during 2000-2006 were

correlated with the ones of the overall ranking with respect to socio-demographic issues, computed in the previous step (covering the period 2002-2011).

In all cases, classes were defined such that high values indicate local problems.

## Results and Discussion

The analyses aimed to investigate the social and environmental issues of Danube Delta Biosphere Reserve. Environmental issues were analyzed based on the transitional dynamics reflected by land cover and use changes using CORINE data. The spatial distribution of changes by administrative units is displayed in Fig. 3a (1990-2000) and Fig. 3b (2000-2006). The results indicate that the most important transitional dynamics affecting negatively the area were urbanization, abandonment of agricultural land, floods, deforestation, and desertification during 1990-2000, and urbanization and deforestations during 2000-2006. The positive changes were represented by the regeneration of forests during both periods; however, without local information, despite the fact that ecological restoration projects were developed in the area, these changes cannot be assigned to the two possible explanations: afforestation represents the conversion of other land uses into forest, or the increase of canopy coverage over 10% through plantations or natural regeneration, while reforestation is the re-establishment of forests after a temporary condition decreasing the canopy coverage below 10% due to human-induced or natural perturbations [68].

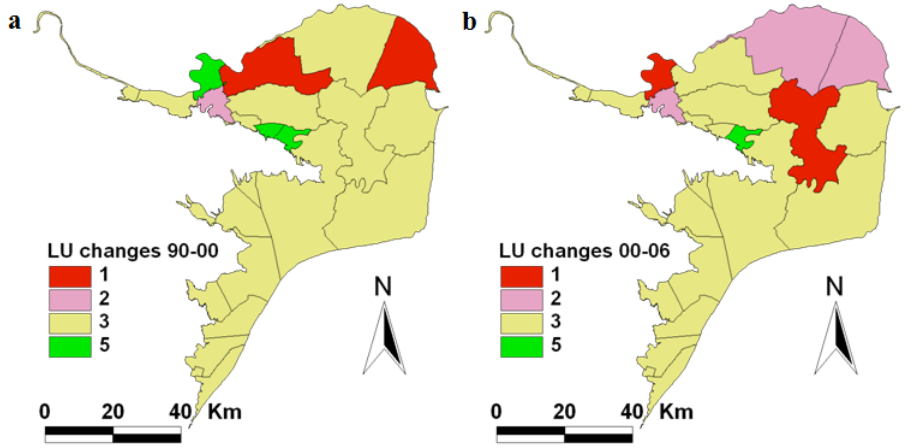


**Fig. 3a**. Land cover and use changes in the administrative units of Danube Delta Biosphere Reserve: a - during 1990-2000, b - during 2000-2006 . Numbers indicate the ranks, high values suggesting local problems.

These results are consistent with the findings of other studies [62, 65, 69-70], which showed that urbanization, deforestations and abandonment of agriculture are the leading causes of land cover and use changes in Romania, but also to transition countries in general [71-73].

The analysis of socio-demographic changes pinpointed several phenomena. One of them is demographic ageing. While the age pyramid (Fig. 4) reveals an overall declining population, there are differences in the trends between 2002-2004 and 2004-2011 (Fig. 4), and important territorial differences. These are shown in Fig. 5a (displaying the distribution of population aged 65 and over), Fig. 5b (displaying the distribution of the cumulate ageing index), and Fig. 5c and Fig.5d (displaying the distribution of the ageing index for 2004-2006 and 2009-2011). Again, these results are consistent with previous findings [28]; while such phenomena are a general characteristic of Europe [74], they seem to be exacerbated in Romania [74-75] due to the emigration of workforce, especially in the rural areas, where they produce radical transformations in conjunction with the increased shared of the elderly and poverty [74].

Moreover, unemployment is an additional cause of migration from the Danube Delta villages [28].

