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Barriers against data sharing for Disaster Risk Reduction (DRR) at borders

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ABSTRACT

Data sharing is a major driver to disaster Risk Reduction (DRR), which is essential to cross-border regions' resilience. However, sharing data for DRR at borders remains challenging and a limited spectrum of regions have been significantly progressing on this path. While the literature recommends that cross-border regions and organizations settle data ecosystems, studies also evidence that ecosystems face difficulties in developing sustainable rules for data sharing. A better understanding of the impediments of data sharing in cross-border DRR ecosystems is therefore necessary and remains missing in the literature. This research, based on a qualitative and collaborative design, is a work in progress focusing on the Italian-French border. Based on 24 qualitative interviews and archive analysis, we have identified four major challenges that organizations need to overcome to support data sharing for DRR at borders. First, cross-border DRR actors struggle harmonizing their perspectives over their common environment, whether it is environmental or data-related. Second, they face persistent elements of fragmentation, particularly reinforced at frontiers. Third, these organizations meet the challenge of building a sustainable bond of trust between one another about data. Fourth, they lack data maturity, thus impeding good use of data within the ecosystem. Our findings contribute to a more situated understanding of data sharing at borders and call for more consideration of the border settings from practitioners that participate in data sharing.

Keywords

Disaster Risk Reduction (DRR), cross-border, data sharing, natural risk, ecosystems.

INTRODUCTION

On the 13th of August 2023, heavy rains in the Savoy region in France generated flash muds in Bardonecchia, in Italy. Also, the rise of temperatures generated major landslides in the Alps, for instance on the 27th of August at La Praz, next to Modane, in the Maurienne valley. These events disrupted railways and highways that support transportation, workers mobility and economic exchanges between Italy and France. The main direct railway between France and Italy for now is and will remain close until the end of 2024. These examples illustrate how vulnerable to disasters cross-border regions can be.

Cross-border regions comprise natural separations such as rivers and mountains. They tend to get marginalized from the center of countries both economically and politically (Şlusarciuc, 2015). However, they frequently host critical infrastructures such as highways, dams, industrial and energy plants. They can even attract exploratory investment, such as in the case of the economic corridor that has been developing between Pakistan and China (Lim, 2019). For these reasons, the capacity of organizations at borders to prevent and address disasters has become a major concern for local and national authorities but also international organizations (Abad et al., 2018). Therefore, all these actors have been working at supporting cross-border DRR, which consists of identifying and

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preventing risks that can generate disasters (Palliyaguru et al., 2014). DRR also encompasses collective response to these disasters.

Data can drive DRR cooperation across borders (Kanbara & Shaw, 2021). First, as a digital resource, it is easy to replicate and share. Second, it calls for collaboration because understanding and preventing disasters cannot rely on a single source of data (Petrenj et al., 2013), as illustrated in the case of Bardonecchia. Indeed, the heavy rains that struck the Italian village had started on the other side of the border, in France.

What is data sharing? Data sharing does not boil down to sporadic sending or reception of data sets. As explained by Jussen et al. (2023), data sharing refers to the collective organizing of data access within a specific ecosystem. To that extent data sharing is sociotechnical and does not restrict to technological interoperability (Liverani et al., 2018). Many barriers can prevent data sharing within ecosystems (Gelhaar et al., 2021), going from the lack of understanding of the value of data to fears regarding data security. In the context of cross-border DRR, data sharing has been already documented but studies on the topic from a technical stance lack (e.g. Toro et al., 2019), leaving the topic of data sharing barriers insufficiently explored (Petrenj et al., 2013).

