

## THE “LOWER DANUBE” EUROREGION: DEVELOPMENT EMERGENCE OF THE ENVIRONMENTAL MANAGEMENT CLUSTER FORMS

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**Abstract.** Enlargement of the European Union within the context of structural priorities transformation and globalization of the international economy makes it necessary to find the approaches to adapt the “Lower Danube” Euroregion to new challenges, particularly as regards the ecological safety in the Danube delta. In the authors’ opinion, it is the trans-border cluster nature that is nowadays one of the most advantageous processes to deliver against goals in regard to restructuring of the Danube region environmental complex. In the article, the theoretical approach to the development of the mechanism of environmental management is presented, taking into account the possible clusterization of environmental management system of the “Lower Danube” Euroregion. The essence of the concept “trans-border environmental cluster” is explained. *The main directions* for the development of the eco-economic management mechanism are singled out with reference to environmental clusters formation, which will make it possible to solve not only economic, but the environmental problems of periphery territories. Target setting is determined by the increasing role of the development emergence of trans-border cluster systems of environmental management under conditions of the transition of the Ukrainian border territories to the integration into the EU common environmental area. *The purpose* of the study is to investigate the scientific approaches to trans-border clusterization of the environmental management in terms of urgent need to prevent pollution of the Danube delta by the sewage waters, by means of self-organization of trans-border environmental cluster – institute of network environmental cooperation over administrative boundaries, which will become the point of environmental risks reduction and of industrial disasters prevention in the “Lower Danube” Euroregion. *The research methodology* is the categorization of the approaches to the implementation of the innovative technologies and to the introduction of the environmental management innovations by means of cluster forms of industrial organization, which explicitly or implicitly facilitate the reduction of ecologically destructive effect of production and consumption on the environment and help solve environmental problems in the Euroregion. *Results.* The eventual outcome of the clusterization of environmental activity management in the “Lower Danube” Euroregion is the beneficial socio-ecological and economic effect providing balanced sustainable development of the Euroregion and the country in particular. Thus, the formation of new forms of trans-border cooperation based on the cluster genesis has become the accelerator of the environmental strategy intensification, encouraged the self-development and restoration of natural resources, innovations generation in the sphere of the Lower Danube ecology, implementation of eco-technologies providing the balance between economic and ecological potential of the European region. All this determines the direction, key features and emergence of the cluster forms development of the environmental management – the Danube synergy.

**Key words:** cluster genesis, environmental strategy, Danube synergy, trans-border environmental cluster.

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## 1. Introduction

The aim of the contemporary ecological strategy of the Eastern European countries is to search new forms and mechanisms of arrangement of the conditions for mobilizing efforts by the Euroregions to effectively use their own ecological potential and protect natural resources.

Trans-border cooperation of Ukrainian and Romanian neighboring border territories in the Danube delta gives the additional opportunities to get the synergistic effects due to the united efforts while solving common environmental problems. Trans-border cooperation is actively evolving in the field of institutional support of environmental cooperation in the form of trans-border environmental clusters. Starting from direct contacts and trans-border agreements, the cooperation in the sphere of the Lower Danube ecology developed into trans-border nature conservancy zones, trans-border cluster systems, “triangles” of reducing ecological risks, trans-border growth poles, “trans-border environmental projects”, etc.

Enlargement of the European Union within the context of structural priorities transformation and globalization of the international economy makes it necessary to find the approaches to adapt the “Lower Danube” Euroregion to new challenges, particularly as regards the enhancement of ecological safety in the Danube delta. The trans-border cluster genesis is nowadays one of the most advantageous processes to deliver against goals in regard to restructuring the Ukrainian environmental complex. Target setting is determined by the growing role of the development emergence of the trans-border cluster systems of environmental management under the conditions of Ukrainian trans-border regions integration into the EU common ecological space (Cluster policy in Europe..., 2008).

In that respect, the aim of creating a common ecological infrastructure, providing effective use of the environmental potential of the “Lower Danube” Euroregion, establishing the conditions for modernization and rapid development of its most competitive segment becomes of paramount importance.