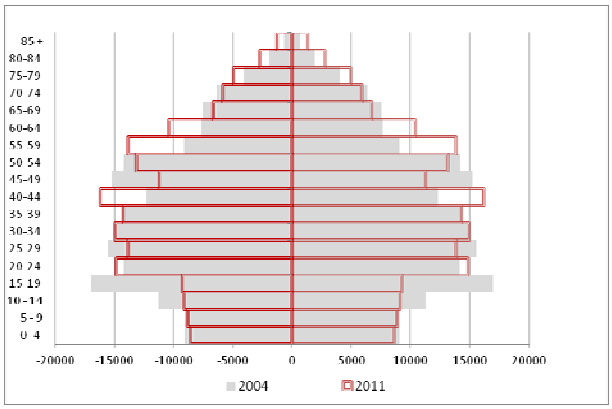


**Fig. 4**. Population of Danube Delta Biosphere Reserve by age.

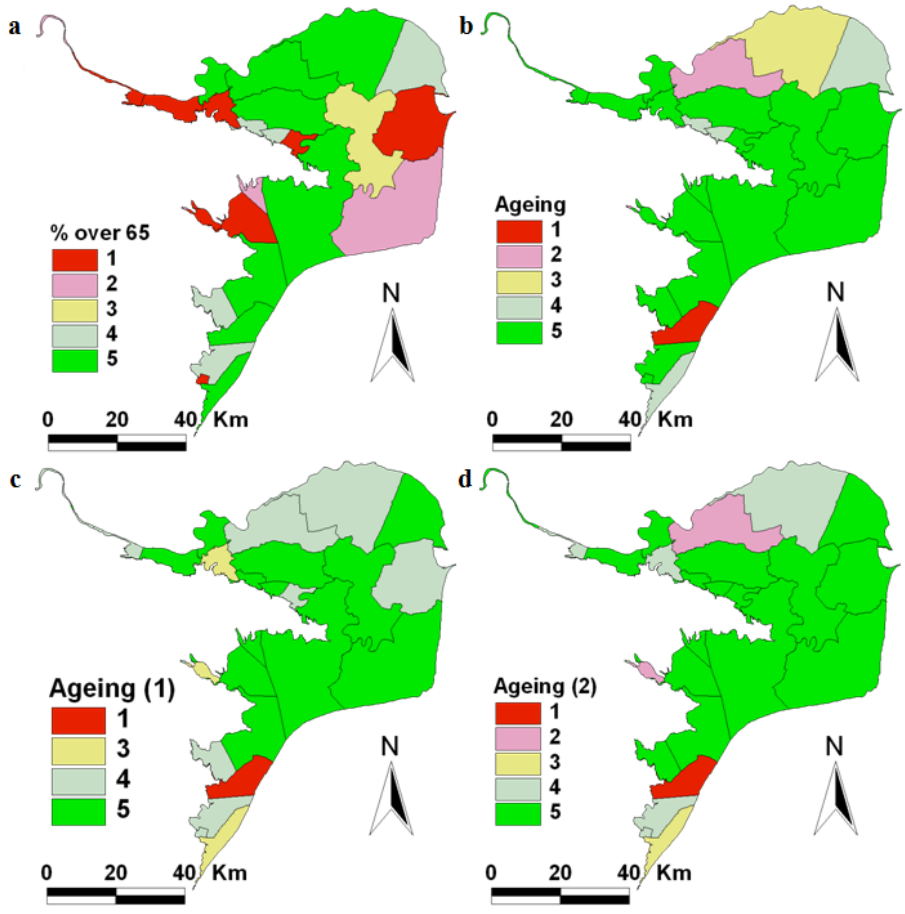


**Fig. 5**. Distribution in the administrative units of Danube Delta Biosphere Reserve:
a - of people age 65 and over, b - global ageing index, c - the ageing index in 2004, d - the ageing index in 2011.
Numbers indicate the ranks, high values suggesting local problems.

Another important characteristic of the population of Danube Delta Biosphere Reserve is the uneven distribution of density, which is higher in the urban areas (Fig. 6). The evolution of settlements and density of population are conditioned by the geographic characteristics of the area [76]. The distribution shows slight differences between the two periods, 2002-2007 (Fig. 6a) and 2008-2011 (Fig. 6b).

As its has been shown before, the reduction of population was determined by migration; in the Danube Delta, its causes include poverty, lack of education and training, and unemployment [77], and also the rural status of most settlements – given the trends of migration from Romanian rural areas [74]. While the results indicate differences in migration between the periods 2004-2005 (Fig. 7a) and 2008-2009 (Fig. 7b), the overall trend suggests that migration is higher in the rural areas and lower in the urban areas.

