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THE ROLE OF ACTORS IN ENVIRONMENTAL-ORIENTED CROSS-BORDER AND TRANSNATIONAL COOPERATION IN THE ADRIATIC IONIAN REGION

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Abstract. Cooperation plays a vital role in solving environmental problems especially when it comes to fragmented regions such as the Adriatic Ionian region. This paper examines the impact of transnational and cross-border cooperation on environmental projects in the 2014–2020 programming period of the European Union. Actor-network analysis helps understand the dynamics among 127 actors across four major EU programmes (Interreg strands A and B). In the results, regional authorities emerge as 'leader' and 'broker' actors, playing a special role in promoting cross-border cooperation. However, the limited involvement of smaller non-EU actors points to opportunities for growth. The development of this network would lead to a stronger resilience of the region, facilitate the solving of environmental problems, and thus contribute holistically to the promotion of sustainable development.

Keywords: cooperation, cross-border, transnational, Adriatic Ionian region, actor-network analyses.

Introduction

In general, it is legitimate to ask what purpose cooperation serves and what benefits it brings. This question becomes particularly important when promoting joint environmental projects and approaches in regions such as the Adriatic Ionian region[1], which is historically and territorially fragmented. Cooperation in the Adriatic region is crucial at present for various reasons, notably from political and economic perspectives (Pinnavaia & Berisha, 2021; Berisha & Nikolov, 2026). Geographical and cultural proximity-related factors strengthen multilateral links among Adriatic coastal areas, thereby fostering regional processes of peaceful growth, sustainable development, and interethnic harmony. Historically, cooperation has been a factor affecting the region's political stability (Gaifami et al., 2021; Berisha, 2023). After years of political turbulence, the region is currently progressing toward 'vertical' (inside European and international institutions) and 'hori-

[1] To the purposes of this contribution, the Adriatic Ionian region includes Albania (AL), Bosnia and Herzegovina (BA), Croatia (HR), Greece (EL), Kosovo (XK), Italy (IT), Montenegro (ME), North Macedonia (MK), Serbia (RS), and Slovenia (SI).

zontal' integration through the establishment of a free trade area (Spiliopoulos & Petropoulos, 2016; Berisha & Cotella, 2025). In this respect, environmental cooperation has gained strategic importance in the region, particularly in light of the EU's Green Agenda for the Western Balkans (Berisha, 2025; Moodie et al., 2025) and growing cross-border environmental risks such as marine degradation and climate-induced disasters. Over time, the Adriatic Ionian countries have participated in numerous European Territorial Cooperation (ETC) programmes (Pinnavaia & Berisha, 2021; Berisha et al., 2025; Moodie et al., 2025; Berisha & Nikolov, 2026). As widely documented in the literature, individuals and organisations that cooperate successfully achieve better outcomes than those that act individually (Jordan et al., 2015; Castañer & Oliveira, 2020).

This paper focuses on environmental and sustainable development projects implemented through cross-border and transnational cooperation in the Adriatic Ionian region. Such initiatives play a vital role in addressing shared ecological challenges – ranging from biodiversity loss and pollution to climate vulnerability – in a historically fragmented and environmentally sensitive area. The analysis concentrates on the 2014–2020 EU programming period and applies actor-network analysis to examine the constellation of actors involved in environmental cooperation. It investigates collaboration dynamics explicitly within three cross-border programmes (Interreg IPA CBC Italy-Albania-Montenegro, Cross-border Programme Serbia-Bosnia-Herzegovina, and Interreg Italy-Croatia) as well as one transnational programme (Interreg ADRION Adriatic-Ionian). Interregional cooperation (Interreg strand C) is not considered here, as it focuses on knowledge exchange across all EU Member States and does not have a specific territorial scope within the Adriatic Ionian region (Solly & Berisha, 2021). In contrast, this paper focuses on cooperation strands that have a direct spatial and functional impact on the macro-region (Interreg A and B).

This study addresses the following research question: what role do specific actors (e.g., regional authorities, public institutions) play in structuring environmental cooperation networks in EU-funded cross-border and transnational programmes in the Adriatic Ionian region? This paper aims to map the actor landscape of environmental cooperation projects across both cross-border and transnational programmes and to assess the structural roles of participating actors using actor-network analysis. By visualising the interconnections between actors and countries, the study seeks to identify current strengths and highlight areas with potential for further development. The paper first examines the importance, mechanisms, and drivers of cooperation. It then provides an overview of EU territorial cooperation, followed by an analysis of the role of ETC in softening regional borders. The methodology and the results of the actor-network analysis are subsequently presented, with attention to the diversity of actors involved. The paper further highlights key nodes within cooperation networks examines, the roles of actors roles, and briefly discusses the main results achieved by the analysis. The final section summarises the findings and outlines future research perspectives.

Cooperation: mechanisms and drivers

Cooperation is a foundational element of human societies, enabling individuals to achieve collective goals that benefit the group while often requiring personal sacrifices (Jordan et al., 2015). Researchers across disciplines have sought to understand the mechanisms, motivations, and conditions that foster cooperation. This section explores key findings from theoretical and experimental studies, emphasizing mechanisms that promote cooperation, the proximate drivers of cooperative behaviour. In this respect, cooperation is often viewed through the lens of strategic interactions,

where mechanisms such as direct reciprocity, indirect reciprocity, and institutional frameworks enable individuals to align their interests with collective goals (Jordan et al., 2015). Direct reciprocity is a critical mechanism in which repeated interactions encourage cooperation by creating future consequences for present actions (Axelrod, 1984). The 'shadow of the future' incentivises individuals to cooperate now in anticipation of reciprocal benefits later. Experimental evidence corroborates the role of direct reciprocity in fostering cooperation; individuals are more likely to cooperate when they anticipate future interactions with the same partner (Dal Bó & Fréchette, 2011). Indirect reciprocity, instead, extends the dynamics of cooperation beyond dyadic interactions to larger social networks. Here, cooperation is motivated by reputation, where individuals gain social approval and future cooperative opportunities by demonstrating prosocial behaviour (Nowak & Sigmund, 2005; Jordan et al., 2015). Moreover, reputation systems are effective in real-world contexts, as demonstrated by increased charitable donations and participation in public good programs when contributors are recognised publicly (Yoeli et al., 2013). When looking at institutions, they provide a structured approach to sustaining cooperation in large groups by formalising rules, incentives, and enforcement mechanisms (Castañer & Oliveira, 2020). Governments, for instance, create legal systems to deter antisocial behaviour, while markets establish trust in transactions among strangers (Ostrom, 1990). From these perspectives, institutions not only deter free riding but also foster environments where cooperation becomes a default expectation. Though experimental research on institutional influences has been limited compared to reciprocity mechanisms, studies demonstrate that institutional incentives significantly impact cooperative behaviour in both laboratory and field settings. Based on this theoretical and empirical approaches, this paper explores cooperation through actor-network analysis, highlighting the complex structures within interacting initiatives. Traditionally, the focus was on human actors like state institutions, NGOs, and private companies. This study distinguishes between two key actor types: leaders and brokers. Leader actors – whether individuals, organisations, or non-human entities – stabilise networks, define cooperation structures, and often control most resources (Callon, 1986; Latour, 2005). Brokers act as intermediaries, connecting actors across sectors, regions, or backgrounds. They facilitate communication, manage relationships, and resolve conflicts to maintain the flow of information and resources, ensuring network functionality (Callon, 1986). Unlike leaders, brokers do not set goals but keep the network operational. More recent scholarship has updated and applied these classical perspectives to the context of cross-border and transnational cooperation. For instance, Wong Villanueva et al. (2020) adopt a systems approach to assess 'good' governance in cross-border regions, highlighting inclusiveness, accountability and trust as central to sustaining cooperation networks.