Environmental management of the Euroregions has become the sphere of trans-border clusterization. At the same time, the process of transboundary cluster genesis (acquiring many invariant manifestations and forms) is most extensively and dynamically deployed on trans-border territories, fulfilling the mission of the most important geo-economical transport corridors of the country, its leading innovation and communication centers in the field of the environmental protection.

The “Lower Danube” Euroregion not only has the most favorable conditions for ecological cluster genesis

but it is also particularly “liable” to the localization of trans-border phenomena and contacts, to generation of the multiple transboundary effect, which reduces the level of environmental risks.

Environmental cluster genesis is the process of concentrating the most effective and interconnected types of environmental activities, i.e., a set of interconnected groups of successfully competing firms, forming the golden section of the entire ecological system of the state and ensuring environmental protection and environmental policy implementation. Trans-border environmental clusters are one of the basic forms of organization of the modern economic complex, characterized by such attributive features as a certain degree of homogeneity, single-order basic number of elements, their super-summative emergence and spatial concentration with a high degree of autonomy and intra-systemic balance of competition and cooperation. In the context of the global interdependence strengthening it is through clusterization mechanisms at the regional and local levels that the imperative to increase economic efficiency and competitiveness of companies is realized, combined with the ability of clusters to provide additional resources for information technology, industrial, trade and logistic interaction and personnel exchange in case of activation of trans-border contacts between the components of the cluster located on the both sides of the border (State Regional Policy of Ukraine, 2007).

Trans-border cooperation has become a determining factor in deepening of European integration within the framework when in political and scientific discourse the meaning of the notion “border” is changed from “frontier” to “contact factor”.

Thus, “border” is no longer “a line, but rather a functional space” where different “societies and communities” come in contact. It can be claimed that now the “second wave” of cluster theory development is being generated. This confirms the topicality of the problem and allows to develop this concept in the field of environmental clusters development (Kovalenko, 2019).

In economy, the term “cluster” has a broader meaning and is understood as a system of combining production units, unlike the meaning of very word “cluster” as the union of several homogeneous elements each of them being considered as an independent unit with certain properties.

“Cluster” can also be used while building analytical procedures because as an “accumulation” it can guarantee singling out of distinctive characteristics of the phenomena under investigation with the accepted features, and while generating the approaches of creating management policy. The use of the clusters theory in management is possible not only in the aspects of the production plan discussed above, the aim of which is to unite the territory into a certain effective and competitive structure. Taking into consideration

the management goal, managerial influence can be of equal importance for one object or a set of objects of management, which indicates the advisability of combining into a cluster. In this case, it becomes possible to form clusters for any socially useful purpose that is important in a particular territory or as a result of the current situation, as well as in connection with territorial specialization. Among such goals, in the first place, the provision of environmental priorities of the territory can be mentioned.

Compliance with stated and other possible ecologically useful measures demands the complex of specific managerial influence with the use of additional financial resources, technical and technological developments, regulatory and other measures to provide for environmental priorities. The support of the economic entities uniting their activities from the perspective of environmental goals (priorities, tasks, problems) of the territory can refer to such measures. Consequently, within the framework of the above stated argumentation, a special type of clusters – an “environmental cluster” (a territorial socio-economic organization of labor, industrial, infrastructural, institutional components, in which the implemented activities are based on the priority of environmental goals while ensuring socio-economic development of the territory) – can be considered.

Taking into consideration the meaning of the term “environmental cluster”, it should be noted that unlike the theory of clusterization in economy, the functioning of the environmental cluster is connected with the goal of the functioning of this specific entity: the activity of the participants of the cluster is organized taking into account the priority of the environmental goals. In fact, in an ideal scenario, economic purposes (high efficiency and competitiveness) should be provided in the economic management of the environmental clusters’ organizations, but this task is very difficult to solve while achieving the environmental goals of the society, because of the discrepancy between the economy as the process of natural resource consumption and resource conservation.

In general, the development of environmental regional clusters is the approach towards the formation of the effective Euroregional specialization aiming at social development with regards to environmental condition and problems of periphery territories. Environmental clusters may contribute to the implementation of new “clean” methods and technology, development of most advanced energy-saving production ensuring the sustainability of Euroregional economy in a dynamic market environment, with the environmental priorities to be restricted.

