

SOCIAL-ECOLOGICAL CONSEQUENCES OF PLANNING AND DEVELOPMENT POLICIES IN THE DANUBE DELTA BIOSPHERE RESERVE, ROMANIA

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Abstract: The Danube Delta acts as a complex social-ecological system where the main driving forces of wetland changes include anthropic activities. At the moment, overfishing and inadequate development actions are responsible for wetland disturbances and biodiversity loss. The aim of this study is to assess the causes of Danube Delta Biosphere Reserve (DDBR) wetland degradation and to identify the impacts on environment and social life. Using primary and secondary data bases (statistical data and field observation), the progress of the social-ecologic system components were investigated. The research was organized around the hypothesis that: through analysis of development activities over time, the territorial effects and demographic responses can be observed which show the significant interconnections in the progress of flows that insure the coherence of the social-ecologic system. The study conclusions emphasize that the existing wetland-protection measures in the DDBR should be further strengthened due to possible environmental consequences of wetland loss and social changes such as destruction of traditional values and social stability.

Keywords: Anthropic activities, land use change, driving forces, sustainable development, adaptive management, Danube Delta

1. INTRODUCTION

According to UNESCO, biosphere reserves are areas comprising of terrestrial, marine and coastal ecosystems. Each reserve promotes solutions reconciling the conservation of biodiversity with its sustainable use. Wetlands provide many important ecosystem functions and services (Acreman et al. 2007; Costanza et al., 1997) although the development value of resources in a wetland is often misinterpreted, leading to the misperception that the wetland areas are unproductive and have low or non-existent development values (Cioacă et al., 2006). Wetland is not only a valuable natural resource for human survival, but it is also one of the most important ecological environments (Kingsford, 2011).

The Danube Delta represents a particular wetland of international value that represents a contested space at regional level (Iordachi & Van Assche, 2014). As a natural space challenged by various territorial processes and phenomena, the

Danube Delta requires a social-ecological system approach to management. This approach provides an integrated pathway for sustainable development in the context of constant and bi-directional interactions between anthropic actions and environmental purposes (Damian & Dumitrescu, 2009; Galatchi, 2009; Hanspach et al., 2014; Iordachi & Van Assche, 2014; Moore et al., 2014).

Anthropic activities resulting from exploitation and planning policies for increased development over time, led to significant impacts on the physical and environmental components in the Delta. They caused related damaging changes to the natural environment (Ianoş et al., 2009; Stănică & Panin, 2009).

Planning policies implemented across different time periods also placed social pressures on the Danube Delta which generated demographic fluctuations, social and community-related issues (Dumitrescu, 2002). The end of the communist political system in 1989, closely followed by the

collapse of the decentralization of agricultural activities, represented a period of massive emigration of population from the Delta. This generated social and development difficulties for the people still living in the communities, in addition to a loss of efficiency of local territorial systems arising from the decrease in the main anthropic activities (Damian, 2011).

Recent studies analyse the level of development of human settlements in the Danube Delta, based on complex assessments that take into consideration multiple social, growth and infrastructural indicators. The main results of these studies emphasize a generally low level of development registering important differences across administrative units. The major findings relate the present level of development to former unsustainable policies and actions (Petrișor et al. 2012).

The impact of the different planning measures implemented during the communist period resulted in important land use changes and land degradation. This led to negative environmental effects in relation to the conservation objectives of the Danube Delta Biosphere Reserve (DDBR) (Gomoiu, 1996; Petrișor et al., 2012).

Damian & Dumitrescu (2009), in an article concerning sustainable development and possibilities for revival in the Delta, consider that agriculture can be practiced in the Delta area, although the restricted areas and reduced fertility of soils can be an obstacle. This can be achieved especially by relying on cultivating medicinal plants for bio-agriculture without using pesticides because their usage is prohibited on the territory of the Biosphere reserve.

A large number of studies show that the multiple changes in land tenure were caused by different territorial policies in different time periods and resulted in both irregular natural and agricultural landscapes and deteriorated water quality due to different techniques used for land fertilisation (Petanidou et al., 2008; Galatchi & Tudor, 2006; Catianis et al., 2013; Iticescu et al., 2013; Daloğlu et al., 2014).

This paper presents a comprehensive review of the anthropic interventions and their territorial consequences on the social-ecological system, in order to give a clear understanding of all territorial processes and phenomena involved and to consolidate the scientific background on the Danube Delta. Based on the outcomes, the paper defines perspectives on governance in a biosphere reserve.

The main purposes of this study are: (1) the analysis of planning policies in the Danube Delta through the related political and development contexts, with a focus on land use changes and the resulting increase in the territory's fragility and certain demographic implications; (2) the

identification of the different territorial processes involved through the use of environmental, demographic and institutional information with the aim to evidence: the territorial factors causing complex system changes; the actors involved in the management and use of territorial resources; the ecological response of the territory to the implemented policies; and the social impact of regional planning actions.

2. MATERIALS AND METHODS

2.1. Study area

The Danube Delta is located in the Southeastern part of Romania, between 44°47'25" and 45°37'30" N latitude and between 28°44'25" and 29°46'00" E longitude (Fig. 1). The study area includes the entire Biosphere Reserve, starting a few kilometers downstream from the city of Tulcea to the Black Sea coast. To the North, it neighbours with Ukraine, having the Chilia Arm as a natural border (neighbouring the Ukrainian Danube Delta Biosphere Reserve). The total surface is 580 000 ha in area, accounting for 8 administrative-territorial entities. The mean altitude is 0-12 m above sea level (Gâștescu, 2009).

The current status as a Biosphere Reserve implies that all anthropic activities have to follow the biodiversity preservation and safety rules. The entities involved in the Delta's management are: fishing and related companies; tourism agencies; maritime and fluvial transport companies; leisure hunting groups; and NGOs for nature preservation and protection. Over time, the use of the Delta's resources has been the point of interest for different activities through the intensification of anthropic activities and the harnessing of various resources starting in the 1940s. After 1990, the expansion of this preserved area has been interpreted through ecological aspects and environmentally friendly lifestyles (Gâștescu, 2009).

After its designation as biosphere reserve, the Danube Delta became part of the international organisations EUROSITE and EUROPARC FEDERATION. Also, for a better recognition and management of the Delta, international agreements were signed with other similar wetlands: France (1991-1998); The Netherlands (1995-2000); Astrakhan Region, Russian Federation (1996); and Italy (2002, 2005).