According to the above discussion, cooperation is an actor's attitude that is influenced by several implicit and explicit conditions that can hinder or facilitate it. Institutional conditions, in particular, play an essential role in creating the basic conditions for facilitating cooperation across various actors and territories. This precondition is at the basis of the European territorial cooperation initiatives that have been introduced so far. Cooperation is not only affected by geographical conditions, but institutional initiatives mainly drive it. For instance, proximity is crucial for cross-border cooperation, while it is less relevant for transnational cooperation, which is primarily driven by common and shared strategies. The following section provides a historical perspective on European territorial cooperation experience in EU member and non-member countries, showing its importance in softening border relations, encouraging informal networking, intergovernmental arrangements and cross-sectoral policy coordination between actors (Böhme et al., 2011).

In the environmental field, cooperation contributes to sustainable development through several mechanisms. First, joint initiatives allow the pooling of financial and technical resources that individual countries or regions would struggle to mobilise alone. Second, cooperation promotes the sharing of ecological data, monitoring systems and good practices, which is essential to address cross-border environmental problems such as marine pollution, biodiversity loss or climate change. Third, harmonising regulations and policy frameworks through cooperative projects reduces fragmentation and increases the effectiveness of environmental governance. Finally, cooperative networks foster mutual trust and long-term institutional capacity, both of which are crucial for sustaining collective action in managing shared ecosystems.

Territorial Cooperation within the EU framework

EU cooperation has been fostered since the inception of the European integration process (Esparza Masana & Montemayor Cesaj, 2023), while ETC programmes have significantly promoted collaboration among territories and institutions (Berisha et al., 2025). In this respect, the EU encourages regional and international collaboration to support each other's economic and social advancement and overcome border-related challenges (Pinnavaia & Berisha, 2021). Historically, territorial cooperation has been at the centre of EU policy (EP, 2016). Indeed, the first examples of transboundary cooperation in Europe date back to 1962 with the Conference of Regions of Northwest Europe (CRONWE), and similar initiatives were organised by the Benelux and Baltic Sea Countries (Dühr et al., 2007). However, at the beginning of the 1990s, the EU started to dedicate greater attention to territorial cooperation among EU and external EU borders (Solly et al., 2018). The first Interreg programme was introduced during the 1989–1993 period, and the specific objectives of each programming period have changed over time (Medeiros, 2018; Reitel et al., 2018). Since then, ETC has become one of the EU's principal instruments for territorial development, evolving from a community initiative to a cornerstone of EU cohesion policy (EP, 2016). Beyond this historical evolution, recent scholarship frames ETC explicitly as a dimension of territorial cohesion and proposes a conceptual framework to evaluate how cooperation contributes to cohesion outcomes, not just that it exists (Medeiros et al., 2024).

Complementing this cohesion lens, recent work uses institutional mapping with the KEEP database to trace how Interreg A programmes actually operate on the ground. Focusing on the 2014–2020 period in border programmes with German participation (nine border regions; thirteen programmes), Chilla and Lambracht (2023) examine relationships between spatial configurations of project networks, thematic foci, and territorial context (degree of urbanisation, distance to border). Their conclusion: KEEP-based mapping is powerful for comparative, exploratory analysis of cooperation geographies, while causal claims require complementary evidence. Such critical case evidence underscores that, beyond typologies and budgets, the actual geography of participation and the balance between rural-urban stakeholders shape whether ETC advances or hinders territorial cohesion (Martín-Uceda & Vicente Rufí, 2021).

According to the European Commission, six strands of ETC have been institutionalised over time:

- Interreg A, or European Cross-Border Cooperation, fosters collaboration between NUTS 3 areas from at least two Member States near borders, addressing shared issues and tapping into growth potential to promote peaceful development in border regions;

- Interreg B, or transnational cooperation, supports collaboration over broader regions or marine basins, focusing on areas such as innovation, green and digital transitions, accessibility, and urban development. It enhances regional development with a European dimension and promotes coordinated responses among participating nations;
- Interreg C, or interregional cooperation, operates on a pan-European scale, facilitating networks to share best practices and tackle current and future challenges, promoting unity across all partners and EU Member States;
- Interreg D focuses on outermost regions, promoting cooperation to support the balanced development of the Union's territory at various levels;
- Interreg IPA supports cross-border cooperation between EU Member States and candidate countries, fostering regional cooperation, economic development, and environmental sustainability. It promotes good neighbourly relations, regional stability, and integration into EU structures through joint projects and shared best practices;
- Interreg NEXT promotes cooperation between EU Member States and neighboring non-EU countries along external borders, addressing shared challenges like environmental sustainability, health, and climate change. It supports peace, stability, and regional integration, aligning with EU neighbourhood policies.

However, the typological structure of Interreg strands does not in itself ensure effective cooperation. As Wong Villanueva et al. (2020) argue, evaluating cross-border cooperation requires attention to the quality of governance systems, including inclusiveness, accountability, and trust-building among actors. Their systems approach highlights that the effectiveness of ETC programmes depends not only on the design of instruments but also on the governance dynamics that underpin their implementation.

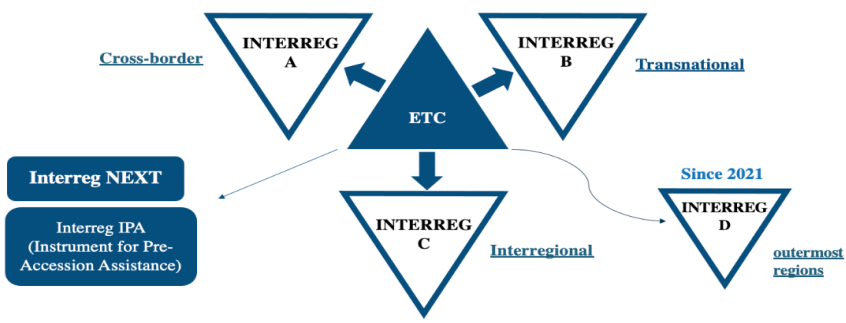

Figure 1. Typologies of ETC Programmes
Source: author's own elaboration based on EC (2021).

While Figure 1 presents the EU's official typologies, the academic literature stresses that these categories alone do not capture the full complexity of cross-border cooperation. Fogarasi (2024), in his review of European CBC research, shows that cooperation has been analysed not only as a structural policy instrument but also as a multi-dimensional process encompassing governance, socio-economic impacts, and identity-building functions. The review highlights recurring challenges such as administrative asymmetries, unequal territorial participation, and the persistent tension between top-down EU programming and bottom-up local needs. This broader perspective situates Interreg strands within a wider scholarly debate on the effectiveness and limits of cross-border cooperation.