From the analysis of the existing approaches to managing Euroregional development in modern conditions of growing environmental problems it should be noted that it is the scientific developments

of the theory of clustering in economics that can have a special application, taking into account the essence of the concepts, principles and tools of this branch of the theory of management. In terms of solving a complex of problems of the European regions, the possibility of creating and functioning of transboundary environmental clusters is the way of improving the mechanism of environmental management (European Outline Convention..., 1980).

## 2. Previously unsolved aspects of the problem

Nowadays global order is outlined around large power poles. The European Union with its growing economic significance becomes a pole that requires the development and realization of the interrelation model of periphery regions of different countries which would correspond to the principles of regional policy of the European Union, which would support the formation of new forms of cooperation in the “region – region” format.

The formation of network economy generates the need for the European regions’ development together with such new forms of trans-border cooperation as “trans-border clusters”, “trans-border industrial areas”, “trans-border partnership”, “trans-border innovative projects” etc. As prospective ways of increasing competitiveness of the border regions of Ukraine, the creation of innovative trans-border clusters and industrial areas, trade and logistics centers should be considered. For this purpose, there must be the practice of the realization of projects (together with foreign partners) concerning the formation of industrial territorial and sectoral production systems to enhance the competitiveness of the enterprises, effective local production, investment and financial attraction to develop the infrastructure of the region, to enhance the energy efficiency of the economy and to improve quality of the environment (Hayek, 1945).

Usage of the cluster policy as the strategic instrument requires appropriate clarification. In spite of high popularity of cluster approach, there has not been found optimum way to define a cluster which makes it difficult to define the cluster policy. This is why cluster policy is used as generalizing name to define different ways of support and development of network union enterprises.

The purpose of the article is to investigate the emergence of the environmental management cluster forms in the frame of the burning need to prevent the sewage pollution of the Danube delta by means of self-organizing of trans-border environmental cluster which being the institution of the ecological cooperation over the administrative boundaries will become the pole of reducing the environmental risks and the pole of preventing the technogenic accidents in the “Lower Danube” Euroregion.

### 3. Research methods

The research hypothesis is the assumption that the cluster approach is the most effective mechanism for the development of international economic cooperation in modern conditions and, ultimately, is the meso-level of competitive cross-border integration systems and a necessary condition for the qualitative growth of Ukraine's integration into the European Economic Area.

The articulation of the problem can be described as a meso-economic synthesis of development of innovation clusters and international integration associations' concepts, and, in our opinion, it allows to develop both the mechanism and the scientific understanding of the development of modern integration systems.

In the middle of the twentieth century, the interconnection of regional space, economic agents and innovation was covered in the work of F. Perroux "Economic Space: Theory and Applications", in which the author draws attention to regional development with his concept of "growth poles" (Perroux, 1950). It is based on the dominance effect, formulated by Perroux, which shows that to understand economic growth, it is necessary to focus on the role of "driving industries", i.e., industries that dominate due to their size, great market power or the role of a leading producer of innovation. Driving industries (or even separate firms) are "poles of growth" that attract, focus and direct a variety of economic resources. Thus, compactly located and dynamically developing industries or enterprises that generate a chain reaction of the emergence and growth of industrial centers are understood by the poles of growth.

The development of the cluster concept is usually associated with the works by M. Porter "Competitive advantage of nations" and "On competition", where the author describes the close interconnections between cluster partnerships, competitiveness of firms, industries and national economies (Porter, 1990).

In his work "Competitive advantage of nations" Michael Porter comes to conclusion that while developing the investment policy of the evolving economy, focus must be given to the developing of interconnected industrial clusters based on the transplantation of economic institutions, the development of cooperation and competition. The approach to assessing the competitiveness of a cross-border region can be defined using the concept of competitive advantage of the country, offered by M. Porter (Porter, 1990).