There are some initiatives on international cooperation and common policies between Romania, Ukraine and Moldova, but the number of projects is low because Ukraine and Moldova are not members of the European Union. The first cooperation

agreement between Romania and Ukraine operated during the period 1996-1999 and it was focused on ecological restoration, territorial management, and participatory governance in the two wetland areas.

2.2. Data acquisition and change detection

The present study involved the assessment of conceptual and practical changes imposed and generated by the implementation of planning policies aiming at the development of the Danube Delta. With an emphasis on resource management, the analysis takes into consideration mostly the impact of these centralized development policies on

the different components of the social-ecological system – ecological, demographic, social and cultural – and on their interaction.

Many useful techniques have been applied to quantify land use and change in land use in order to investigate the social, political and development forces driving the territorial changes.

Land use data employed in this study came from the CORINE Land Cover database. Data at the local level are derived from the Tulcea County statistics yearbooks from 1890 to 2010. We explored census tabulations to investigate the negative impacts of anthropic activities on land change dynamics.

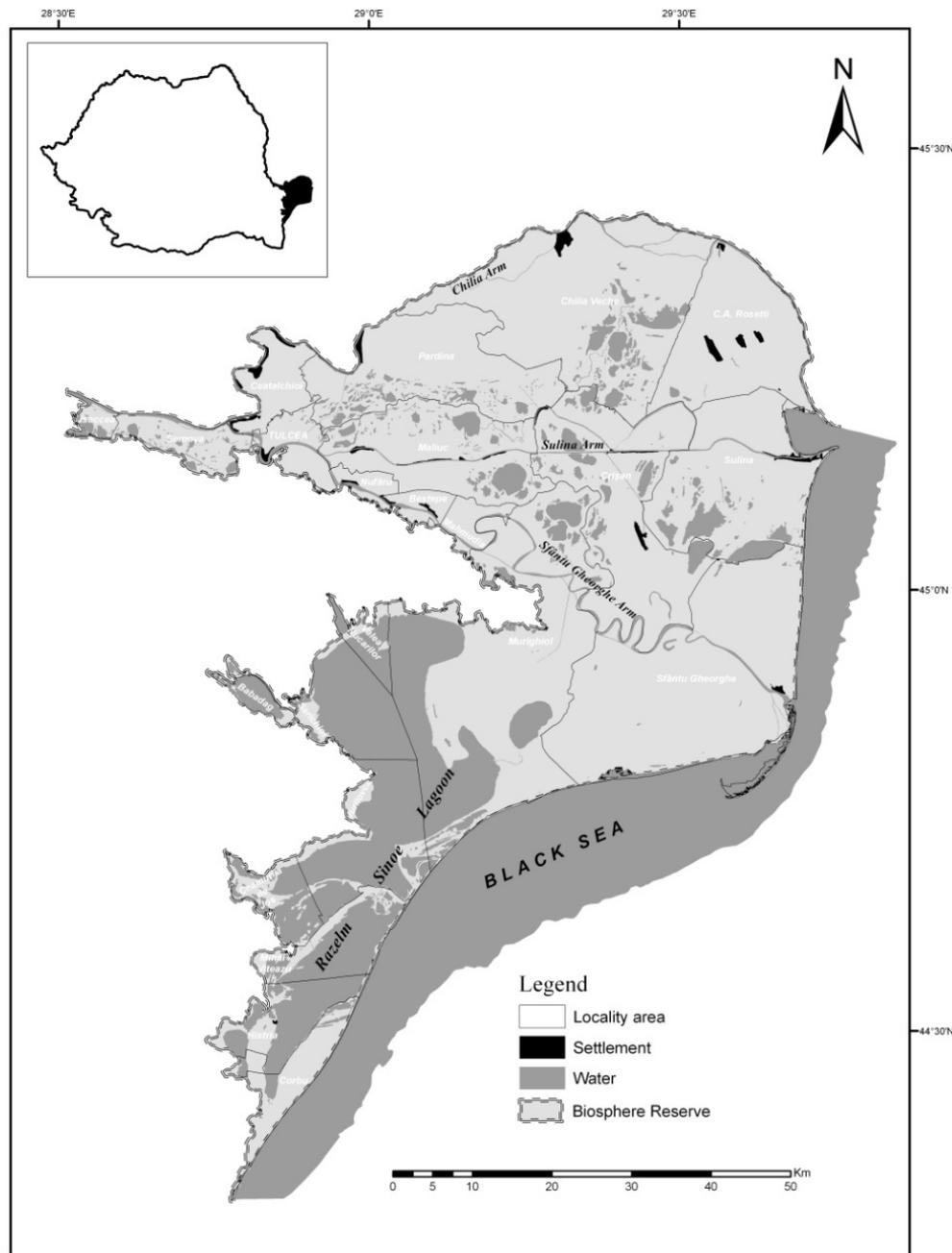


Figure 1. Danube Delta Biosphere Reserve territory

In other words, our study focused on policy analysis of political influences on planning decision making and environmental conditions. However, an important challenge to studying social and ecological consequences in a protected area was represented by the adequate methods to systematically integrate and correlate the physical observations, policy factors and development statistics in order to illustrate the involved territorial problems because of different reference scales or gaps in data sets or inconsistent correlations.

3. RESULTS

Local communities developed an integrated way of living through the harmonised use of Delta resources in the past (Barbier et al., 1997; Boja & Popescu, 2000). Disturbances that intervened over time in the local community living characteristics and within the specific human-environmental interaction led to different cooperation losses between the two major components of the social-ecological system. Another consequence was the low territorial efficiency of planning actions (Van Assche et al., 2009; Moore et al., 2014).

Planning policies had as their main purpose the intensive use of Delta resources, aiming to intensify anthropic activities and to prepare the territory for exploitation and development through diverse spatial planning actions, mainly after 1940 (Iordachi & Van Assche, 2014).

The first population fluctuations were registered starting in 1856, when the European Commission of the Danube was initiated. Following the transformation of the Sulina Arm into a navigation channel, there was an increase of the workforce from outside the Danubian area. An evolutionary analysis of population change on a long term basis is essential in defining the main changes registered in different development periods (Fig. 2).

The first territorial transformations followed the historical colonization of the Dobrogea region (Tudorancea, 2006; Enachescu, 2013). As a result of the analysis, a major trend indicates that the Delta's population had a traumatised demographic transition, with substantial changes in population numbers and age group structures. The most important development characteristics to analyse for the wetland territory are: population density, mortality rate, poverty rate, and unemployment rate (Table 1).