EU territorial cooperation in the Adriatic Ionian region

EU territorial cooperation has played a pivotal role in deepening integration among EU member states and supporting the Western Balkans in their EU accession process (Petričušić, 2005). Although excluded from EU structural funds, the Western Balkans benefit from funding schemes under the Instrument for Pre-Accession Assistance (IPA) (Cotella & Berisha, 2019; 2021). Since IPA I (2007–2013) and IPA II (2014–2020), the EU has invested over EUR 23 billion, with a significant focus on regional cooperation and connectivity. Under IPA II, substantial funds have been directed to cross-border projects to bridge distances between border communities, involving both member states and candidate/neighbourhood countries. However, funds were not distributed evenly across sectors: most investments targeted the rule of law and competitiveness, whereas issues such as the environment, transport, and social policies received less attention (Table 1). Similar to pre-accession mechanisms in Central and Eastern Europe, these tools have advanced EU priorities, including sustainable regional development, tourism, environmental protection, and measures to address social exclusion (Cotella & Berisha, 2021). Moreover, ETC has fostered cooperation in the Adriatic Ionian area, notably through programmes like Italy-Slovenia, Italy-Croatia, Slovenia-Croatia, and Italy-Greece.

Table 1. IPA allocations by sector and country (programming periods 2007–2013 and 2014–2020)

	Sector	Albania	Bosnia and Herzegovina	Croatia	Montenegro	North Macedonia	Serbia	Kosovo
2007-2013	Justice	18%	18%	9%	17%	12%	16%	-
	PA Reform	13%	13%	9%	23%	13%	22%	-
	Transport	16%	8%	12%	13%	20%	10%	-
	Energy. and Climate	18%	16%	15%	8%	18%	19%	-
	Social Development	10%	14%	34%	8%	12%	22%	-
	Agriculture and Rural development	22%	5%	21%	18%	17%	6%	-
	others	3%	26%	0%	13%	8%	5%	-
	Total (M EUR)	**512**	**554**	**802**	**191**	**508**	**1,213**	**679**
2014-2020	Democracy and rule of law	27%	28%	-	19%	15%	22%	22%
	Democracy and governance	16%	8%	-	11%	11%	15%	14%
	Rule of law and fundamental rights	10%	7%	-	7%	4%	8%	8%
	Competitiveness and growth	23%	42%	-	30%	35%	27%	28%
	Environment, climate change, and energy	3%	6%	-	6%	10%	10%	12%
	Transport	2%	3%	-	5%	10%	3%	0%
	Competitiveness, innovation, agriculture, rural development	14%	4%	-	12%	11%	11%	10%
	Education, employment, and social policies	5%	2%	-	8%	4%	4%	6%
	Total (M EUR)	**1279**	**789.3**	**-**	**568.2**	**1217**	**3078.8**	**1204.2**

Source: Cotella and Berisha (2021).

CBC cooperation in the Adriatic Ionian region

Table 3 illustrates the cross-border cooperation dynamics in the Adriatic Ionian region, where different funds are mobilised based on the countries involved (Pinnavaia & Berisha, 2021; Berisha & Nikolov, 2026). During the 2014–2020 programming period, the following initiatives were activated:

- Four INTERREG CBC programs involving EU member states: Italy, Croatia, Slovenia, and Greece.
- Ten INTERREG-IPA programs engaging both EU member states (Italy, Croatia, Greece, Bulgaria, Hungary, and Romania) and most Western Balkan countries, excluding Kosovo.
- Ten IPA programs exclusively between Western Balkan countries: Albania, Bosnia-Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia.

From these categories, three cross-border programs were selected for actor-network analysis:

- *Interreg Italy-Croatia*: Focuses on research and innovation, climate change adaptation, natural and cultural heritage preservation, and low-carbon transport systems.
- *Interreg-IPA CBC Italy-Albania-Montenegro:* Aims to enhance competitiveness, tourism, cultural and natural heritage, climate change adaptation, sustainable transport, and public infrastructure.
- *CBC Programme Serbia-Bosnia-Herzegovina:* Promotes employment, social inclusion, environmental protection, climate change mitigation, risk prevention, sustainable tourism, and technical assistance.

Table 2. List of EU cross-border cooperation programmes in the Adriatic Ionian region

CBC	AL	BA	HR	EL	IT	ME	MK	RS	SI	XK
INTERREG	n.a.	n.a.	IT-HR SI-HR	IT-EL	IT-EL IT-HR IT-SI	n.a.	n.a.	n.a.	IT-SI SI-HR	n.a.
INTERREG IPA	IT-AL-ME EL-AL	HR-BA-ME	HR-BA-ME HR-RS	EL-AL EL-MK	IT-AL-ME	HR-BA-ME IT-AL-ME	EL-MK BU-MK	HR-RS BU-RS HU-RS RO-RS	n.a.	n.a.
IPA	AL-ME AL-XK AL-MK	RS-BA ME-BA	n.a.	n.a.	n.a.	AL-ME ME-XK ME-BA RS-ME	AL-MK XK-MK	RS-BA RS-ME	n.a.	AL-XK XK-MK ME-XK

Source: authors' own elaboration based on Pinnavaia and Berisha (2021).

Transnational cooperation in the Adriatic Ionian region

Table 3 shows that during the 2014–2020 programming period, the Adriatic Ionian region actively participated in six transnational cooperation programs. Among these, the Adrion program stands out, as it included nearly all countries in the region, with the notable exceptions of North Macedonia and Kosovo.

The primary objective of the Adrion program is to foster policy advancements and governance innovation, promoting European integration while leveraging the region's natural, cultural, and human resources. It aims to strengthen economic, social, and territorial cohesion across the Adriatic and Ionian areas through four thematic priority axes:

- Axis 1 – Innovative and Smart Region: Enhancing skills, improving research and innovation frameworks, mobilising stakeholders, and identifying emerging market opportunities;

- Axis 2 – Sustainable Region: Promoting the sustainable use and preservation of natural and cultural assets while addressing environmental vulnerabilities and ecosystem fragmentation;
- Axis 3 – Connected Region: Enhancing integrated transport, mobility services, and multimodality;
- Axis 4 – Supporting Governance: Facilitating coordination and implementation of EUSAIR priorities by enhancing institutional capacity and collaboration among key stakeholders.

While Adrion is central, countries in the region also benefit from other transnational programs. As shown in Table 2, countries like Slovenia, Italy, and Croatia participated in at least four programs, whereas Montenegro and Serbia were eligible for only two. Kosovo, however, remains an exception, as it was excluded from any transnational cooperation initiatives.

Table 3. List of EU Transnational Cooperation Programmes insisting totally or partially in the Adriatic Ionian

Transnational	AL	BA	HR	EL	IT	ME	MK	RS	SI	XK
Adrion	X	X	X	X	X	X	-	X	X	-
Central Europe	-	-	X	-	X	-	-	-	X	-
Alpine Space	-	-	-	-	X	-	-	-	X	-
Danube	-	X	X	-	-	X	-	X	X	-
Mediterranean Area	X	X	X	X	X	X	X	-	X	-
Balkan-Mediterranean	X	-	-	X	-	-	X	-	-	-
Participation by each country/ transnational programmes insisting in the region	3/6	3/6	4/6	3/6	4/6	3/6	2/6	2/6	5/6	0/6

Source: authors' own elaboration based on EC (2025).