In his contributions, M. Porter, in contrast to the prevailing development goals, the aim of which is to support the diversification of the economy, in the United States of that time, justifies the need for industrial specialization, which is carried out in accordance with historical preconditions. He notes that various factors (external as related to the firm) can improve its

functioning. Porter defines a cluster as "geographically concentrated groups of interdependent companies, specialized suppliers, service providers, firms in relevant industries, and related organizations (e.g., universities, standardization agencies, trade associations) in certain industries that compete but at the same time work together" (Porter, 1998).

M. Porter investigated the most successful companies on a global scale and found out that, with some regularity, firms from one or more countries achieve much greater results than their competitors. It was the beginning of the theory of industrial clusters. An important distinguishing feature of the development of industrial innovation clusters, from the point of view of M. Porter and many other researchers, is the combination of cooperation and competition: firms cooperate and at the same time compete with each other (Porter, 1998).

This paradoxical effect of the coexistence within the cluster is called co-competition. In this case, clusters of companies compete with each other in the markets of goods and production factors and cooperate to obtain funding from governments while developing new markets and technologies.

Many researchers have attempted to structure the basic theoretical premises of the cluster concept. For example, M. Enright points at the connection of the observed spatial clustering with the theories of business externalities, savings from agglomeration, labor unions and knowledge mobility (Enright, 2000).

Urbanization expert Jane Jacobs claimed that cities play a crucial role in economic development: new knowledge generated in cities contributes to different economies and human potential development (Jacobs J, 2000). It is especially important that the scale of cities and the diversity of their residents provide many relationships that generate new ideas. The creation and development of new products and new technologies (in Jacobs' terminology, "new work") is a source of economic development (Jacobs Jane, 2009).

Reducing the importance of the territorial component of the location of production operation with the development of information technology leads to the formation of virtual inter-firm networks and the possibility to create international cluster systems that can evolve rapidly in modern conditions. Thus, the cluster approach becomes broader and allows to involve more companies and countries in the information exchange. Actual experience and previous scientific research prove that the most effective interaction between organizations is possible in trans-border cluster systems, and this is especially important for the development of regional integration associations.

### 4. Results

Management of the Danube river basin (with the territory of only the Danube delta of 6750 sq. km.) is

focused not so much on the amount of water with any restrictions in the water apportioning, as on the problems of water quality and organic pollution, presence of nutrient/biogenic and hazardous substances, as well as on hydromorphological issues, in view of the fact that the corresponding transboundary water resources are used as the source of potable water and for shipping purposes.

Sewage water coming from urban settlements and industrial plants is a serious pollution factor affecting water quality. As of 2020, about 90 million people in the Danube Basin produce more than 10 million m<sup>3</sup> of sewage water every day. More than 6.5 million tons of hazardous substances are stored at more than 250 large industrial facilities located in the basin. Most of the sewage water (80%) is either collected in the sewer network or treated on location.

Another part of the sewage water undergoes treatment at centralized pollution control facilities. It is necessary to increase the amount of collection and treatment of the remaining part of the sewage water. Over the past 12 years, the countries of the Danube basin have invested over 200 billion EUR in the construction and modernization of sewerage systems and pollution control facilities. More than 400 industrial plants achieved certification to raise the technological standard. The number of settlements and industrial facilities connected to the sewerage network and treatment systems has grown significantly (and now is almost 75% throughout the Danube basin). At the same time, the number of sources of pollution with hazardous substances remains unknown, and only limited information, based on the results of an inventory of industrial facilities, is available. The Convention on the Protection of the Danube River emphasizes that the signatory states are responsible for the quality of water resources on their territory. The Water Quality Information and Monitoring System is in charge of the following technical instruments:

1. The Danube Emergency and Accident Warning System is activated whenever there is a risk of transboundary pollution or an excess of permissible concentrations of hazardous substances. By means of this early warning system, warning messages are sent to the countries in the lower part of the basin, which are located along the presupposed route of the emergency event.
2. Transnational Monitoring Network – collection and analysis of data on concentrations of pollutants to assess the quality of surface and groundwater.
3. Flood risk maps containing data on the vulnerability of the basin areas to the risk of natural disasters, visualized on an agreed scale indicating the extensiveness of the relevant emergency events.
4. The MONERIS model calculates the amount of nitrogen and phosphorus emissions to surface water in different ways, as well as flow retention in the surface water network.