Figure 2. Dynamics of Danube Delta population between 1900 and 2010 (the grey rectangle represents the communist period). Source: National Institute of Statistics

Table 1. Development characteristics of Danube Delta's settlements

Territorial units	Surface (ha)	Population	Density	Mortality rate (‰)	Poverty rate (%)	Unemployment rate (%)
C.A. Rosetti	276.45	965	3.5	42.17	61.0	2.58
Ceatalchio	108.06	777	7.2	13.16	58.7	10.76
Chilia Veche	533.58	2487	4.6	39.68	45.7	28.18
Crișan	406.26	1312	3,2	38.17	47.9	8.23
Maliuc	257.76	989	3.8	40.57	42.1	3.99
Pardina	308.74	616	2	15.04	46.2	16.25
Sf. Gheorghe	541.21	865	1.6	33.02	31.2	10.14
Sulina	329.59	4527	13.7	29.48	No data	18.41

Source: National Institute of Statistics, 2010-2012

Rural areas of the Delta experienced drastic changes due to different movements of labour and transformation of land use. The subsequent enhancement of planning and exploitation activities (new canals, built for reed harvesting; extension of arable land, through damming and draining), especially during the communist period, produced intense positive demographic processes consisting of an influx of migrants (Hall et al., 1994; Mihnea et al., 2008; Lascu, 2013; Iordachi & Van Assche, 2014).

The main anthropic activities with a direct impact on the Danube Delta's environment were: a) the Sulina canal's being harnessed for maritime navigation; and b) the capitalising on the Danube's natural resources, by damming almost 110 000 ha. Approximately ¼ of the territory has been brutally modified and the rebuilding of ecosystems is a serious challenge (Gâstescu & Ştiucă, 2008).

As observed in the case of other areas, transformation of the Delta had a set of components that involved gradual changes in agricultural production and the local workforce (Chen et al., 2010). Only Sfântu Gheorghe commune has a better than average status in the whole Delta, due to the increase in tourism activities, mainly based on coastal and cultural activities. The Northern part is the poorest (C.A. Rosetti, Ceatalchioi, Pardina) given the great distance from the gateway – Tulcea city.

By analysing the main factors and the major quantitative changes influencing the demographic discrepancies, the findings indicate three relatively homogenous periods in terms of length, but having distinctive features.

3.1. First “reform”

Between 1850 and 1920, a liberal political development approach implied the free use of wetland resources and the main beneficiary was the local population. The first main event with a big impact on population was the harnessing of the Sulina Arm by the European Commission of the Danube. After 1856, an increase in trade and transportation activities was evident.

Agriculture is one of the main traditional activities of the inhabitants, including mainly two significant directions – fishing, in decline due to the decrease of fishing resources (the villages where fishing represents the main activity are: Crişan, Mila 23, Gorgova and Sfântu Gheorghe); and animal breeding which, from a temporary activity (transhumance), was transformed into a permanent one by the end of the XIX century (the villages with a strong tradition in animal breeding are: Letea, Periprava, C.A. Rosetti, Caraorman) (Boja &

Popescu, 2000).

The first attempt of designating land for agricultural purposes predated the fishing establishments, being from 1895. It was initiated on the left side of Sfântu Gheorghe Arm bank, between km 82 and km 88 downstream from Mahmudia village, but this endeavor was not successful (Năvodaru & Staraş, 1995).

Starting in 1910, following the research of Antipa, the law on valorization of wetlands was enacted. To valorise the rush-beds, for the first time in 1906, Antipa managed to influence the formation of a syndicate in order to harvest the reed from the delta for industrial purposes. This syndicate set up a cellulose reed-based fabrication plant in Chiscani, Brăila, in 1907-1908. This was the first such fabrication plant and it was open until 1916 when it was destroyed because of the war (Gâstescu & Ştiucă, 2008).

During this period, there were new settlements being created: Ilganii de Sus, Carol I (subsequently named Partizani), Carmen Sylva and Floriile (subsequently they were united and formed Crisan), Vultur, Regele Ferdinand, Mila 23 (Gâstescu & Ştiucă, 2008). The rapid increase in population (Fig. 2) was due to colonization in Dobrogea region with Romanian populations coming mostly from Moldova and Muntenia (Echim, 1995; Tudorancea, 2006; Enachescu, 2013).

3.2. Second “evolution”

Between 1920 and 1989, the morphology of the settlements in the area changed. The Delta was transformed into an enormous construction site.

3.2.1. Before the communist period (1920-1940)

Around the year 1927, Grigore Antipa carried out several studies around the possibilities of exploiting the reed from the Delta and he noted a series of recommendations and proposals which targeted the advantages of reed exploitation.

Traditional agriculture had been practiced mostly in the areas with important farmland surfaces: Chilia, Pardina, Plauru, Sălceni, Ceatalchioi and Pătlăgeanca, formed on alluvial soils from the river banks with a low risk of flooding. Because of the unproductive soils (sand-type), agriculture had a slower development on the maritime banks in Letea and Caraorman.

Between 1938 and 1940, with the volunteering contribution of Chilia Veche inhabitants, the damming of Tătaru holm was realised, located between Chilia Arm (km 45-61)

and Tătaru Arm (3400 ha).

3.2.2. The communist period (1940-1989)

After 1944, the studies were carried forward from 1948 when the Reed Experimental Station was created, being tasked with research studies on valorizing rush-beds in the delta in terms of reed establishments, mechanization of exploitation, sustainable valorization of the reed and its by-products (Rudescu et al., 1965).

The interest in the field developed rapidly and, starting in 1960, it was at the core of the works for harnessing the Delta, and, without expecting results from the scientific research, they started developing enclosures for growing reed in a partially controlled manner.

For this reason, in 1960, the conduct of fundamental research for an in-depth knowledge of reed biology was established, at the Maliuc Centre for reed exploitation. In 1970, it was integrated in the organisation chart of the Institute of Research and Projection Danube Delta with its headquarters in Tulcea (Gâstescu & Ştiucă, 2008).

In order to accomplish the applied research objectives, different centres were created: centers for experiments and research (the experimental factory of cardboard Tulcea, 1949 – transformed in 1950 into a Reed Cardboard Factory); and a research centre in Crişan, functional between 1948 and 1950 and closed after the Maliuc Centre's creation.

By setting up the reed Station Operations at Maliuc in the Danube Delta, it was expected to build a town in this area as a result of a political and development decision (Zamfir et al., 2009), hence the physical appearance (98% housing blocks) of the settlement and its equipment with “utilities” of a city. Other research centers were an experimental arrangement in Matita I, created in 1955 and Rusca experimental arrangement, which began on a trial basis in 1952 and it was carried out between 1957 and 1960 (Sfântu Gheorghe Island).