Given the foregoing, this work addresses the following question: “*What is the nature of barriers against cross-border data sharing for DRR?*”

This work aims at addressing this question by relying on a qualitative research design. We have considered the case of the Italian-French border, which has been struggling with the increasing frequency of disasters triggered by landslides and floods in the Alps. While Italy and France have been separately working on elaborating data bases on natural risks and vulnerabilities, there is no official data sharing system between the two countries. This research is still in progress and requires further enrichment. So far, data has been collecting through 24 interviews, archives and meetings with experts and practitioners. We have been following grounded theory principles (Glaser & Strauss, 1967; Suddaby, 2006). Some preliminary findings have been emerging and outline four major barriers against data sharing at borders: lack of a shared vision of DRR and data, fragmentation, lack of trust and lack of data maturity. We detail each barrier as well as the interdependencies between the barriers. We then discuss the novelty of these findings, the future avenues to improve the research as well as their practical implications.

THEORETICAL BACKGROUND

Disasters and DRR at borders

Borders are particularly exposed to disasters and critical situations. Most borders are shaped by topological elements prone to disruptive events. For instance, water zones – like the Rhin between Germany and France – or the Tanganyika Lake between Democratic Republic of Congo and Tanzania- are subject to floods. As another example, mountains – like the Alps between Austria and Italy or the Himalayas between China and India- are subject to landslides and earthquakes. Cross-border regions have been increasingly vital for economic integration, in all the continents (Brunet-Jailly, 2022). Paradoxically they also become more vulnerable because they host critical infrastructures, such as nuclear plants, energy infrastructures, dams and transportation channels.

For this reason, cross-border regions – defined here as territories at the jointure between distinct countries separated by a topological or administrative border – need to become resilient. DRR can drive the strengthening of this resilience while achieving sustainable development by preventing new and reducing existing and new disaster risks (Palliyaguru et al., 2014).

There has been discussion of the key concepts of DRR (Palliyaguru et al., 2014). Disaster risk corresponds to the possibility of harmful consequences resulting from the interactions between hazards and vulnerable conditions (UN-ISDR, 2009). In this context, vulnerability covers both exposure to hazards and capacity to address them. In other terms, vulnerability is the combination of, on the one hand, the degree of exposure of a system (societal, productive, etc.) and on the other hand its capacity to prepare for and respond to the hazard (UN-ISDR, 2009). It is important to note that hazards are not purely natural. Indeed, floods, fires and landslides can be favored – if not triggered - by urbanistic design and human intervention.

Based on the review provided by Palliyaguru et al., DRR can be approached as a set of four interdependent strategies, namely i) eliminating (avoiding the risk), ii) mitigating (which means reducing the impact of hazards, as well as their frequency, intensity and scale), iii) preparing (developing resilience and response capacities and plans) and iv) advocacy (favoring good practices through influence). Mitigating disaster related risks thus depends on decades-long projects that involve international and national planning (McConnell & Drennan, 2006). Also, advocacy is a long-term stake of DRR because it consists of lobbying institutions, organizations and communities.

Furthermore, the management of crises and disasters at borders requires collaboration between a large spectrum of organizations: companies, administration, agencies, communities and authorities, from multiple countries and

sectors (Ansell et al., 2010; Ansell & Boin, 2009). In line with this view, DRR at borders involves a large spectrum of stakeholders, from local to national and international actors. At a local level, municipalities endorse the responsibility of citizens but also of access to commodities including water, transportation, etc. Communities are involved to promote well-being and sustainability of economies, which also depend on infrastructures. At a national level, states are responsible for the protection of their population and the mobilization of their emergency actors. At an international level, transborder organizations can encourage - legally or not - the use of good practices. Increasingly, DRR actors have been aiming at integrating the diversity of processes and approaches to disaster risks, but without significant success (Abad et al., 2018).

Data Sharing for DRR at Borders

A critical resource to manage disasters is reliable data (UNDRR, 2015). Organizations involved in disaster response hardly dispose of the data that can address all their informational needs (van den Homberg et al., 2018). For this reason, organizations need to work on data preparedness (van den Homberg et al., 2018) by sharing data before a disaster strikes (Sarker et al., 2020). Data used for DRR can be very diverse, ranging from natural and industrial risks to demographic data. However, challenges remain regarding timeliness, completeness and precision of data.