Methodology and data collection

This research employs a structured, multi-stage methodology to analyse the roles of actors in cooperation initiatives, drawing on actor-network theory (Fig. 2). The methodological approach is divided into four essential steps: 1) selection of actors' 'environment', 2) development of an analytical matrix, 3) data processing, and 4) network visualisation. Each step is designed to ensure a thorough analysis of actor networks, particularly in the context of transnational and cross-border projects.

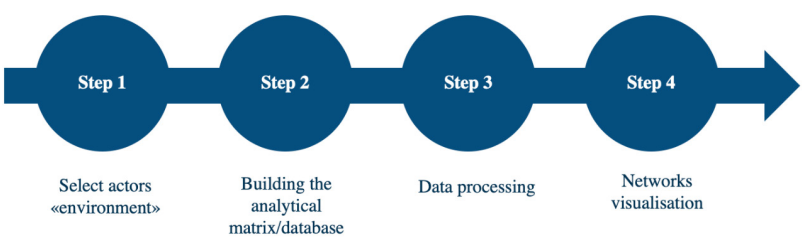

Figure 2. Research Methodological Steps
Source: authors' own elaboration.

The first step is to identify relevant measures or actions within the selected cooperation initiatives. Measures are defined as specific projects or processes in which actors – such as institutions, governments or organisations – interact. The selection of measures is based on their relevance to environmental objectives, the degree of stakeholder interaction, and the objectives of cross-border cooperation. Emphasis was placed on projects that involved a wide range of actors, including public and private entities operating at the local, regional, and national levels. Care was taken to ensure that the selected projects represented a balanced representation across countries in the Adriatic Ionian region and among various institutions and stakeholders. Although there are many Interreg programs, the ADRION IPA transnational program and three CBC programs – Interreg Croatia-Italy, Interreg IPA CBC Italy-Albania-Montenegro and Interreg IPA CBC Serbia-Bosnia-Herzegovina – were used for this analysis. The ADRION IPA program was selected for its transnational perspective, as it covers almost all countries in the Adriatic Ionian region (and the Western Balkans) and focuses on large-scale cooperation to address regional challenges. The three CBC programs were selected because they focus on cross-border cooperation and involve actors from the countries analysed. In selecting the programs, attention was paid to ensuring that the countries from the Adriatic Ionian region were proportionally represented. The CBC programs provide insights into cross-border interactions among EU member states and non-member states (e.g., transnational programs). In combination, the selected programs offer a comprehensive overview of the cooperation dynamics in the region, ranging from broader transnational initiatives to more focused bilateral and trilateral cross-border projects.

The second step focuses on developing an analytical matrix to systematically organise and interpret the collected data (Fig. 3). The matrix serves as a tool for capturing critical dimensions of stakeholders' involvement, including their types and operating levels. Actors are classified as public (national institutions, regional authorities, municipalities, or universities) or private (including companies, research centres, associations, or NGOs). In addition, the matrix captures the influence of the stakeholder group, which ranges from local and regional to national, and the country in which the stakeholders operate, including Albania, Bosnia and Herzegovina, Croatia, Greece, Italy, Montenegro, Serbia, and Slovenia.

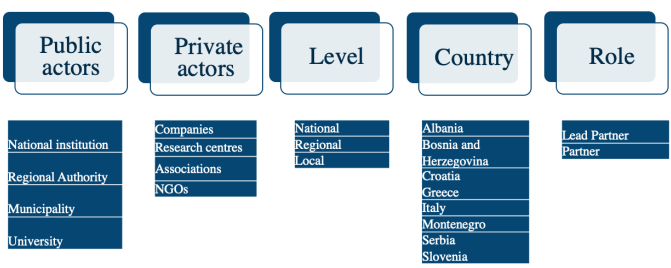

Figure 3. Analytical matrix of cooperation initiatives
Source: authors' own elaboration.

Furthermore, the matrix distinguishes between lead partners and partners in a project. While this distinction is important for understanding the general dynamics of project coordination and the distribution of responsibilities, it was not further explored in the analysis below. This decision was made because the primary focus of the research is on broader patterns of actors' participation and their interactions rather than on the hierarchical roles within the projects. Nonetheless, this differentiation provides useful context for interpreting the dataset and understanding the leadership structures within transnational and cross-border cooperation initiatives. To sum up,

it can be said that this matrix and categorisation of the actors provide a solid foundation for further analysis to identify the reasons why cooperation in projects may fail.

The third step is to process and analyse the data to understand the interactions of the actors. To ensure a detailed assessment, a mixed methodological approach was adopted, combining quantitative and qualitative analyses. The quantitative analysis focused on measuring interaction frequency and identifying influential actors within the network, using metrics such as centrality. This analysis highlighted key actors based on their degree of connectivity (degree centrality) and their role as intermediaries (betweenness centrality). These metrics provided insights into which actors played key roles in fostering collaboration and facilitating cooperation across the network. In addition, modularity clustering was employed to identify communities or clusters within the network. This method groups actors that are more densely connected to each other than to the rest of the network, revealing clusters of collaboration or areas of concentrated activity. The qualitative analysis examined the characteristics of key actors, focusing on their country of origin and institutional type (e.g., public institutions, private organisations, or NGOs). This provided a deeper understanding of the composition and diversity of the network, revealing whether certain types of actors or specific countries were disproportionately represented or influential. Together, these methods provide an understanding of the networks of actors, from the influence of individual actors and their ability to cooperate to the dynamics within communities in cross-border cooperation initiatives. The final methodological step focused on visualising the actor networks using the network analysis tool Gephi. In these visualisations, nodes represent actors, while edges illustrate their relationships. Network visualisation provides valuable insights into the structure and dynamics of cooperation initiatives by highlighting the density of connections, key actors who occupy central positions, and clusters of stakeholders demonstrating strong collaboration. It also reveals gaps, such as underrepresented sectors or isolated actors.

A systematic data collection process was followed to analyse and compile the data presented in the tables. Projects under the 2014–2020 programming period were examined, as noted earlier, focusing on four main programmes: ADRION IPA, Interreg Croatia-Italy, Interreg IPA CBC Italy-Albania-Montenegro, and Interreg IPA CBC Serbia-Bosnia-Herzegovina. When selecting the specific projects, care was taken to cover various environmental topics, connecting different types of actors (e.g., from other sectors) in the network. The actor data used for the network analysis was primarily extracted from the KEEP database (KEEP, 2025), which aggregates structured partner-level information for ETC projects. This was supplemented with project websites and official documentation to verify and enrich the dataset. All data was carefully validated using official program materials and reports to ensure accuracy and completeness. The study examined 20 projects funded by the selected programs. These projects, as mentioned earlier, involved countries from the Adriatic Ionian and Balkan regions, including Albania, Bosnia-Herzegovina, Croatia, Greece, Italy, Montenegro, Serbia, and Slovenia.

The identified cooperation initiatives are grouped into several categories, which are presented in Annex 1 (Tables 1–4). These tables provide an overview of the selected projects, including their main aims and the actors involved.