For the reed exploitation, there were developed numerous technical recommendations related to the total and permanent damming of the entire delta in order to easily harvest the reed and to create modern facilities. There were many ideas to harvest the reed: from the air using openings in high suspension bridges or even from a plane or helicopter, but they decided it was necessary to build more channels, on the edges of which were formed some ground platforms for storing reeds, which resulted in the destruction of other hydrophilic plant species (Rudescu et al., 1965; Năvodaru & Staraş, 1995).

In the maritime delta, there have been designed access works and low value storage spaces

for the harvested reed. The reed collecting points were widely spread in the Delta due to the quantitatively limited exploitation possibilities. Still, in the upper Delta, the projects' prospects exceeded 80% of the total reed available surface in the entire region. In order to accommodate the human resources needed during the reed exploitation, several types of settlements were designed and built. An example of a newly created settlement is Pardina for which the aim was to have a normal format, not the linear layout of the existing settlements on the Danube's banks. That is the case of Maliuc settlement as well. In some of the existing settlements (Sfântu Gheorghe), blocks of flats with 3 or 4 storeys were built, although they did not fit in the deltaic landscape pre-designed for housing, office spaces, labs, mechanical shops and stores (Rudescu et al., 1965).

Between 1950 and 1965, the damming in the delta continued more or less provisionally and without drainage works on the landings in Popina I – and Victoria – Beştepe – Mahmudia (Banu & Rudescu, 1965). Meanwhile, 105 000 ha were transformed into farmland in order to develop different activities: agriculture (53 000 ha); forestry (8200 ha); fisheries and rush-bed exploitation (Gomoiu, 1996). In the same period, the Center for the Danube Delta had been established, directly dependent on the Agricultural State Department and responsible for managing all companies with a commercial activity in the Delta.

After 1960, there were alteration measures for fishing and agriculture by intensifying reed exploitation (later abandoned), fishing, agriculture and forestry establishments (Banu & Rudescu, 1965). The period 1960-1970 represented the main stage of modifying the natural ecosystems and it was considered the “period of the reed” as it represented an important raw material used for the intensified industrial production of cellulose and paper. Although important actions were taken for the efficient harvesting of reed, results proved that polder agriculture represented an inadequate approach for exploitation as production failed to meet the expected quotas (Gomoiu, 1996). In many instances, the establishment works, due to their location and the scheme adopted, produced major anthropic influences both for the ecosystems specific to the regions and the neighbouring villages (Penescu, 1937).

In the 1970s, following massive floods (Mihnea et al., 2008), a large part of the population decided to move from the Delta to Tulcea and Constanţa. This was the time when the law forbidding the Delta's citizens to change residence was declared nul and void. Therefore, all those

living in Tulcea, but officially residing in the Delta, changed their residential address. This migration process had a significant impact in accounting for the changes, especially in the 1977 census, when the population number considerably decreased.

3.3. Post-communism evolution – sustainability and conservation reforms

The specific natural conditions were damaged by the industrial works on DDBR's territory and in the whole Danube hydrographic basin. The decree from February 1990 imposed to cease the implementation of the establishment and holistic exploitation programme, formerly enacted in 1983, and it ended also other activities with a negative impact on the deltaic environment. Therewith, it was decided to set up a study on the necessary measures to be taken for the anthropic usage of the area's territory, in the context of recovery and balance of ecological stability.

A step forward in establishing a new deltaic environmental protection and preservation regime was Romania's legislative adhesion to the Convention on Wetlands of International Importance, in 1991, and the enlistment of the Delta in the list linked to the Convention, especially as an Aquatic Birds Habitat. All these regulations brought into existence an international rule set for the Delta, in addition to the internal regulation.

In 1993, the Romanian Parliament voted a new law, modified in 2001, regarding the creation of the Danube Delta Biosphere Reserve (DDBR). In the light of these accomplishments and based on the Government regulation in 1990 (regarding the functioning and organisation of the Ministry of Environment), the Danube Delta Biosphere Diversity Administration (DDBRA) was established, as a juridical legally binding body, under the Ministry of Environment. DDBRA was created to manage and control all scientific, tourism and leisure activities in the Delta.

Likewise, in the 2001 law, reinforcing the Government regulation in 2000, regarding the regime of naturally protected areas, the conservation of natural habitats, flora and wild life, it is noted that the current establishments legally created inside the protected natural areas will be carried out with public investments on publically owned land; also these establishments will be prevalently allocated for administrative and scientific activities of those ensuring the management of the protected area.

In the framework of the ecological reconstruction programmes, a criterion was taken into consideration based on increasing an area's

natural potential or biodiversity, where there is a conservation potential, to renature the anthropically damaged ecosystems (or in an area with a latent ecological potential to create new highly natural value habitats). Reconstructing the bank areas represented a key objective in the World Bank's funding of the Global Environmental Facility project "Conserving the biodiversity in the Danube Delta" (before 2007) and in the European Commission's Sectoral Operational Programme Environment (after Romania's EU accession).

The activity of ecological reconstruction started in 1994 with Babina, with a total surface of 2100 ha. The projects that followed helped to expand the ecologically rebuilt area to more than 15 000 ha (Gomoiu, 1996).

Nowadays, after the designation of the areas with a holistic protection regime and the buffer zones linked to them, attention is being given to the economic zones. In these zones, the development activities are in line with the safety instructions and the preservation of Delta's natural heritage values.

A feature of the farmlands in the DDBR, with a major impact on their usage and on the traditional activities of the inhabitants, is that up to 64% of the farmlands are on banks and polders, and the remainder, mainly grass land, is on the banks with a free flooding regime (Fig. 3).

4. DISCUSSION

The results illustrate that development strategies and planning actions failed in achieving sustainable development through stabilizing win-win relationships inside the complex social-ecological system of the Danube Delta.

The following scheme represents a synthesis of the findings explained in the previous section (Fig. 4).

Based on a synthesis of the primary and secondary research, and accepting that the empirical data are preliminary, it is clear that DDBR situation results from a number of interconnected factors and sustainability dimensions (Table 2).

Planning and development policies had as their main purpose the intensive use of Delta resources aimed at intensifying anthropic activities and preparing the territory for exploitation through diverse spatial planning actions, mainly after 1940. Conservation objectives for this area gained influence only after 1990, when the deltaic space was recognized as a valuable ecological system and it was included in international recognition programmes (Iordachi & Van Assche, 2014).