Growing use of data for DRR illustrates the search for digital maturity worldwide, supported by the United Nations (for more detail check the UNDRR report 2022). While some countries in the world have been working on centralized disaster data systems, other countries have been promoting collaboration to share data. These countries have put efforts in developing data ecosystems (van Esch, 2021) and open data (Kanbara & Shaw, 2021).

In the scholar sphere, data sharing has been investigated as a socio-technical phenomenon observable in a large spectrum of sectors (see for instance Hazell et al., 2023 and Ure et al., 2009). This means that data sharing does not restrict to the settling of infrastructures and programs that can make data sets interoperable. Rather, data sharing is also a human practice that involves multiple organizations (especially for DRR) and requires willingness and efforts to harmonize data and make it accessible to others (Migliorini et al., 2019). However, there has been a persistent knowledge gap regarding the use of multiple data sets (for instance provided, consumed and exchanged in a data ecosystem) in the programming of resilience (Migliorini et al., 2019).

Therefore, data sharing represents a major component of resilience. At European borders, projects such as ESPRESSO or GIOCONDA (Toro et al., 2019) have outlined the benefit from data sharing across the border. Also, the European commission has been supporting the rise of data ecosystems by producing data frameworks to help organizations address the diversity of rules and standards about data (European Commission. Joint Research Centre., 2021). Beyond Europe, the World Economic Forum (WEF) has supported the sharing of data between Turkey and Greece to produce an early warning system about fires. In Asia, such at the border shaped by the Mekong river, cross-boundary organizations were created to promote data sharing between countries (Thu & Wehn, 2016).

The mutualization of data can better help grasp the nature and the amplitude of a risk. Once the crisis strikes, data sharing can help coordinate actions (Liverani et al., 2018). Even when tensions arise between countries, organizations still persevere to collect and share data (Thu & Wehn, 2016), which also reveals the importance of data sharing. However, sharing data for DRR at borders remains easier said than done. The literature has reported many difficulties. First, data sharing, as a socio-technical phenomenon, is complex (Liverani et al., 2018). It relies on a set of technologies whose interoperability needs to be designed (Jussen et al., 2023; Toro et al., 2019). Going further, the literature has documented the diversity of issues inherent to data sharing in ecosystems (Jussen et al., 2023)

Despite growing interest in data sharing in the context of cross-border DRR, there is a lack of comprehensive understanding of the challenges inherent to data sharing at borders. This calls for more investigation of the nature of phenomena that can prevent data sharing. In the following section we detail the methodology that we have been following to address the research question.

METHODOLOGY

Research Design

As a reminder, this work addresses the question of the nature of the barriers against data sharing for DRR across borders. To do so, we have been conducting a qualitative research design, which focuses on the case of the Italian-French cross-border regions. We detail in this section our choices and the challenges that we met to collect data. We also present our analysis practices and tools. In a nutshell, this study embeds into a wider collaboration with

a Non Governmental Organization (NGO) to conduct an action research project. This study is also inclusive and has been involving master students.

Case Study: the Italian-French Cross-Border Region

To address the research question, we have been conducting a case study focusing on the Italian-French border region, which comprises multiple valleys (such as the Suza, Vésudie and Roya).

The Italian-French cross-border regions have been impacted by natural hazards several times. The two countries are separated by the Alps and share a common Mediterranean coast. The latest disasters were the most impactful. For instance, in October 2020, Alex storm impacted the cross-border territory between Liguria (Italy) and Alpes-Maritime (France). Alex destroyed many infrastructures (including cemeteries and roads) as well as houses. The damages from Alex are still being addressed. In August 2023, a major railway connection between Lyon and Torino was damaged by a landslide. As a result, transportation of goods had to be deviated towards Vintimiglia in the South of Liguria. Last summer, massive waves of mud damaged roads, cars and buildings in Bardonecchia. These waves resulted from particularly heavy raining on the French side.