The solution of environmental problems in the “Lower Danube” Euroregion presupposes the usage of a wide arsenal of scientific, technical and other methods, in particular, the development of the theory and practice of environmental management. Modern environmental management is a set of hypotheses, principles, methods, being a new environmental management philosophy. Environmental management is one of the internationally accepted tools for reducing environmental impact. It is a process of internally motivated, proactive activities of economic entities aimed at consistent improvement in achieving their own environmental goals and objectives, implementation of projects and programs developed on the basis of an independently adopted environmental policy. Environmental management is applied for modern production. Its primary task is to achieve an optimal balance between economic and environmental performance of companies.

To ensure sustainable development, in addition to solving the listed problems of the first two levels of the system of goals, it is necessary to achieve the co-evolution of man and nature, which, in its turn, requires significant changes in the value orientations of the society itself.

At the local level, environmental management is mainly aimed at:

- control over the implementation of environmental legislation, ecological standards and quotas;
  - ensuring the improvement of production technology in terms of reducing its accident rate, the degree of technological risk, energy and material consumption, the amount and toxicity of emissions;
  - optimization of district planning in order to reduce the harmful influence of production facilities on the population and its rehabilitation from these influences, transport and industrial fatigue;
  - ecological impacts on nature and public health;
  - organization of a system of operational information equal to the real environmental situation;
  - organization of universal continuous environmental education within the framework of currently operating preschool institutions, general education schools, colleges, lyceums, universities and specially created courses for improving environmental literacy.
- At the regional level, except from using all the above-mentioned opportunities for environmental management at the local level, the following are added:
- research and experimental design works aimed at organizing an effective system for monitoring the natural environment and industry-related factors affecting it;
  - ecological forecasts;
  - working out and implementation of the mechanism for managing the processes of interaction between society and nature within the boundaries of the region, taking into account the trans-regional processes of pollution transport in air and water mediums;

- development and implementation of regional environmental standards and requirements determined by local natural and social conditions and traditions of nature management;
- optimization of the location, functioning and interaction of enterprises exploiting natural resources;
- infrastructure optimization, including the road transport scheme, the location of energy facilities, places and operating conditions of all kinds of disposal sites.

The aim of the environmental European regional cluster is to create an ecologically reasonable specialization of the Euroregion's economy. The structure does not necessarily presuppose the presence of a leading enterprise – the system of cluster members is formed through production links for ecologically justified types of industries in the Euroregion and the scale of business entities across the administrative boundaries.

Ecological Euroregional cluster is a territorial system of economic activity that promotes environmentally reasonable economic activities, taking into account environmental priorities and resources of transboundary territories. Such clusters have a significant potential for social capital with the geographic proximity of their location, but there is no close interrelation between firms in comparison with production (traditional) clusters. The difference between ecological clusters is that the priorities of their formation are established and implemented taking into account a special type of goals – the preservation and maintenance of environmental parameters of the environment at the expense and in the conditions of the development of a set of European regional entities.

Ecological trans-border cluster system is an innovation-oriented structure that integrates production, science and public administration of the Euroregion into a single system, and is formed on the basis of information and technological cooperation, pursuing common environmental interests of neighboring countries on both sides of the border, connected by a certain corporate culture of relationships and generating environmental effects.

The main advantages provided by the cluster of the Euroregion can be described as the possibility of efficient use of water resources, access to advanced technologies of nature management, expansion of instruments for interaction between the state and business in the field of environmental safety. It should be noted that the successful functioning of the ecological cluster requires a supportive and incentive scheme within the framework of the Euroregional strategy, and while developing it, it is necessary to take into account the key points of growth of the Euroregion as a whole with consideration to the ecological state and the prospects for its change.

Environmental clusters in the European regional aspect, combining scientific potential, design and engineering development, environmental production and

infrastructure elements, can create conditions for higher priority investments and form complex production and technological packages for making profitable investment decisions with the financial support of Euroregional management structures. Investment promotion into environmental clusters provides a multiplier effect of the development of the Euroregion's economy and the solution of environmental problems, as well as out of the funds received by economic entities of transboundary territories, whose activities do not conflict with the environmental goals of society (Mikula, 2004).