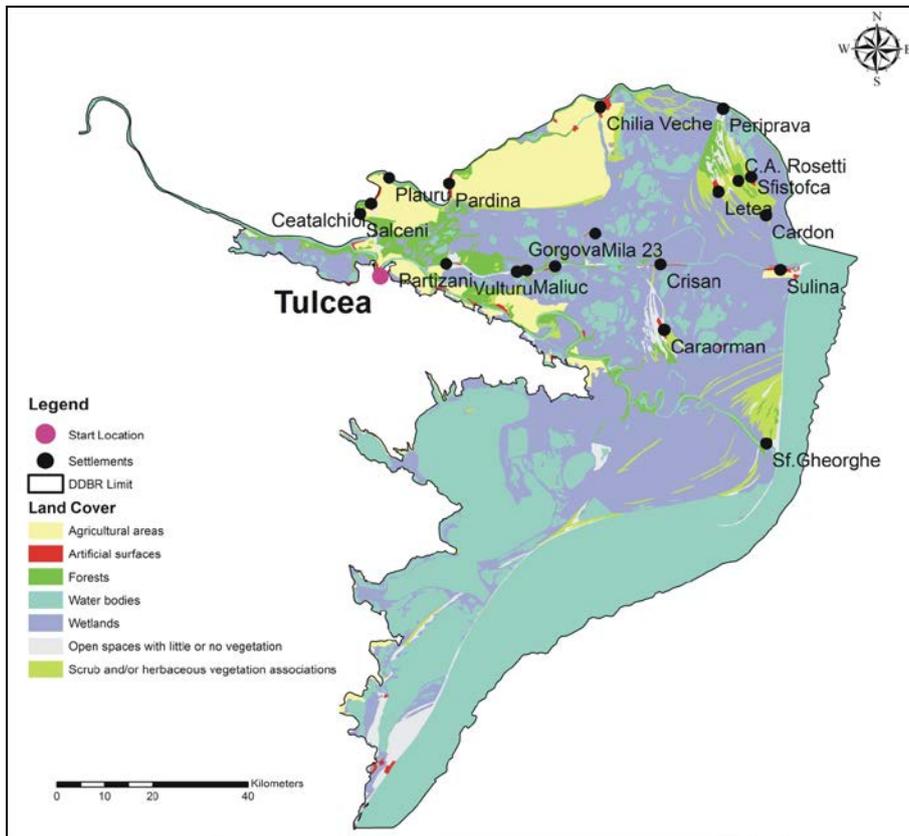


Figure 3. Land use of the Danube Delta territory
 Source: CORINE LANDCOVER, 2006

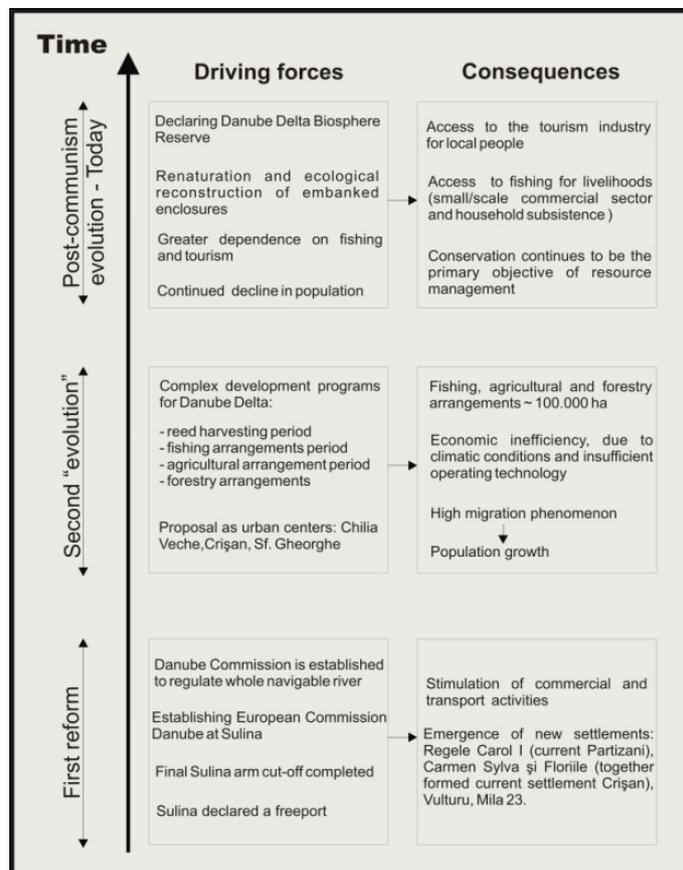


Figure 4. Driving forces causing territorial changes over time and consequences of political interventions in the Danube Delta

Table 2. Sustainability dimensions of Danube Delta development

CONSEQUENCES	Positive	Negative	COUNTER MEASURES
<i>Ecological</i>	<ul style="list-style-type: none"> - biosphere reserve label; - a slightly improved management approach; - laws and regulations in place; - raising awareness and responsibility of all people by national and international fora and NGOs. 	<ul style="list-style-type: none"> - reduction of the water retention capacity – reduction of biodiversity. - reduction of flooding areas – destruction of natural ecosystem and fish nurseries; - increase of damaged water input – increased eutrophication. 	<ul style="list-style-type: none"> - pollution alleviation and control; - establishment of local waste management schemes; - proper implementation of regulations and laws; - sharing information among different government departments; - environmental education and conservation.
<i>Social</i>	<ul style="list-style-type: none"> - cultural heritage (music, traditional costumes, reed weaving); - fast development of infrastructure. 	<ul style="list-style-type: none"> - identity loss because of globalization and tourists behaviours; - creation of new inequalities; - destruction of traditional values and social stability. 	<ul style="list-style-type: none"> - consciousness among the local population with regards to their identity and to tourism development; - capacity to prevent and limit conflicts.
<i>Economic</i>	<ul style="list-style-type: none"> - employee salaries and incomes of the owners (vacation homes/hotels); - rents (boat rentals); - incomes for the public sector (municipality). 	<ul style="list-style-type: none"> - costs for life quality (environmental pollution, health and property endangerment); - changing consumption patterns. 	<ul style="list-style-type: none"> - strong and effective promotion of culture and traditions through small targeted projects; - investments should involve local people in order to promote local growth.

Despite the diversified actions to transform the Delta territory, it remained weakly connected internally (among the settlements situated within DDBR) and with the exterior, respectively the main entrances to the Delta. The limited accessibility in the Danube Delta creates difficulties for the communities to access basic life services (health care, schools, administration, supplies) and to develop activities such as tourism (Ianos et al., 2012). The limits imposed by the inadequate accessibility negatively intervene also in terms of respecting the Biosphere Reserve sustainability purposes (Văidianu & Iosub, 2011).