Empirical evidence of actors' cooperation

When running the network analysis, it can be recognised that the involvement of various actors – from government authorities and non-governmental organisations to research institutions – shows

a high degree of complexity and networking. In the four programmes examined, a total of 127 actors were involved in 20 projects. This broad spectrum of participants emphasises the multidimensional nature of cross-border cooperation. A key insight from the analysis is the recurring role that certain actors play across multiple projects, often acting as hubs or key figures in the network. Several critical *leader actors* and *broker actors* were identified by mapping them onto a network matrix. According to the data, the leader actors are those who participate in multiple projects and programs, creating a net of connections that facilitates knowledge transfer and strategic collaboration. Meanwhile, broker actors link different projects, ensuring that best practices and innovations spread across boundaries. The presence of these pivotal actors underscores the importance of cross-border cooperation in dealing with environmental challenges. The links between the participating actors and the intricacy of their interactions are highlighted in the image below (Fig. 4), which depicts the network matrix of actor collaboration in the selected projects. The red dots named "nodes" represent actors like organisations, institutions, etc., while the lines connecting the dots (so-called "edges") signify collaborations and interactions between these actors.

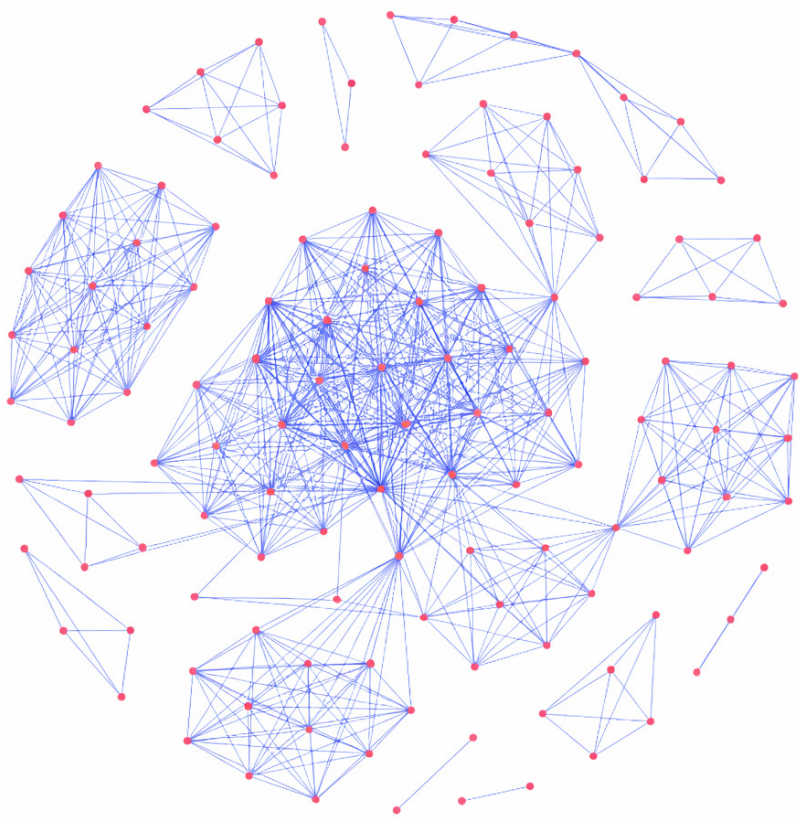

Figure 4. Actor-Network Matrix
Legend: red nodes = actors (organisations, institutions, etc.); lines (edges) = collaborations between actors.
Source: authors' own elaboration.

Figure 5 shows the same actor network matrix illustrated with modular clustering. The size of each node reflects its relative importance within the network, which is likely determined by centrality measures such as degree centrality, indicating the number of connections a particular actor has. Larger nodes, therefore, represent key actors that play a central role in maintaining the network's cohesion. The colours of the nodes correspond to modularity classes, which represent distinct clusters or communities identified by the modularity algorithm. Modularity measures the network structure by identifying groups of nodes that are more densely connected to each other than to the rest of the network. In this graph, each modularity cluster is visualised in a different colour, highlighting communities of actors that share stronger internal connections than external ones. The green cluster is one of the most prominent and well-connected institutions. Actors within this cluster likely collaborate intensively on projects, share common interests, (but) participate in different programmes (in this example, ADRION IPA and Interreg Italy-Albania-Montenegro). In contrast, peripheral clusters, such as those shown in pink or orange, consist of smaller, less connected groups of actors.

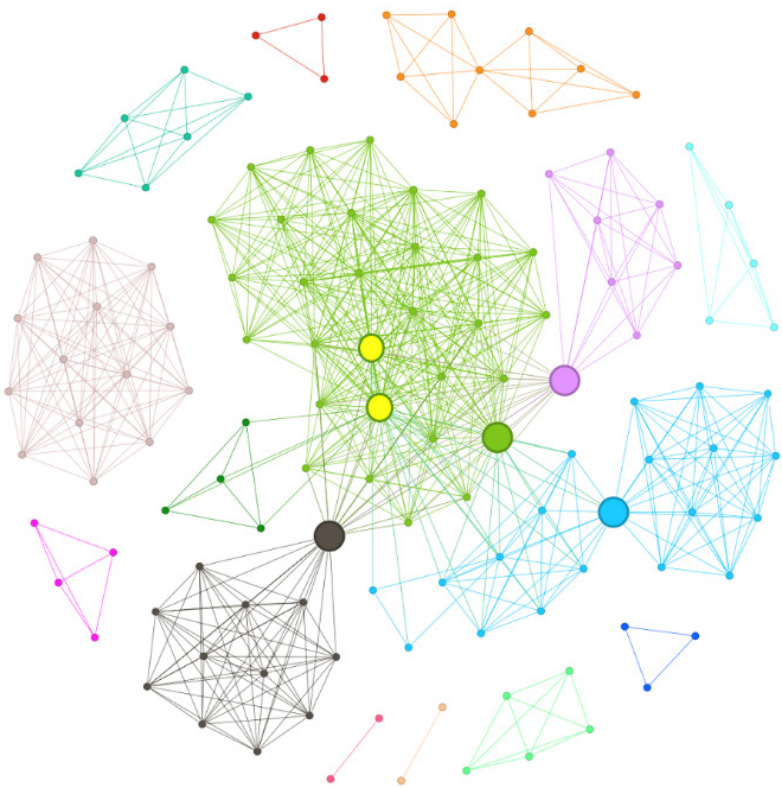

Figure 5. Actor-Network Graph with Modularity Clustering
Legend: node size = number of connections (degree centrality); node colours = modularity clusters (communities of actors with stronger internal connections).
Source: authors' own elaboration.

Figure 6 highlights the leader and broker actors in this actor-network analysis. The yellow-coloured nodes indicate the leader actors in the network: the regional authorities of Apulia region and the Dubrovnik-Neretva County. The large blue nodes highlight the broker actors, which act as intermediaries connecting different network parts. The identified broker actors include Emilia Romagna region, Primorje-Gorski Kotar County, CORILA (Consortium for Managing Research Activities in Venice Lagoon) and Public Institution Development Agency of Šibenik-Knin County. These broker actors are crucial bridges, linking various actors within the network. Their role is essential for maintaining the network's overall cohesion and facilitating communication and cooperation across different projects. The graph reveals a dense central core, where the leader actors (yellow) and broker actors (large blue) are situated. This central position highlights their prominent role in connecting and coordinating activities within the network, ensuring its structural integrity and fostering broader participation among all actors.

