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Multi-level collaborations in the European climate governance: a network analysis of LIFE projects partnerships.

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INTRODUCTION

The European Green Deal & European Climate Law

The European Green Deal aims to make the European Union (EU) the **first climate-neutral continent by 2050**. Through this new growth strategy, the EU aims to improve the quality of life of European people and future generations, addressing the two most important challenges threatening the EU and the whole world: climate change and environmental degradation (COM(2019) 640). Consequently, climate actions must be considered opportunities for all economic sectors to foster innovations and global EU leadership. In particular, the energy sector is considered strategical to reach EU climate objectives, ensuring a safe, sustainable, affordable and secure transition (R. EU. 2021/1119). Currently, the **energy sector is the most critical in greenhouse gas (GHG) emissions**, contributing to 76% of total emissions in 2020 (EEA, 2022).

The multi-level climate governance approach

Even if climate change is a global challenge, it requires a sustainable energy transition through local interventions, evidencing its ***glocal* nature** (Gupta *et al.,* 2007). Additionally, while **mitigation is a global concern**, **adaptation is mainly addressed locally** (Di Gregorio *et al.,* 2019). Accordingly, the EU recognizes the need to address climate change challenges using **multi-level governance** approaches, integrating activities placed at different jurisdictional levels, from local to international, through collaborations between multiple actors, where local levels lead the implementation of EU and national policies and climate initiatives are diffused and upscaled through networking (Dobracev *et al.,* 2021; Jänicke and Quitzow, 2017; Gupta, 2007). Accordingly, the EU Climate Law recognizes the multi-level nature of climate actions, aiming to establish a multi-level dialogue with local authorities, civil society organizations, the business community, investors and other relevant stakeholders (R. EU. 2021/1119).

The LIFE Programme

As one of the most important European funds aimed to concretize the EU environmental policy objectives (Hermoso *et al.,* 2017), the **LIFE Programme clearly focuses on climate change adaptation and mitigation** through specific sub-programmes for the climate, using a **collaborative approach**. LIFE projects are usually proposed by partnerships of actors who share resources to reach a common goal. In the last programming period (*i.e.,* 2014-2020), the LIFE Programme sustains specifically climate actions introducing, for the first time since 1992, a specific sub-programme for Climate Actions composed of three Priority Areas: Climate Change Adaptation (CCA), Climate Change Mitigation (CCM) and Governance and Information for the Climate (GIC) (R. EU No 1293/2013).

RESEARCH OBJECTIVES

The exploration of multi-level connections enabling collaborations for climate actions and supported by LIFE projects helps identify the best composition of actors able to stimulate effective collaborative initiatives for the climate.
Discerning mitigation from adaptation projects, this study aims to:

- **verify if LIFE projects promote multi-level governance in both sectors,**
- **identify what jurisdictional level leads collaborations for the climate through LIFE projects.**

MATERIALS AND METHODS

Social Network Analysis

Social Network Analysis (SNA) is the methodology used in this study. SNA analyzes relations among multiple nodes defined by edges constituting networks. SNA analyzes the node position in the network and predicts the performances and behaviours of every node embedded in the network (Borgatti *et al.,* 2013). This methodology allows the identification of central nodes which can control information and resource flow in the network (Bodin and Crona, 2009). In this study, nodes represent actors benefitting the LIFE co-funding, and edges connect the coordinating beneficiary with associate beneficiaries composing the partnership of every LIFE project through undirected relationships.

Data extraction and network creation

We select all LIFE projects belonging to the Climate Action Sub-Programme co-funded in the 2014-2020 programming period using information reported in the LIFE Programme database (https://webgate.ec.europa.eu/life/publicWebsite/index.cfm). We consider projects belonging to CCA and CCM priority areas. After their extraction and in order to perform SNA, we create two MS Excel spreadsheets with all information related to actors and their relationships, respectively named node and edges spreadsheets. Consequently, data have been elaborated by Gephi® software.

Network statistics

Multi-level governance is verified by analyzing the **homophily** in relationships composing the network. Homophily refers to the tendency of actors to relate with actors having similar characteristics compared to others (Di Gregorio *et al.,* 2019). To verify the homophily in relationships, we calculate the E-I Index (Krackhardt and Stern, 1998), which ranges from -1 to +1. If the E-I index value is negative, there is homophily in relationships, and if it is positive, there is heterophily. In this case, we calculate homophily considering jurisdictional levels of beneficiaries. If E-I Index is positive, it attests the presence of multi-level interactions among beneficiaries composing the analyzed network.
SNA statistics of centrality (i.e., **degree** and **betweenness centrality**) are instrumental in identifying central actors. We analyze the degree centrality and betweenness centrality of nodes. The degree centrality index measures the number of relationships established by every node, and the betweenness centrality index measures how often a node is placed in the shortest path between the other two nodes (Borgatti *et al.,* 2013), revealing the most influent actors and gatekeepers (Bodin and Crona, 2009) respectively.

RESULTS

The analysis considers 190 LIFE projects, 1012 beneficiaries, and 987 relationships. We create two different networks related to the CCA and CCM priority areas identified by the LIFE Programme. Table 1 summarizes how they are constituted.

Tab.1: Composition of networks. Source: our elaboration from LIFE Database through Gephi ®

Priority area	Projects	Nodes	Edges
CCA	98	555	551
CCM	92	457	436
TOT	190	1012	987

Analysis of relationships (E-I Index)

E-I Indexes calculated for the two networks verify that **LIFE projects sustain multi-level governance**. The issue is evident in CCA LIFE projects (0.30). Conversely, the E-I Index calculated for CCM projects is equal to 0.12, attesting to a low tendency to associate with beneficiaries of a different jurisdictional level.