Tourism activities in the Delta are strongly related to the environmental characteristics of the territory so that spa, sports, recreational and youth tourism represent the main forms of tourism, as well as a constant scientific and increasing educational tourism, connected mostly with the Biosphere Reserve objectives (Hontuş, 2013).

Tourism represents an important anthropic activity which, if it is sustainably managed, has the potential to bring benefits to the area's development. So that, tourism is a tool for promoting territorial resources but it is also a driving force which could affect environmental quality. The relationship between visitation and impact in a fragile ecosystem is not clearly understood, but the impact increases exponentially with each additional tourist. Managing biosphere reserves requires information about the percentage of visitors attracted by the biosphere reserve label and the visitors' attitudes towards the protected area management (Văidianu, 2013a).

Environmental and political factors intersect and

affect different social actors in different ways and the distribution of influence is often inequitable between tourists and locals. Sometimes conflicts arise for different uses by different groups (Văidianu et al., 2014a).

The main obstacles in promoting rural tourism as a sustainable anthropic activity relate to structural deficiencies from national and regional level, such as lack of adequate ecotourism policies and lack of a good entrepreneurial culture (Hall, 1993; Hall et al., 1994).

Reed harvesting has the potential to constitute a long term sustainable anthropic activity, meeting a double purpose – consideration for both natural environmental integrity and traditional activity support. In this sense, reed harvesting needs to fulfil its aim of being a complementary activity for the local community, which is mainly focused on fish exploitation and to become an adequately regulated activity based on modern technology producing both good productivity and a mild ecological impact (Van Assche et al., 2011a; Ioan & Costea-Dunarintu, 2014).

Generally, ecological policies for environment restoration adopt a complex approach involving multiple directions of intervention: biodiversity conservation; sustainable use of natural renewable resources; ecosystem reconstruction; pollution alleviation and control; tradition based society; and environmental education (Belacurencu, 2007).

In this context, adaptive management represents the sustainable solution for meeting the complex needs of the Danube Delta social-ecological system that requires adequate policies and actions both for environmental conservation and community

development (Văidianu et al., 2014b). Adaptive management should involve the strong accountability of decision makers and public institutions acting in the Delta; in this respect, they should have the responsibility to empower citizens in a common action towards a superior path of managing the complex issues of this social-ecological system through participatory governance (Hall et al., 1994; Boja & Popescu, 2000; Galatchi, 2009; Van Assche et al., 2011a; Van Assche et al., 2011b). In the end, Danube Delta requires also the common action of all regional actors that need to get involved in the management of its territory by overcoming geopolitical tensions and favouring enhanced cooperation for sustainable development (Galatchi, 2009; Saghin et al., 2013; Goulding et al., 2014; O'Higgins et al., 2014b).

5. CONCLUSIONS AND RECOMMENDATIONS

The environmental and political factors that intersect and result in inequity are already causing social conflict and environmental problems internationally. Territorial policies for the use of resources were characterized as being inadequate and lacking harmonization both inside the area and with the external and adjoining territories. The top-down approach of conducting development and its specific processes resulted in territorial responses that proved to have negative effects on the social-ecological system. Some policies had a profound impact on change in the wetlands of the DDBR, especially in playing a key role in protecting their suitable evolution. The results showed that DDBR sustainability requires political leadership and that integration of various sectors is critical to make the governance process successful.

Current fish harvesting faces also new types of challenges arising from social differences among the members of the community in relation to possible ways of conducting the activity. Different understanding and positioning towards the same activity lead to variable environmental impacts. In the same community, fishing represents both a way of life, as it is the case for the older fishermen and a profitable business for young harvesters. The social-ecological system therefore faces the need to adopt adaptive coping strategies, meeting the different needs of the population but also the environmental objectives of the Delta (Văidianu, 2013b; Goulding et al., 2014; Moore et al., 2014; Power et al., 2014).

A sustainable way of developing tourism would be the promotion of traditions and local culture through the construction of a Delta specific tourist village, based on the community way of living (Ianoș et al., 2012; Văidianu et al., 2014b). Rural tourism, as an

ecotourism based activity, represents the optimal option for the sustainable development of the local community (Merciu et al., 2011).

The present management approach makes use of the physical restrictive elements and legislative limits in the planning of the Danube Delta through its international (Ramsar site; UNESCO World Heritage) and national (Biosphere reserve) territorial protection status. At the same time, the Danube Delta management struggles to achieve efficient participatory governance within a framework of awareness and involvement of all stakeholders in the territory's development processes. These processes focus on nature conservation and community support to achieve the general sustainable development of the social-ecological system (Galatchi, 2009; Van Assche et al., 2011a; Van Assche et al., 2011b). Considering the current territorial context of the Delta, the measures necessary for sustainable development should include an adequate use of natural resources, human capital growth and consolidation of institutional management (Șirbu, 2012; Văidianu, 2013b; Iordachi & Van Assche, 2014).

In this sense, the Delta needs to be involved in a more robust and direct relationship between the scientific environment and decision making actors (Pringle et al., 1993; Van Assche et al., 2011a; Eddy et al., 2014). Science based policies and planning decisions constitute the leading model in addressing social and ecological issues in the Delta for the efficient promotion of an integrated approach (Van Assche et al., 2011a; Eddy et al., 2014).

First, adaptive management of such an area has to focus on dealing with the social and ecological impact of former territorial and planning actions, which continuously manifest a significant impact on subsequent conservation, social and development activities (O'Higgins et al., 2014a). Secondly, adaptive management has to consider the resilience capacity of both social and ecological components of the complex territorial system in order to make adequate adjustments in planning decisions for sustainable development (Hanspach et al., 2014; Olsson et al., 2014; Spies et al., 2014).

The above conclusions to this study provide the basis for the sustainable management and decision-making of the Danube Delta Biosphere Reserve.