To understand barriers against data sharing in this case study, we first identified the actors involved in DRR in the region. Data collection from both a literature review and some interviews (see below) led us to list over 70 entities, of which 31 are Italian, 37 are French, 5 are international actors and 5 are European. Interestingly, the diversity of the DRR ecosystem implies the possibility for organizations from various sectors to share data (health, transports and energies, security of people and goods, etc.). The ecosystem also comprises organizations with complementary interests in data (from consuming to producing and communicating). However, few interactions between organizations at the border about DRR involve data sharing. Organizations might tend to cooperate when they are linked hierarchically or functioning. But sharing a same territory does not incent organizations to share data.

Data Collection

We have been collecting data from both experts and individuals from organizations that participate into DRR at the Italian-French border. During our interviews, we have been relying on a dictionary theme and an interviewer guide that have been iteratively refined. In the interviews, we first ask the interviewee to present one's work and contribution to DRR and resilience. Some interviewees were specialized in territory cohesion, some others in natural risks and others in responding to disasters. We have been collecting data on the various steps of DRR. In parallel, we also relied on various archives (such as articles and reports on the use of data for DRR at borders). Even though cross-border data sharing for DRR is not extensively documented in the literature yet, many organizations (such as the European Commission in Europe) as well as communities have been organizing events to promote collaborative usage of data for DRR at borders. Table 1 presents the interviews that we have already conducted, it highlights the diversity of interviewees, in terms of occupation and profiles. Roughly, we did our best to interview experts who have knowledge and expertise of cross-border cooperation, natural risks and DRR, as well as subjects who had some practical experience of cooperation for DRR and data sharing. Finally, we interviewed people from various nationalities, including Italian, French, but also German and Canadian.

Approaching the topics of data and data sharing has been a challenge in our study. While experts can have a precise idea of the data needed for DRR (in particular at borders), they do not always have an exhaustive view on the data practically used by organizations. Similarly, some operationals could not tell us which data they use and whether these data have been shared. Our difficulty collecting precise and exhaustive data about data remains unsurprising. As documented, data is not a trivial asset for organizations. Most of the time, its access remains confidential. To address the difficulty of interviewees expressing themselves about data, we multiplied interviews. We also made a parallel search in 2023 to find data sets that were accessible on the web (through portals and open data sources). We then identified the organizations that provided the data and contacted them. We also relied on snowball sampling to identify organizations that shared data with the interviewees. By doing so, we have progressively improved the richness and relevance of the interviews and we almost reached semantic saturation. Our next step is to refine our coding through cross-coding and conduct the interviews necessary to reach semantic and theoretical saturation.

Despite our focus on the Italian-French frontier, we have been expanding data collection on multiple borders in Europe and beyond. For instance, we have been considering the cases of the Greece-Turkye, as well as the frontier formed by Mekong River between Thailand, Lao, Cambodia and Vietnam. This has helped us identify whether the barriers identified in our data related to the Italian-French border specifically or manifested in other cross-border regions as well. This practice has helped us refine our findings and supports the reliability of it.