Analysis of networks

Networks show how the collaborative climate governance fostered by LIFE projects is composed (fig.1). Networks are displayed in order to highlight the jurisdictional level of every node and the typology of actor, distinguishing public actors (State), private actors (Market), and not-for-profit actors (Community). Central actors are highlighted through node size. In both networks, it emerges that partnerships are often multi-level, with **national actors leading LIFE projects proposal**. Differences in the two networks are related to the numerosity of local and international actors. In CCA projects, local actors represent the highest portion of beneficiaries (36.22%). Similarly, international actors are the most representative category in CCM projects. Public actors prevail in CCA projects (54.95%), while market actors prevail in CCM projects.

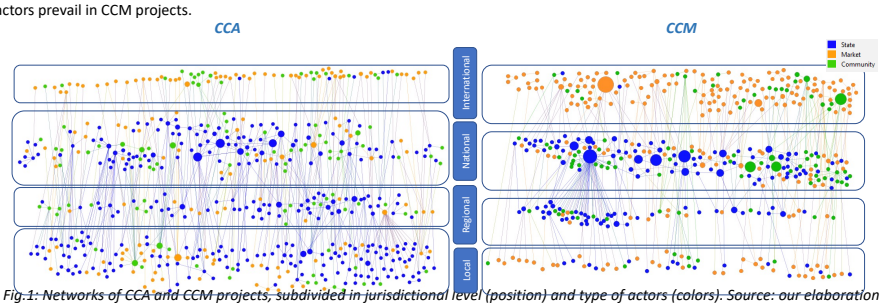

Fig.1: Networks of CCA and CCM projects, subdivided in jurisdictional level (position) and type of actors (colors). Source: our elaboration from LIFE Programme Database through Gephi ®

Analysis of most central actors

Most central actors of the two networks identified through SNA are specified in tab.2. In this case, most central actors are nodes with the five highest betweenness centrality values. Generally, in both networks, most central actors are **knowledge-related institutions** (*e.g.,* research institutions, universities) from countries belonging to the **Mediterranean Basin**, and they mainly act at a **national level**. Conversely, it is possible to detect the difference between the two sets of beneficiaries considering the presence of a local actor in CCA and an international actor in CCM. Additionally, in CCM, there are two beneficiaries from western Europe, in contrast with CCA, where all selected beneficiaries are from the Mediterranean Basin.

Table 2: Most central actors in CCA and CCM LIFE projects. Source: our elaboration from LIFE Database through Gephi ®

CCA

Beneficiary	Country	Type	Jurisdictional level	Degree centrality	Betweenness Centrality
Consiglio Nazionale delle Ricerche	Italy	Research Institution	National	4	0.15
Agencia Estatal Consejo Superior de Investigaciones Científicas	Spain	Research Institution	National	14	0.14
National Observatory of Athens	Greece	Research Institution	National	7	0.13
Galvez Productos Agroquímicos S.L.U.	Spain	SME	Local	8	0.10
Ministry of Agriculture, Rural Development and Environment	Cyprus	National Authority	National	7	0.09

CCM

Beneficiary	Country	Type	Jurisdictional level	Degree centrality	Betweenness Centrality
Centro Ricerche Produzioni Animali	Italy	Research Institution	National	6	0.12
Institut de l'Elevage	France	Research Institution	National	56	0.10
Scuola Superiore di Studi Universitari e di Perfezionamento Sant'Anna	Italy	University	National	8	0.08
Stichting LIFE Terra	Netherlands	NGO - Foundation	International	15	0.07
Legambiente Onlus	Italy	NGO - Foundation	National	2	0.07

DISCUSSION AND CONCLUSIONS

- LIFE Projects foster collaborations among beneficiaries acting at different jurisdictional levels, supporting multilevel climate governance. Multilevel partnerships composing LIFE project networks evidence the **suitability of the LIFE Programme in pursuing EU climate objectives through participatory approaches**, as highlighted by the EU Climate Law.
- National actors lead the proposition, implementation and coordination of LIFE projects in the two priority areas. Conversely, even if local actors are the most represented category in CCA and international actors in CCM, they often participate as associated beneficiaries. **Local actors in CCA could be impeded by the lack of high-knowledge skills and economic relevance required to coordinate LIFE projects** (e.g., organizational and linguistical skills). **International actors** in CCM are often large enterprises that usually contribute to identifying, developing and testing innovations. Therefore, they are private entities which presumably do not have an interest in coordinating LIFE projects, but they **foster them through public-private partnerships** with other national public authorities.
- CCA projects are proposed mainly by local, regional and national public actors. Accordingly, **adaptation needs local and targeted interventions which address specific problems characterizing the area where they are implemented**. Usually, public actors, such as local or regional authorities, have the institutional duty to prevent climate change effects, increasing the resilience of public areas (e.g., streets, urban parks, mountain slopes, riverbanks).
- The global nature of **mitigation requires identifying new technologies and innovative approaches** that could be replicated in multiple contexts, involving primarily national and international actors. Accordingly, CCM projects are mainly implemented through public-private partnerships involving national public actors and large international enterprises.
- Most CCA LIFE projects are implemented in the Mediterranean Basin. Conversely, CCM projects also involve a relevant number of actors from Western Europe. Such results reveal that **adaptation activities are implemented primarily in areas where climate change effects are most pressing** than mitigation activities.
- The centrality of knowledge-related actors highlights the **need to develop, test and spread technical knowledge and information through LIFE projects to empower people**.

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