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REFERENCES

- Acreman, M.C., Fisher, J., Stratford, C.J., Nould, D.J. & Mountford J.O.,** 2007. *Hydrological science and wetland restoration: some case studies from Europe*. Hydrol.Earth Syst. Sci., 11(1), 158-169.
- Banu, A.C. & Rudescu, L.,** 1965. *Danube Delta* (In Romanian). Scientific Publishing House, Bucharest, 296 p.
- Barbier, E.B., Acreman, M. & Knowler, D.,** 1997. *Economic valuation of wetlands: A guide for policy makers and planners*. Ramsar Convention Bureau, Gland, 116 p.
- Belacurencu, T.,** 2007. *Implementation of Ecological Policies in Danube Delta Area*. Theoretical and Applied Economics, 4, 9-24.
- Boja, V. & Popescu, I.,** 2000. *Social ecology in the Danube Delta: Theory and practice*. Lakes & Reservoirs: Research & Management, 5, 2, 125-131.
- Catianis, I., Rădan, S. & Grosu, D.,** 2013. *Distribution of lithological components of recent sediments from some lakes in the Danube Delta; environmental significance*. Carpathian Journal of Earth and Environmental Sciences, 8, 2, 55-68.
- Chen, Y., Liu, Y. & Xu, K.,** 2010. *Characteristics and Mechanism of Agricultural Transformation in Typical Rural Areas of Eastern China: A Case Study of Yucheng City, Shandong Province*. Chinese Geographical Science, 20(6), 545-553.
- Cioacă, E., Nuttle, T. & Bredeweg, B.,** 2006. *The Danube Delta Biosphere Reserve: a Case Study for Qualitative Modelling of Sustainable Development*. Proceedings of the 20th International Workshop on Qualitative Reasoning, 5 p.
- Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P. & van den Belt, M.,** 1997. *The value of the world's ecosystem services and natural capital*. Nature, 387, 253-260.
- Daloğlu, I., Nassauer, J.I., Riolo, R. & Scavia, D.,** 2014. *An integrated social and ecological modeling framework – impacts of agricultural conservation practices on water quality*. Ecology and Society, 19(3), 12.
- Damian, N. & Dumitrescu, B.,** 2009. *Sustainable development prospects for the Danube Delta rural communities*. Rev. Roum. Géogr./Rom. Journ. Geogr., 53, 2, 153-163.
- Damian, N.,** 2011. *Unemployment and poverty in the Danube Delta settlements. Territorial disparities*. Rev. Roum. Géogr., 55, 1, 11-22.
- Dumitrescu, A.,** 2002. *The impact of the social and economic policies on the local people of the Danube Delta and the necessary measures*. Scientific Annals of the Danube Delta Institute for Research & Development, 9, 75-83.
- Echim, A.,** 1995. *The state of the population from the Danube Delta Biosphere Reserve* (In Romanian). Lumina LEX, Bucharest, 208 p.
- Eddy, B.G., Hearn, B., Luther, J.E., Van Zyll de Jong, M., Bowers, W., Parsons, R., Piercey, D., Strickland, G. & Wheeler, B.,** 2014. *An information ecology approach to science-policy integration in adaptive management of social-ecological systems*. Ecology and Society, 19(3), 40.
- Enachescu, V.-A.,** 2013. *Understanding multicultural communication and cooperation through multicultural Dobrogea*. Journal of Community Positive Practices, 13, 2, 108-115.
- Galatchi, L.-D. & Tudor, M.,** 2006. *Europe as a source of pollution – the main factor for the eutrophication of the Danube Delta and Black Sea*. In: Simeonov, L. & Chirila, E. (eds.), Chemicals as Intentional and Accidental Global Environmental Threats, Springer, pp. 57-63.
- Galatchi, L.-D.,** 2009. *Environmental management of intentional or accidental environmental threats to water security in the Danube Delta*. In: Jones, J.A.A., Vardanian, T.G. & Hakopian, C. (eds.), Threats to Global Water Security, Springer, pp. 305-315.
- Gâțescu, P. & Știucă, R.,** 2008. *Danube Delta. Biosphere Reserve* (In Romanian), CD Press, Bucharest, 400 p.
- Gâțescu, P.,** 2009. *The Danube Delta Biosphere Reserve. Geography, biodiversity, protection, management*. Rev. Roum. Géogr./Rom. Journ. Geogr., 53, 2, 139-152.
- Gomoiu, M.-T.,** 1996. *Facts and remarks on the Danube Delta*. Geo-Eco-Marina, 1, 70-82.
- Goulding, I.C., Stobberup, K.A. & O'Higgins, T.,** 2014. *Potential economic impacts of achieving good environmental status in Black Sea fisheries*. Ecology and Society, 19(3), 32.
- Hall, D.R.,** 1993. *Ecotourism in the Danube Delta*. The Tourist Review, 48, 3, 11-13.
- Hall, D., Kinnaird, V. & Cater, E.,** 1994. *Ecotourism in Eastern Europe*. In: Cater, E. & Lowman, G. (eds.), Ecotourism: a sustainable option? Wiley, Chichester, pp. 111-136.
- Hanspach, J., Hartel, T., Milcu, A.I., Mikulcak, F., Dorresteijn, I., Loos, J., von Wehrden, H., Kummerle, T., Abson, D., Kovács-Hostyánszki, A., Báldi, A. & Fischer, J.,** 2014. *A holistic approach to studying social-ecological systems and its application to southern Transylvania*. Ecology and Society, 19(4), 32.
- Hontuş, A.C.,** 2013. *Spatial Danube Delta Biosphere Reserve within the context of sustainable tourism*. Management Agricol, 15 (4), 11-19.
- Ianoş, I., Peptenatu, D. & Zamfir, D.,** 2009. *Respect for environment and sustainable development*. Carpathian Journal of Earth and Environmental Sciences, 4, 1, 81-93.
- Ianos, I., Stoica, I.-V., Talanga, C. & Vaidianu, N.,** 2012. *Politics of Tourism Development in Danube Delta Biosphere Reserve*. SGEM Conference Proceedings, 4, 1067-1074.
- Ioan, I. & Costea-Dunarintu, A.,** 2014. *Adaptive management on Danube Delta's biodiversity*. Journal of Knowledge Management, Economics and Information Technology, 4, 2, 1-10.
- Iordachi, C. & Van Assche, K.,** 2014. *The Bio-Politics of the Danube Delta. Nature, History, Policies*. Lexington Books, Lanham, 482 p.
- Iticescu, C., Georgescu, L.P. & Topa, C.M.,** 2013. *Assessing the Danube water quality index in the city of Galati, Romania*. Carpathian Journal of Earth and Environmental Sciences, 8, 4, 155-164.
- Kingsford, R.T.,** 2011. *Conservation management of rivers and wetlands under climate change - a synthesis*. Marine and Freshwater Research, 62, 3, 217-222.
- Lascu, A.,** 2013. *Demographic policy of the communist regime in Dobrogea (1965-1989)*. Romanian Review of Eurasian Studies, 9, 1-2, 137-144.
- Merciu, C., Cercleux, L., Peptenatu, D., Văidianu, N., Drăghici, C. & Pintilii, R.,** 2011. *Tourism - an*

opportunity for the economic invigoration of rural areas in Romania? *Annals of the University of Bucharest – Geography Series*, 75-90.