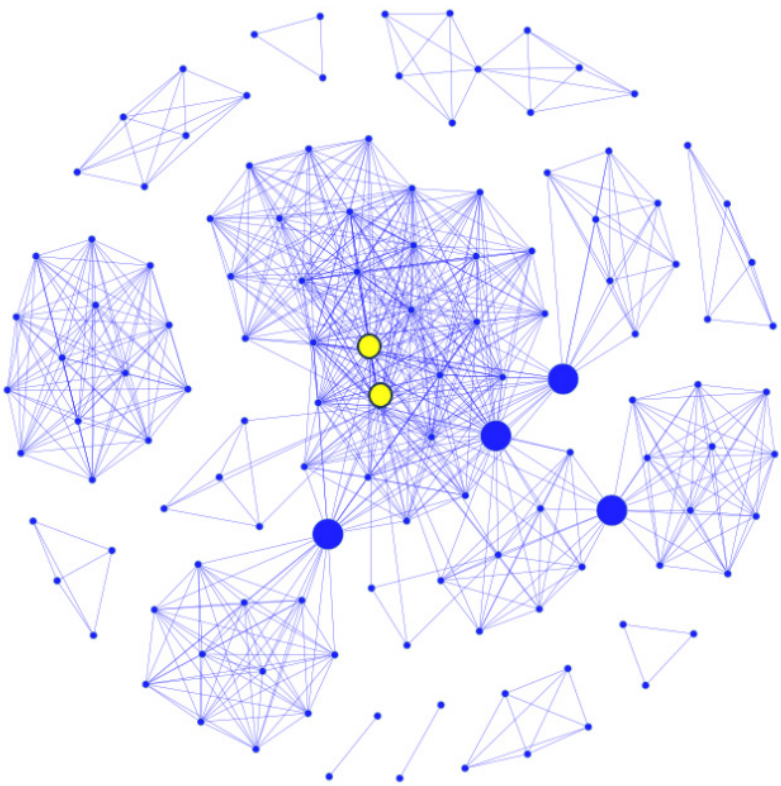

Figure 6. Actor Network Graph highlighting leader and broker actors
Legend: yellow nodes = leader actors; large blue nodes = broker actors.
Source: authors' own elaboration.

Clear patterns in the key roles of the leading and mediating actors can be identified. The leading and facilitating actors of the network, originating from Italy and Croatia, play a crucial role in fostering regional cooperation in this study. Given their institutional capacity and regional influence, the regional authority from Italy, the Apulia region, and the Dubrovnik-Neretva County

(Croatia) act as key leaders. The broker actors serve as vital intermediaries, connecting different network parts and ensuring cohesion. The region of Emilia-Romagna in Italy, known for its territorial cooperation and environmental efforts, connects Italian and foreign stakeholders via its expertise in EU-funded programs. Similarly, the Primorje-Gorski Kotar district in Croatia strengthens relations between Croatian institutions and cross-border partners.

In the process, CORILA (Italy), a research consortium, provides fundamental scientific knowledge, thus promoting evidence-based cooperation. Finally, the Public Institution Development Agency of the Šibenik-Knin County in Croatia links local implementation efforts with EU funding opportunities, thereby supporting economic growth and environmental sustainability initiatives. On closer analysis, it can be concluded that actors who appear more than once in the projects are from Italy and Croatia. Indeed, this can be inferred from the selected projects, but Italy exhibits the highest participation rate in all projects. On closer analysis, it can be concluded that actors who appear more than once in the projects are from Italy or Croatia. The ability of the institutions to manage cross-border projects, especially in the context of the selected INTERREG programmes, is significant in transnational cooperation. National institutions and regional authorities (from Italy) appear most frequently in the selected projects. This suggests they have an established institutional network and strong cross-border administrative capacity. Their role ensures the smooth coordination of projects and the dissemination of best practices throughout the Adriatic Ionian region. In contrast, smaller municipalities and local institutions from countries such as Bosnia and Herzegovina, Serbia, Albania and Montenegro are less frequently involved, which leads to the assumption that they often play a supporting role in specific initiatives. While these actors are essential for tackling local problems, they tend to focus on their immediate environment and are less involved in broader, transnational networks. This disparity in project participation points to an opportunity for growth, as smaller actors, who tend to be involved in fewer projects, could benefit from greater involvement in cross-border networks. This could increase their contribution to regional cooperation, particularly in addressing local environmental problems through knowledge and resource sharing. The analysis also reveals significant differences between the various programmes. For example, INTERREG Italy-Croatia is characterised by a top-down approach, with greater involvement of regional authorities and national institutions. On the other hand, INTERREG IPA CBC (Italy-Albania-Montenegro) involves more local stakeholders such as municipalities and non-governmental organisations, indicating a bottom-up approach. The Interreg Serbia-Bosnia and Herzegovina program, by contrast, involves more specialised actors, such as associations and local companies, that focus on sector-specific activities.

Discussion

Considering cooperation mechanisms (direct/indirect reciprocity, institutional capacity, and governance conditions) and actor-network theory, the results provide several key insights that both confirm and refine prior research.

The strong presence of regional authorities from Italy and Croatia as leading actors indicates that institutions with substantial administrative capacity and repeated project experience occupy central positions within cooperation networks. This aligns with theoretical perspectives on direct reciprocity (Axelrod, 1984;Jordan et al., 2015), which suggest that successful past collaboration encourages continued engagement. At the same time, this finding corresponds to Latour's (2005) view that leading actors stabilise networks by coordinating key resources and shaping decision-making

processes. The recurrence of the same institutions across several programmes demonstrates continuity and confirms Chilla and Lambracht's (2023) observation that ETC networks are strongly influenced by established administrative structures. The number of intermediary actors – such as the Emilia-Romagna region, Primorje-Gorski Kotar County, and CORILA – highlights the importance of such actors for maintaining network cohesion and continuity. They facilitate the exchange of knowledge and link actors who might otherwise have little interaction. This corresponds to the conceptual distinction between leaders and brokers and is consistent with Callon's (1986) argument that intermediaries are essential to maintaining the functionality of complex networks. Current literature on cross-border cooperation (Wong Villanueva et al., 2020) also stresses that trust, coordination, and effective information flows are central conditions for successful collaboration. Some institutions occupy central roles, whereas others remain at the margins and are involved only on an ad hoc basis. This uneven participation reflects existing differences in institutional capacity (Cotella & Berisha, 2021) and shows that cooperation capability – rather than geographical proximity – determines the degree of involvement. The lower participation of peripheral actors further suggests that the support mechanisms outlined in the conceptual framework are, so far, only partially effective. The identified modularity clusters reveal that the network comprises several interconnected sub-communities characterised by distinct programme logics and administrative traditions. This confirms the findings of Fogarasi (2024) and Medeiros et al. (2024), who argue that territorial governance dynamics strongly shape ETC outcomes.

Beyond this, the results extend existing research in several ways. First, the analysis shows that the network is considerably more centralised than is often assumed in the ETC literature: rather than broad participation, a small number of key actors bear much of the burden of cooperation. Second, the modularity clusters demonstrate that programmes create their own sub-communities that influence cooperation more strongly than territorial proximity – a dimension that has received limited attention to date. Finally, the low level of engagement among local actors indicates that the goals of an inclusive, multi-level governance structure are only partially realised in practice. Finally, it can be said that cooperation in the Adriatic Ionian region is shaped less by formal programme logic and more by concrete constellations of actors and institutional capacities. This underscores that sustainable strengthening of regional cooperation will be possible only if both central and peripheral actors are equally empowered and effectively integrated.