Table 1. List of the interviewees

N°	Interview ID	Occupation	Duration	Date
1	16_01_Exp_01	Scholar in Climatic Geopolitics	44:28	16/01/23
2	02_03_Op_01	Civil protection commandant	01:13:15	02/03/23
3	28_02_Exp_04	Scholar in Humanitarian studies	01:21:09	28/02/23
4	27_01_Exp_02	Humanitarian project manager	59:56	27/01/23
5	27_02_Exp_03	Chief Officer of a project on resilience and critical infrastructures	01:04:10	27/02/23
6	23_06_Op_02	Emergency manager	37:38	23/06/23
7	10_07_Op_05	Emergency manager	01:27:32	10/07/23
8	27_06_Exp_07	Scholar in geography, risks and data	44:38	27/06/23
9	03_07_Op_04	Firefighter Captain	42:54	03/07/23
10	29_06_Exp_08	Scholar in geography, risks and data	01:03:20	29/06/23
11	16_08_Op_06	Emergency Manager	01:03:00	16/08/23
12	23_06_Op_03	Prefectural decision maker	51:03	23/06/23
13	29_12_Exp_09	Former manager of cross-border projects	50:00	29/12/23
14	04_01_Exp_10	Director of natural risks prevention unit	01:32:38	04/01/24
15	18_01_Exp_11	Territorial Cohesion advisor	49:09	18/01/24
16	26_01_Op_07	Chief Officer of a service devoted to risks and territories	01:26:13	26/01/24
17	02_02_Op_08	Emergency Manager	01:17:43	02/02/24
18	05_02_Exp_12	Natural risk expert	01:16:12	05/02/24
19	05_02_Exp_13	Scholar in cross-border resilience	01:29:15	05/02/24
20	06_02_Exp_14	Chief officer of service devoted to natural risks	01:06:05	06/02/24
21	06_02_Exp_15	Scholar on cross-border cooperation	01:31:46	06/02/24
22	13_03_Exp_06	Scholar in Climate Change Response Strategies	01:00:13	13/03/23
23	10_03_Exp_05	Scholar in International Humanitarian Law	59:21	10/03/23
24	14_02_Exp_16	Director of non-profit organization	45:00	14/02/24

Data Analysis

So far, we have been relying on qualitative coding of the interviews on MaxQDA to identify themes and let them emerge in an inductive modeling. We are still processing the analysis of the collected data and it seems that, as said, we have almost reached semantic saturation.

Our data analysis has been following the principles of grounded theory. First, based on literature reviewing and focus groups, we identified a main concern, which corresponds to the practical issue that the subjects of the study intend to address (Glaser and Strauss 1967). Second, we systematically compared data across interviews. By doing so, our findings emerged from data. We also based our reasoning on abduction by putting into perspective the various sources of data. For instance, based on literature reviewing and focus groups, we elaborated a theme dictionary that we iteratively refined when completing interviews.

We found several ways to support the reliability of our coding. First, we relied on dialogical reasoning to challenge each other's views to refine our findings. Second, in April 2024, we will present these findings during a workshop

gathering both some experts and some operational actors. This will be an opportunity to discuss and refine our findings.

FINDINGS

The findings of this research remain preliminary and require refinement. Though, we present in this section four interrelated barriers against data sharing for DRR across borders. We have been inferring them from our data analysis. First, multiple legal, institutional and political legacies co-exist at a border. In addition, countries work on different standards and methods that do not necessarily meet. We label this phenomenon fragmentation. Fragmentation results in poor knowledge and awareness of other organizations' needs and data usage at the border. It thus contributes to the lack of mutual trust especially related to data use. Also, organizations are not equally acculturated to data in relation to DRR. This implies the lack of mutual understanding of data usage between organizations and thus the lack of trust regarding data. The lack of data maturity among organizations also undermines the building of a shared vision of data for DRR. Finally, both lack of mutual trust and shared vision of DRR and data prevents organization from addressing fragmentation.

These four challenges are depicted in Figure 1. Each barrier is symbolized by a box. The arrows represent how one barrier fuels another. In the findings section we detail each barrier but also their interdependencies.