The "Lower Danube" Euroregion is an international European organization founded on August 14, 1998, in Galați (Galați County, Romania) by the heads of the border regions of Ukraine (Odesa region), Romania (Galați, Tulcea, Brăila Counties) and the Republic of Moldova (Vulcănești, Cahul, Cantemir regions) (Figure 1).

At present, the "Lower Danube" Euroregion includes Odesa region (Ukraine), Galați, Tulcea, Brăila (Romania), Cahul and Cantemir (Republic of Moldova) districts. The formation of the "Lower Danube" Euroregion has created new opportunities for extension of cooperation in various fields between the border regions of the Republic of Moldova, Romania and Ukraine. The "Lower Danube" Euroregion is one of the largest European regions. It covers an area of 53.55 thousand km and has the population of about 4 million people (Table 1).

The boundary length of Odesa region with the "Lower Danube" Euroregion is the following:

- with the county of Tulcea (Romania) – 181 km (along the Danube);
- with the district of Cahul (the Republic of Moldova) – 26 km.

Table 1

**The administrative and territorial units included in the "Lower Danube" Euroregion**

Administrative and territorial unit	Territory, thousands of square kilometers	Population, thousands of people
Odesa region (Ukraine)	33.3	2394.7
Galați county (Romania)	4.6	619.55
Tulcea county (Romania)	8.49	265.34
Brăila county (Romania)	4.76	373.17
Cahul district (Moldova)	1.5	119.2
Cantemir district (Moldova)	0.9	61.3
Total	53.55	3833.260

*The "Lower Danube" Euroregion was created to solve the following tasks:*

- to achieve harmonious and balanced economic development;
- to solve a number of issues and problems in the field of environmental protection;
- to ensure an appropriate level of employment and social protection of the population;



Figure 1. The “Lower Danube” Euroregion

- to create conditions for improving the level and quality of life in our regions;
- to make steps to integrate the transport infrastructure of border regions into a single network of European transport corridors;
- to create a common cultural space in the Danube.

### 5. The transboundary ecological cluster “Clean Danube”

This cluster was created in order to prevent and exclude emergencies caused by human-made disasters in the drainage and sewerage system in the border zone of the Danube delta by means of:

- construction, reconstruction and modernization of the sewerage network and thorough repairs of water-pumping stations in Izmail and Izmail district;
- reconstruction of the sewerage network and wastewater treatment facilities in Tulcea;
- starting up a quality control system for surface and waste water based on their biochemical analysis.

It is a large-scale infrastructure project the beneficiaries of which are:

- Izmail municipal council (Izmail, Ukraine);
- Tulcea district council (Romania);
- Association of the transboundary cooperation “Lower Danube” Euroregion.

Creating of a transboundary environmental cluster in the Danube delta is aimed to achieve the following goals:

- to prevent the emergencies caused by human-made disasters by means of improving the infrastructure of the drainage system located near the border area of the Danube delta, in the process of construction, reconstruction and modernization of 11,226 km of sewerage network, installation of water-pumping stations in Izmail and Izmail region and reconstruction of 1,114 km of sewerage network and wastewater treatment plants of Tulcea County Hospital (Romania);
- to increase awareness of stakeholders about the prevention, monitoring and control of emergencies caused by human-made disasters in the border area of the Danube delta, through the implementation of joint transboundary measures: creation of a common environmental monitoring system, development of a joint transboundary investment strategy of the European region capacity strengthening program. Among the problems in the ecology of the Danube region the following can be singled out:
  1. Poor status of the state environmental monitoring system. Lack of general environmental programming, prevention and monitoring.
  2. Uncontrolled process of wastewater discharge, pollution of watercourses and reservoirs with industrial, household and agricultural waste.
  3. Lack of modern treatment facilities and water treatment technologies.
  4. Environmentally hazardous facilities.