Conclusion

This study analyses a selection of projects implemented under the umbrella of EU transnational and cross-border cooperation in the Adriatic Ionian region of the programme period 2014–2020. One of the most significant insights from this analysis is the complexity of interactions within these networks, which highlights the different roles that actors play in environmental cooperation. Leader and broker actors, particularly regional authorities, proved to be the leading actors that coordinate activities, link and implement projects, and support the transfer of knowledge and practices across borders. Their repeated involvement indicates that these actors possess the institutional capacity and administrative experience needed to manage cross-border environmental projects effectively.

However, while the importance of these key actors is evident, the analysis also reveals significant differences in the levels of their participation. The periphery of the network shows that actors that can be defined as 'followers' are not fully or constantly engaged in cooperative experiences. Smaller municipalities and local actors from non-EU countries such as Bosnia and Herzegovina,

Albania and Montenegro are generally less involved in the broader transnational networks and often play more limited, localised roles within individual projects. Their limited participation suggest that institutional or logistical obstacles prevent 'smaller' actors from taking part more actively in cooperation. The heterogeneity of the relationships between the actors is also noteworthy. Some are firmly embedded across multiple projects, while others remain more isolated and participate only occasionally. This uneven engagement suggests that institutional or logistical obstacles continue to limit the involvement of smaller or more peripheral actors. Strengthening their ability to participate helps ensure that local expertise is better integrated into broader cooperation processes. One way to achieve this would be programmes aimed at improving the administrative and technical skills of 'smaller' actors so that they can play a more active role in transnational cooperation. Also, the project size and scope are noteworthy observations of this actor-network analysis. Projects with more participating actors show stronger connectivity and greater potential for cross-border knowledge exchange. In contrast, smaller projects often struggle to achieve the same level of interaction and to benefit from the diversity of actors.

This is particularly relevant for isolated actors from non-EU countries, who may lack the resources and institutional support required for successful cross-border cooperation. Integrating these actors into broader networks through targeted funding and more comprehensive cooperation structures can help address this problem. The disparity in project participation between EU and non-EU countries points to a broader challenge: the need to harmonise administrative procedures and institutional frameworks across borders. While EU member states benefit from well-established mechanisms, non-EU countries often face difficulties aligning their policies and practices with those of EU member states, thereby constraining practical cooperation. Addressing this requires a more streamlined and harmonised framework, including standardised administrative procedures, joint training programmes and formalised communication channels between EU and non-EU actors.

Looking to the future, the success of these environmental projects offers valuable lessons for other sectors where cross-border cooperation could be beneficial. The actor-network approach provides a helpful framework for analysing cooperation dynamics in areas such as economic development, public health and cultural exchange. By mapping relationships among actors and identifying key nodes of influence, future research could uncover new opportunities for cooperation and further strengthen links among countries in the Adriatic Ionian Region. For this purpose, the paper recommends additional research to expand the current analysis by incorporating all projects implemented not only during the 2014–2020 programming period but also in the preceding period. This approach could improve understanding of the cooperative environment by demonstrating the importance of ETC funds in overcoming regional barriers and facilitating EU integration for countries willing to join the EU (Coletti & Chiodi, 2024; Berisha & Nikolov, 2026).

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Annex 1. Supplementary tables

Table 1. Selected projects from ADRION IPA Programme 2014–2020

Project title	Project aims	Actors involved
Adrilink	Creating a network of Landscape Interpretation Centers as hubs for themed paths and routes, digitally connected through an ICT platform to enable integrated tourism management and foster creative solutions.	Municipality of Jesi, Albanian Development Fund, City of Gradiška, Corila - Consortium for Managing Research Activities in Venice Lagoon, Development Centre Murska Sobota, Early Childhood Education, Social Policy and Sports Agency of Serres Municipality
Adriaticaves	Encouraging the sustainable use of speleological sites in tourist caves and improving the protection of caves closed to the public.	Municipality Mošćenička Draga, Municipality of Tepelene, Public Institution National Park "Sutjeska", Tourist Organization of Sremska Mitrovica, Vrsar Tourist Board, Majella National Park, Authority for the Management of Parks and Biodiversity Romagna, Cantonal Public Institution for Protected Natural Areas, City of Čačak, TC Lipa Cave ITD
Circle	Advancing waste management and recycling in the Adrion region by promoting circular economy principles for environmental restoration, climate change mitigation, and the creation of eco-friendly businesses and jobs.	Municipality of Forlì, Anatoliki S.A Development Agency of Eastern Thessaloniki's Local Authorities, Energo-Data, Environmental Protection and Energy Efficiency Fund of the Republic of Srpska, Faculty of Applied Ecology – Futura, Institute for Innovation and Sustainable Development – Aeiploous, Municipality of Laktaši, Municipality of Tirana, Municipality of Ulcinj, Public Institution for the Development of the Medimurje County REDEA, RDA od Northern Primorska Ltd. Nova Gorica, Regional Agency for Socio-Economic Development - Banat Ltd, omagna Tech, School Center Velenje
Portodimore	Enhancing a geoportal for data and decision support tools in the region to integrate resources and develop strategies for environmental protection and sustainable development, thereby supporting sustainable blue growth.	Emilia-Romagna Region, Directorate General for Territory and Environment Protection, Abruzzo Region, Apulia Region - Department of Civil Protection, Centre for Economic, Technology and Environmental Development - CETEOR Sarajevo, Corila - Consortium for Managing Research Activities in Venice Lagoon, Hellenic Centre for Marine Research, Institute for Physical Planning Region of Istria, Priority Actions Programme Regional Activity Centre, Public Enterprise for Coastal Management of Montenegro, Regional Development Centre Koper, Veneto Region, Environment Directorate – Integrated, Water Service and Water Protection Unit
Transfer	Creating a common Governance Model for ancient Parks to enhance the protection and valuation of Adrion's heritage.	University of Macerata, City of Ptuj, Computer Technology Institute and Press "Diophantus", Ephorate of Antiquities of Ioannina, European Youth Center, Horizont-Albania, Institute for Philosophy and Social Theory, Institute of Archaeology, Municipality of Omišalj, PlayMarche SRL, Postgraduate School ZRC SAZU, Public Institution Development Agency of Šibenik-Knin County

Source: authors' elaboration based on the KEEP database (INTERACT Programme) and official ADRION IPA Programme documentation (2014–2020).