- Mihnea, I., Mândru, R. & Bran M.**, 2008. *Danube dams – necessity or calamity?* *Carpathian Journal of Earth and Environmental Sciences*, 3, 1, 31-38.
- Moore, M.-L., Tjornbo, O., Enfors, E., Knapp, C., Hobdod, J., Baggio, J.A., Norström, A., Olsson, P. & Biggs, D.**, 2014. *Studying the complexity of change: toward an analytical framework for understanding deliberate social-ecological transformations.* *Ecology and Society*, 19(4), 54.
- Năvodaru, I. & Staraș, M.**, 1995. *Evolution, research and administration of fisheries from Danube Delta Biosphere Reserve* (In Romanian). *Scientific Annals of Danube Delta Institute*, 4, 1, 241-248.
- O'Higgins, T., Cooper, P., Roth, E., Newton, A., Farmer, A., Goulding, I. C. & Tett, P.**, 2014a. *Temporal constraints on ecosystem management: definitions and examples from Europe's regional seas.* *Ecology and Society*, 19(4), 46.
- O'Higgins, T., Farmer, A., Daskalov, G., Knudsen, S. & Mee, L.**, 2014b. *Achieving good environmental status in the Black Sea: scale mismatches in environmental management.* *Ecology and Society*, 19(3), 54.
- Olsson, P., Galaz, V. & Boonstra, W.J.**, 2014. *Sustainability transformations: a resilience perspective.* *Ecology and Society*, 19(4), 1.
- Penescu, P.**, 1937. *Economic movement of Tulcea County: monography, history, organization, economic forces, movement of commerce and industry* (In Romanian). *Tipografia Moderna, Tulcea*, 159 p.
- Petanidou, T., Kizos, T. & Soulakellis, N.**, 2008. *Socioeconomic dimensions of changes in the agricultural landscape of the mediterranean basin: a case study of the abandonment of cultivation terraces on Nisyros Island, Greece.* *Environmental Management*, 41, 2, 250-266.
- Petrișor, A.-I., Ianoș, I., Iurea, D. & Văidianu, M.-N.**, 2012. *Applications of Principal Component Analysis integrated with GIS.* *Procedia Environmental Sciences*, 14, 247-256.
- Power, N.G., Norman, M. E. & Dupré, K.**, 2014. *"The fishery went away": The impacts of long-term fishery closures on young people's experience and perception of fisheries employment in Newfoundland coastal communities.* *Ecology and Society*, 19(3), 6.
- Pringle, C., Vellidis, G., Heliotis, F., Bandacu, D. & Cristofor, S.**, 1993. *Environmental problems of the Danube Delta.* *American Scientist*, 81, 350-361.
- Rudescu, L., Niculescu, C. & Chivu, I.P.**, 1965. *Monography of reed of the Danube Delta* (In Romanian). *Romanian Academy, Bucharest*, 542 p.
- Saghin, I., Pascariu, G., Stoian, D.R., Stoica, I.-V. & Zamfir, D.**, 2013. *Rethinking the territorial pact in the context of european territorial cohesion.* *Journal of Urban and Regional Analysis*, 5, 1, 89-98.
- Sîrbu, C.**, 2012. *Agriculture in terms of European Union Strategy for Danube Delta adoption.* *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 12, 1, 229-232.
- Spies, T.A., White, E.M., Kline, J.D., Fischer, A.P., Ager, A., Bailey, J., Bolte, J., Koch, J., Platt, E., Olsen, C.S., Jacobs, D., Shindler, B., Steen-Adams, M.M. & Hammer, R.**, 2014. *Examining fire-prone forest landscapes as coupled human and natural systems.* *Ecology and Society*, 19(3), 9.
- Stănică, A. & Panin, N.**, 2009. *Present evolution and future predictions for the deltaic coastal zone between the Sulina and Sf. Gheorghe Danube river mouths (Romania).* *Geomorphology*, 107, 1-2, 41-46.
- Tudorancea, M.M.**, 2006. *Human presence in the Danube Delta.* In: Tudorancea, C. & Tudorancea, M. M. (eds.), *Danube Delta: Genesis and Biodiversity*, Backhuys Publishers, Leiden, pp. 399-410.
- Van Assche, K., Devlieger, P., Teampau, P. & Verschraegen, G.**, 2009. *Forgetting and remembering in the margins: Constructing past and future in the Romanian Danube Delta.* *Memory Studies*, 2, 2, 211-234.
- Van Assche, K., Beunen, R., Jacobs, J. & Teampau, P.**, 2011a. *Crossing trails in the marshes: rigidity and flexibility in the governance of the Danube Delta.* *Journal of Environmental Planning and Management*, 54, 8, 997-1018.
- Van Assche, K., Duineveld, M., Beunen, R. & Teampau, P.**, 2011b. *Delineating Locals: Transformations of Knowledge/Power and the Governance of the Danube Delta.* *Journal of Environmental Policy & Planning*, 13, 1, 1-21.
- Văidianu, N. & Iosub, F.**, 2011. *Implications of accessibility degree in the Danube Delta human community, Romania.* In: Longhorn, R. & De Zori, S. (eds.), *Proceedings of CoastGIS 2011: 10th International Symposium on GIS and Computer Mapping for Coastal Zone Management - Marine and Coastal Spatial Planning*, 1, 68-73.
- Văidianu, N.**, 2013a. *Fuzzy cognitive maps: diagnosis and scenarios for a better management process of visitors flows in Romanian Danube Delta Biosphere Reserve.* *Journal of Coastal Research*, 65, 1063-1068.
- Văidianu, N.**, 2013b. *Danube Delta Biosphere Reserve. Partnership between people and nature for sustainable development* (In Romanian). *ARS DOCENDI, Bucharest*, 201 p.
- Văidianu, M.N., Adamescu, M.C., Wildenberg, M. & Tetelea, C.**, 2014a. *Understanding public participation and perceptions of stakeholders for a better management in Danube Delta Biosphere Reserve (Romania).* In: Papageorgiou, E.I. (ed.), *Fuzzy Cognitive Maps for Applied Sciences and Engineering*, Springer, Berlin, pp. 355-374.
- Văidianu, M.-N., Pavel, O. & Călin, I.-E.**, 2014b. *Promoting Arts-based Activities for Local Sustainability: Danube Delta Case Study.* *Procedia - Social and Behavioral Sciences*, 122, 105-109.
- Zamfir, D., Tălângă, C. & Stoica, I.V.**, 2009. *Romanian small towns searching for their identity.* *Journal of Urban and Regional Analysis*, 1, 1, 41-53.

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