The tasks of the transboundary environmental cluster are the following:

- International cooperation in the field of environmental protection and environmental safety.
- Integrated monitoring of the environment, control of the environmental protection, rational use, reproduction and protection of natural resources.
- Construction, reconstruction and modernization of drainage systems.
- Building of sewage pumping stations with a system of biological wastewater treatment.
- A number of joint activities, including “soft” events, as well as joint infrastructure investments in the field of emergency situations and prevention of human-made disasters.

Collocated system of monitoring and announcing is a means to monitor and inform about emergency situations that will display the results of studies of waste emissions from the border area of the Danube delta – Izmail district and Tulcea county, collected from households, private companies and government agencies.

The key players for obtaining data that will be displayed in the system are organizations with which partners have the necessary agreements (on the exchange of data), namely: research institutes, centers for environmental research, State Service of Ukraine on Food Safety and Consumer Protection, State Emergency Service of Ukraine, Ministry of Health of Romania, State Emergency Service of Romania, Water Resources Management Services of Romania.

The results of the project are the following:

1. Reconstructed drainage and sewerage systems in Izmail (Ukraine) and Tulcea (Romania).
2. Modernized treatment facilities.
3. Prevention, monitoring and control of emergency situations caused by human-made disasters in the Danube delta.

4. Development of cross-border cooperation in the field of emergencies and prevention of human-made disasters in the “Lower Danube” Euroregion.

5. Increased awareness of the population of Odesa region and Tulcea district about the advantages and results of the actions to prevent the pollution of the Danube as a result of rain-storm run-offs and reconstruction of sewage disposal plants on the both sides of the Danube (Figure 2).

Soft events under the “Clean Danube” project are the following:

1. Development of a Joint Investment Strategy in the field of increasing the capacity of emergency response.
2. Development of a Joint Operating Plan.
3. Development of a Joint Monitoring and Warning System (online platform).
4. Signing by both sides the cooperation agreement in the field of emergency situations between Ukraine and Romania.

One of the largest infrastructure projects in Izmail of recent years is the construction of a main sewer, which is first of a kind in Ukraine. The facility is being built as a part of a trans-border cooperation project, in which Izmail has won participation. The project is being implemented within the framework of joint operational program “Ukraine-Romania 2014-2020”. The total budget of the project is 4 million 353 thousand EUR, the budget of Izmail is 3 million 510 thousand EUR. In general, within the framework of the project, 11 kilometers and 226 meters of sewer networks will be changed in the town. Nowadays, the drainage of sewage in Izmail is carried out along an emergency line, therefore, until 2022, the city will have carried out a complete reconstruction of the sewer system. Sewerage pumping stations are being reconstructed, sewer lines are completely changed, a main sewer is



Figure 2. The territory of the self-organization of transboundary environmental cluster “Clean Danube”

being built, high-pressure pipes are being laid, pumping equipment, mechanisms for crushing and grinding sewage drains are being replaced, and automation is being changed. The work is being carried out simultaneously in several areas. The main aim of the "Clean Danube" project is to prevent and eliminate emergencies caused by human-made disasters in the sewage system in the border zone of the Danube delta. In case the project is implemented, in spring of 2022 Izmail will have a completely reconstructed, and therefore environmental, sewage system.

Nowadays, there is either no legislation in Ukraine that could help launch the active introduction of "green" technologies, or it is ineffective.

It is necessary to emphasize the urgency of developing a common conceptual approach to the problems of transboundary ecology for the economic development of the "Lower Danube" Euroregion:

- the role of border areas in terms of globalization;
- negative impact of the economic development of the European region on the local ecological system of the Danube region (high rate of urbanization, civil and road construction, anthropogenic load);
- the problem of trans-border transfer of substances taking into account the problems of corporate development in the region;
- lack of unitary adopted legislation in the field of ecology and environmental protection, common principles of sustainable environmental development and approaches to environmental risk assessment.