Table 2. Selected projects from Interreg Croatia-Italy Programme 2014–2020

Project title	Project aims	Actors involved
AdriaMORE	Improving the framework for integrated hydro-meteorological risk management in cross-border coastal areas by leveraging the outcomes of IPA Adriatic ADRIARadNet and CapRadNet.	Abruzzo Region - Department for territorial cooperation, Dubrovnik and Neretva County, Meteorological and Hydrological Service of Croatia (DHMZ), Institute of Atmospheric Sciences and Climate
AdriaClim	Supporting local and regional governments in developing climate change adaptation plans using current meteorological and oceanographical data from new Adriatic Sea observation and modeling systems.	Adriclim - Regional Agency for Prevention, Environment and Energy in Emilia Romagna, National Research Council (CNR), Alma Mater Studiorum - University of Bologna, Environmental Protection Agency of Friuli Venezia Giulia, Italian National Institute for Environmental Protection and Research ISPRA, Marche Region – Productive Activities, Education and Labour, Local Health Authority, Molise Region, Emilia-Romagna Region, City of Venice, Regional Agency for Environmental Protection and Prevention of Veneto, Zadar County, Dubrovnik Neretva County, Ruđer Bošković Institute, Public Institution RERA SD for Coordination and Development of Split-Dalmatia County, Institute of Oceanography and Fisheries, Apulia Region, Adriclim - Euro-Mediterranean Center on Climate Change Foundation, Region of Istria
Adripromtour	Promoting cross-border heritage through sustainable cultural routes to combat mass tourism by encouraging experiential tourism and using innovative methods like virtual reality to boost visibility and attract more visitors.	Primorje-Gorski Kotar County, University Polytechnic of Marche, Municipality of Cervia, Municipality of Cesenatico, University of Pula "Juraj Dobrila", City of Kaštela, Consorzio Punto Europa Teramo (COPE), Šibenik-Knin County
Argos	Establishing a governance framework for Adriatic fisheries and aquaculture institutions to manage shared biological resources, guided by the Adriatic Advisory Council on sustainable practices and environmental protection.	Autonomous Region of Friuli Venezia Giulia, Veneto Region, Public Institution RERA SD for Coordination and Development of Split Dalmatia County Dubrovnik Neretva County, National Research Council Institute of Oceanography and Fisheries, Emilia Romagna Region, Marche Region, Molise Region Department of Agriculture, Rural and Environmental Development of the Apulia Region, Region of Istria, Primorje-Gorski Kotar County, Zadar County, Public Institution Development Agency of Šibenik-Knin County, Italian Ministry of Agriculture, Food and Forestry Policies, Croatian Ministry of Agriculture
Cascada	Enhancing ecosystem knowledge in Italy and Croatia by restoring endangered species and implementing pilot projects to protect biodiversity.	Apulia Region, Euro-Mediterranean Center on Climate Change Foundation Ruđer Bošković Institute, Dubrovnik Neretva County, Environmental Protection Agency of Friuli Venezia Giulia, IUAV University of Venice, Alma Mater Studiorum - University of Bologna Adriaclim - Regional Agency for Prevention, Environment and Energy in Emilia Romagna, Delta 2000 Consortium Company with Limited Liability, University of Salento, Institute of Oceanography and Fisheries Adriatic Training and Research Centre for Accidental Marine Pollution Preparedness and Response – ATRAC, City of Nin, University of Molise, Marche Region – Productive Activities, Education and Labour, Public Institution for the Management of Protected Areas in the Area of Split-Dalmatia County Sea and Karst

Source: authors' elaboration based on project data from the KEEP database (INTERACT Programme) and official documentation of the Interreg Croatia-Italy Programme 2014–2020.

Table 3. Selected projects from Interreg IPA CBC Italy-Albania-Montenegro Programme 2014–2020

Project title	**Project aims**	Actors involved
3 watch out	Facilitating trilateral cooperation in civil protection to prevent hydrogeological, seismic, and fire risks by creating a joint risk management system for cross-border emergencies.	Apulia Region, University of Bari, Këshilli Qarkut Lezhë, Ministry of Internal Affairs - Directorate for Emergency Situations, Foundation "Partneritet për Zhvillim
Co-clean	Promoting energy efficiency and renewable energy use through pilot actions, creating an energy community, and raising public awareness via training and events.	Municipality of Brindisi, Municipality of Racale, Consortium for the Industrial Development of the Biferno Valley, Municipality of Vlora, Municipality of Berane
Flat	Improving institutional capacity for flood and landslide management, enhancing cross-border response, and developing risk management tools while establishing a training center and a data-sharing platform.	Municipality of Danilovgrad, Municipality of Brindisi, Association of Municipalities of Albania, Municipality of Nikšić, Mountain Rescue Service of Montenegro
Reehub	Increasing energy efficiency in public buildings by creating training hubs for building managers, raising public awareness, and promoting sustainable growth through low-energy or zero-energy buildings.	‚Ministry of Energy and Industry Barleti Research and Development Institute, ENEA - National Agency for New Technologies, Energy and Sustainable Economic Development, National Technological District on Energy SCARL, Municipality of Agnone, Public Institution University of Montenegro
Smartport	Strengthening energy efficiency in South Adriatic and Ionian ports with eco-sustainable LED lighting, renewable energy strategies, and smart grid technologies to reduce energy consumption and CO2 emissions.	Port System Authority of the Ionian Sea Port of Taranto, Regional Agency for the Prevention and Protection of the Environment, Municipality of Termoli, Luka Bar Joint Stock Company, Porti Detar Vlores Sh.A

Source: authors' elaboration based on project data from the KEEP database (INTERACT Programme) and official documentation of the Interreg IPA CBC Italy-Albania-Montenegro Programme 2014–2020

Table 4. Selected projects from Interreg IPA CBC Serbia-Bosnia-Herzegovina Programme 2014–2020

Project title	Project aims	Actors involved
Zero waste municipalities	Improving sustainable environmental planning and promoting biodiversity by enhancing public services related to solid waste and wastewater management, increasing effectiveness through joint initiatives on both sides of the border.	Center for Energy, Environment and Resources - CENER 21 Sarajevo, Environment Engineering Group Novi Sad,
Safeguarding unique biodiversity of Drina valley environment	Contributing to the conservation and promotion of the region's biodiversity through joint actions to protect endangered species and key biodiversity features in the Drina catchment area using innovative tools for Omorika natural site conservation.	Public Enterprise "Nacionalni Park Tara" Bajina Bašta, Public Forestry Enterprise "Šume Republike Srpske"
Establishing the system of sustainable bulky waste management Uzice and Tuzla	Enhancing sustainable environmental planning in the Serbia-Bosnia and Herzegovina cross-border area by improving waste management efficiency through a sustainable bulky waste management system.	PUC Regional Waste Management Centre Duboko, Užice, Public Utility Company Komunalac Tuzla, Centre for Ecology and Energy Tuzla
Upgrading of the waste management public service capacities in cross border region	Improving sustainable environmental planning and biodiversity by enhancing public services for solid waste and wastewater management and strengthening effectiveness through cross-border joint initiatives.	Provincial Secretariat for Urban Planning and Environmental Protection (Srem District Office) , Ministry for Spatial Planning, Civil Engineering and Ecology of Republic of Srpska, Republic Administration for Inspection Activities of the Republic of Srpska, Psri Institute for Protection and Ecology of the Republic of Srpska
Solid waste management upgrading	Elevating the quality of life in the cross-border region by strengthening solid waste management, improving waste separation and collection efficiency, and raising awareness of environmental protection.	Public Utility Company "Rad" Sarajevo, Public Utility Company "Vidrak", Danube Competence Center

Source: authors' elaboration based on project data from the KEEP database (INTERACT Programme) and official documentation of the Interreg IPA CBC Serbia-Bosnia and Herzegovina Programme 2014–2020.