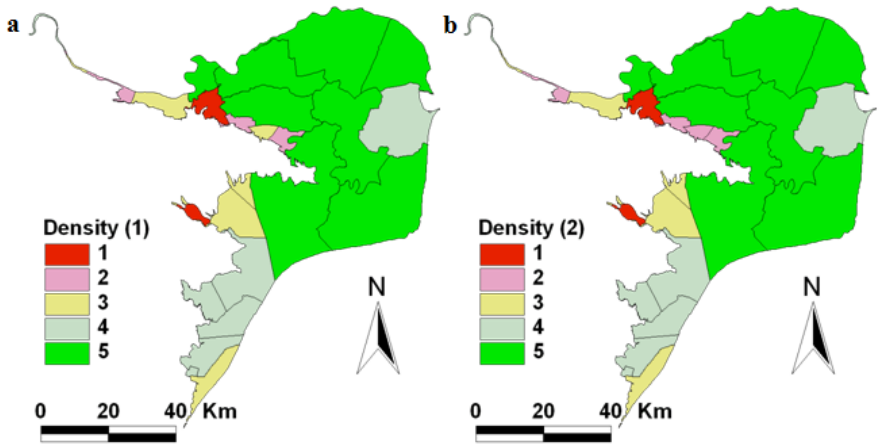


**Fig. 6**. Population density in the administrative units of Danube Delta Biosphere Reserve in: a – 2007 and b – in 2011. Numbers indicate the ranks, high values suggesting local problems.

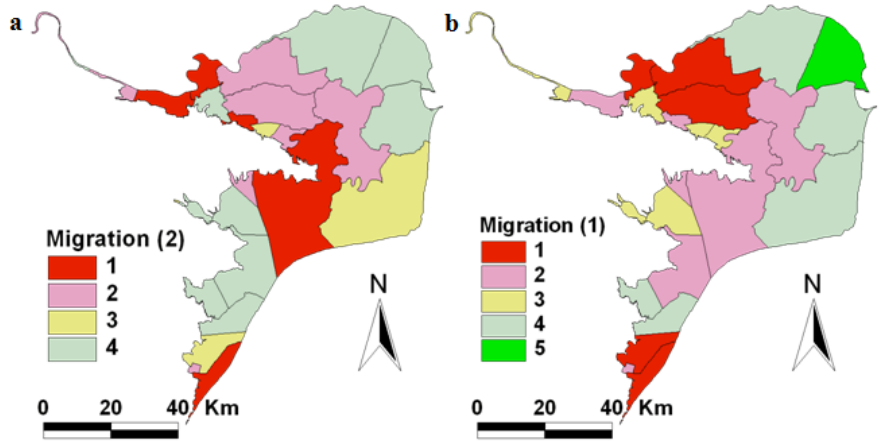


**Fig. 7**. Migration of population in the administrative units of Danube Delta Biosphere Reserve: a - during 2004-2005 and b – during 2008-2009. Numbers indicate the ranks, high values suggesting local problems.

The overall results are showed in Fig. 8 (dynamic of population) and Fig. 9 (overall socio-demographic ranking). The spatial distribution suggests that the disfavored areas are the rural ones. The urban areas have a better status. If this spatial distribution is compared with the one of environmental changes, similarities can be easily noticed. Environmental impacts

induced by urbanization or tourism occur close to the urban settlements, since they offer better infrastructure for tourism, and also attract the job seeking population of rural settlements [28], who eventually move closer. The incoming local migration determines additional environmental impacts. The spatial pattern supports the findings of Andam *et al*. [8], who considered that the remoteness of protected areas could result into a decline of the economical activities within their boundaries. In this particular case, the urban settlements were favored by access to the Black Sea in the western side [78-79] and upstream navigation on the Danube in the eastern side, while the ones situated in the central part maintained their rural status due to the fact that navigation was the only access gate; in the Danube Delta, weather conditions (ice) prevent navigation during the cold season [80, 81].

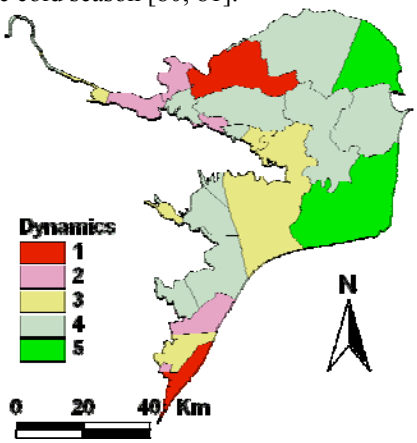


**Fig. 8**. Dynamics of population in the administrative units of Danube Delta Biosphere Reserve during 2004-2005. Numbers indicate the ranks, high values suggesting local problems.