The aim of the trans-border strategy is to conceptually proclaim the principles of sustainable environmental development and the approaches to environmental risk assessment for different economic clusters operating in the "Lower Danube" Euroregion, based on the criteria of legal regulation of its participants: Romania, Ukraine and Moldova, within the framework of European environmental legislation, natural complexes, aimed at increasing the prestige and attracting more attention to the region as to a possible area for investment and stimulating economic development of the Euroregion with minimal negative natural and anthropogenic impact on the environment. The threat to the natural hydrological regime, habitats, biodiversity, water quality and ecosystem services of the Danube delta is posed by anthropogenic changes, including the construction of industrial enterprises, navigable canals, drainage, strengthening of river banks, construction of dams, locks and spillways, and also drainage of swamps along the banks of the entire Danube River and its tributaries.

The factors of transboundary interaction based on the self-organization of the ecological cluster are the following:

1. integration with neighboring experienced countries concerning water management, taking into consideration the fact that the Danube basin has the status of a transboundary watercourse;

2. the activities of working groups are the basis for international cooperation in the field of water resources management;
3. taking the samples of surface waters for hydrochemical analysis together with the representatives of the Romanian hydrochemical laboratory;
4. the Program for the exchange of monitoring information system is implemented;
5. regulations and plans of practical measures for the protection and joint use of transboundary water bodies are tried and tested.

The strategic goal of environmental risk management is to justify practical activities: no activity in the Danube region aimed at achieving the goal can be justified if its benefits to society as a whole do not exceed the resulting losses and threats to the Danube delta ecosystem. In our opinion, it is important to create information databases for the trans-border cluster in order to manage environmental risks, as well as to create groups of enterprises according to the degree of potential environmental hazard. During the process of risk evaluation, it is important to have access to information about possible environmental risks. It is the responsibility of every company related to environmental risks to get acquainted with all accidents that have occurred at the enterprises using similar processes, materials and chemicals. Obtaining relevant information allows to determine whether there is the possibility for one of the incidents that have occurred in the past at a particular enterprise to happen again, and to realize what should be done to prevent this.

## 6. Conclusions

The economic development of the "Lower Danube" Euroregion often leads to a deterioration in the quality of the environment and local / regional ecosystems, and to raise of environmental risks. High rate of urbanization, increase of civil and road construction, strengthening of anthropogenic load in general lead to pollution and transformation of existing landscapes and environment of the Danube region, which causes urgent need to harmonize environmental standards within the Euroregion and form a trans-border monitoring strategy.

The Republic of Moldova, Romania and Ukraine signed the "Joint Declaration on the Development of a Nature Management Program in the Danube delta for Sustainable Environmental Development of the Region", which became the foundation for cooperation of these three countries aimed at ensuring good environmental status of the Danube delta.

Romania and Ukraine support regular transboundary cooperation within the Transboundary Biosphere Reserve and the territories covered by the Ramsar Convention, in particular in the field of cataloguing and quality monitoring of water resources.

Prospects for the development of cross-border clusters, taking into account current trends in the use of “green” and resource-saving technologies will become added incentives for reconstruction and restructuring of existing enterprises in the Danube region, and for improving production chains as the most effective mechanism for achieving noticeable environmental impact of modernization. Usage of “green” technologies is often of cross-cluster character and has a positive effect from implementation not only for one particular company, which reduces the cost of purchasing resources and paying fines, but also for the environment as a whole.

Active formation of network forms of self-organization in trans-border economic space corresponds to impulse of creating a newer economic reality of the post-modernity, which refuses from “total ideology”, but admits variety and freedom of economic choice. Network clusters become a new source of competitive advantages for Euroregions involving Ukraine and, as such, change not only systems of deployment factors, but even the structure of economic space. Implementation of cluster system of business organization in trans-border scale facilitates to a great extent development of network structure

of economic space, strengthening its unity and integrity.

Current situation demands development and implementation of trans-border strategy of Euroregional development taking into account European practical experience in transregional strategy aimed at achieving steady social and economic development of Euro regional system in unity of its human, natural resource and manufacturing potential and institutional environment. Ukraine, making its way to EU should summarize experience of cross-border cooperation as preliminary and supplementing stage of integration in regional scale. Ukraine should develop theoretical and methodological principles of quasi-integration of economic entities and find newer forms and mechanisms of its implementation in view of network cluster systems concept.

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