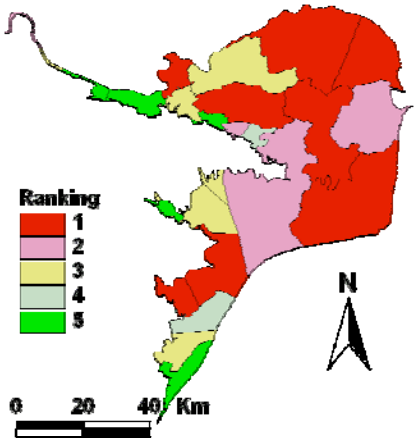


**Fig. 9**. Overall socio-demographic ranking of administrative units of Danube Delta Biosphere Reserve during 2002-2011. Numbers indicate the ranks, high values suggesting local problems.

Another possible explanation consists of the development of tourism [28, 82]. Traditional cultural values are lost along with the housing and architectural principles that worked for centuries, leaving room for an invasion of aggressive tourism and its equally forceful infrastructure. If the socialist period created an unsustainable local economy based on industry, the recent 'democratic' tourism-based economy seems to have deleterious effects too; new estranged constructions seem to take over the natural and cultural landscapes [62, 83-84].

The correlation of the two distributions was tested using the linear correlation of ranks (Fig. 10). The coefficient of correlation was $R^2 = 0.189$. The value is not significant at 0.05. The explanation can consist in the low sample size (values were available only for 28 units). Nevertheless, the negative correlation supports the arguments, showing that administrative units with social problems did not experience significant environmental impacts; environmental issues are characteristic to urban settlements, with a better socio-demographic status.

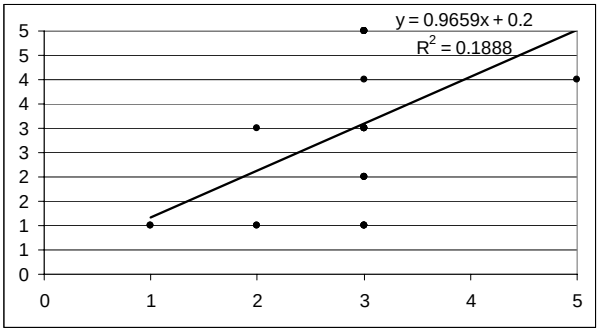


**Fig. 10**. Correlation of the rankings of Danube Delta Biosphere Reserve territorial units with respect to environmental and socio-demographic issues.

Possible limitations of the study include:

(1) This study was carried out as an ecological study, meaning that the units of analysis were territorial units. In this case, correlations do not necessarily involve causality, but can be the result of spurious associations [85].

(2) The small sample size and lack of data for certain units or periods could have affected the power of statistical test, preventing the detection of a significant correlation.

(3) As it has been mentioned before, the methodology cannot provide sufficient evidence for causality. While the urban areas seem to concentrate population and impacts and rural areas have a better environmental status, but experience socio-demographic issues, the analysis does not allow for testing whether socio-demographic issues are a consequence of poverty resulting from the restriction imposed to the use of resources by the conservation status.

(4) From a spatial perspective, the Danube Delta covers entirely the territory of certain administrative units and embeds parts of other units. Assigning the overall values for the units included partially in the territory of the reserve to the parts included in its territory does not necessary reflect the reality.

## Conclusions and recommendations

The study aimed to test whether there is any correlation between socio-demographic and environmental issues at the level of administrative units within the Danube Delta Biosphere Reserve. While the statistical analysis was unable to detect a significant correlation, most likely due to the reduced sample size, the spatial analyses suggest that rural areas have a better environmental status, but experience the loss of population through migration and demographic ageing, due to poverty and unemployment. There is no sufficient evidence that the protection status led to this situation through the restrictions imposed to the use of natural resources.

Nevertheless, this study has pointed out several issues of the area. From an environmental perspective, the most important impacts induced by transitional dynamics are due to urbanization, deforestation, and abandonment of agricultural land. Additional pressure was induced by tourism; the aggression of the new tourism played a key role in this process.

From a socio-demographic perspective, ageing and migration are the leading cause of the potential depopulation of the area.

Recommendations for the authorities focus on addressing the economic, societal, and environmental issues in an integrated approach, granting them equal priorities. The literature suggests that the involvement of local population, in conjunction with educating them and increasing their environmental awareness, is crucial for achieving the sustainable development of the area. This goal could be achieved if the traditions and practices of the local culture become an integrant part of the development strategies, and if sufficient emphasis is placed on the local needs in the planning process.

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