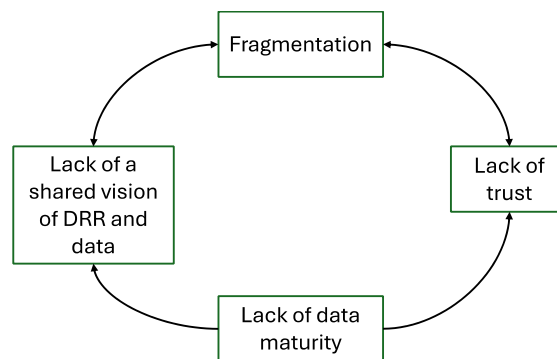


Figure 1. Interdependent barriers against data sharing at the Italian-French border

Fragmentation at Borders

In this work, fragmentation refers to the divides, differences and inconsistencies of views and practices between multiple stakeholders. Fragmentation manifests in the lack of cooperation but also technical inconsistencies (organizations using different standards), organizational and cultural divides. Fragmentation can also stem from different languages. Borders are naturally fragmented territories because they comprise natural or artificial separations. Even on the same side of a border, divides and rivalries exist between organizations.

In a fragmented ecosystem, organizations might be interested in the same topic but never interact with each other. An expert explains how fragmentation, by preventing communication between DRR actors, impedes the development of a shared knowledge on the risks and the methods to address them :

"France is specific in that responsibilities are spread between various organizations. In France, these organizations do not communicate with each other. This means that organizations do not share their knowledge on risks inherent to a specific territory. This also means that no organization has a complete understanding of the risks. This electricity provider, for instance, focuses on the risks that are the most important to its functioning and relies on its own methodologies. It is the same for train transportation companies. The State manages national roads, and the issue is the same. Highways? The same. And so on. No exchange". [26_01_Op_07].

This quotation highlights that each organization deals with the risks it could be affected by, whereas their concern should also extend to the risks that can affect other organizations and the other side of the border. Fragmentation represents a vicious circle. The less organizations are aware of the multiplicity of risks (and methods), the more they focus on their own risks and methods. And the less they become aware of the systemicity of risks on a cross-border territory. Because organizations hardly communicate on risks, they hardly develop an overview of risks at the border. This means that in the long run, fragmentation undermines the emergence of a shared vision related to DRR. Fragmentation is also a problem in terms of data sharing because it prevents the emergence of a common representation of data, both from a technical perspective (formats, metadata that is necessary, means to store the data) and from an organizational/social perspective (how to use data, methods to transmit the data).

Lack of a Shared Vision of DRR and Resilience at Borders

Cross-border territories are often characterized by the presence of topological obstacles, whether these obstacles are embodied by a river, a mountain or a desert for instance. Organizations from the diverse sides of the border might not identify the same risks and/or not prioritize risks in the same order. This is the case at the Italian-French border, where Italy has developed stronger vigilance towards volcanoes' activity and earthquakes than France.

Simultaneously, Italian and French plans might struggle to coexist in a unique framework. To nuance our view, though, a shared vision of cross-border DRR is emerging. The two countries have recently experienced cross-border disasters (such as Alex storm and 2023 landslides). They both agree on the need to tackle these risks. However, this vision of cross-border DRR turns out fragile. Primarily, DRR is still perceived as a local issue and cross-border territories remain traditionally approached as two separated territories rather than one single liminal space. An expert of the Italian-French border explained that the Alps remain a line and a separation between two territories rather than a single shared territory. In addition, DRR actors suffer from a lack of clear overview on how the Italian-French cross-border area will practically tackle disaster risks in the future. The building of a shared vision implies the need to redefine the cross-border territory.

This prevents DRR actors from making choices about the future avenues to support data sharing. Frequently, frontiers are primarily represented as lines of separation. This is how they appear on maps and official documents for instance. Historically approached as a separation, the Italian French border was not an object that required attention. Therefore, collaboration for cross-border DRR requires the renewal of the vision of the border.

Also, beyond these topological matters, the lack of vision concerns what data could be helpful for and what usage should be settled in priority. Even though DRR actors share common concerns across the border (for instance, how to reduce vulnerabilities, how to evacuate people and how to allocate resources), a shared vision of what data could help achieve remains missing and prevents the development of a shared data culture.

In other terms, the absence of a shared vision impedes data sharing. Indeed, most interviewees outlined that the rise of a cross-border strategy for DRR should be inclusive and involve proactive collaboration. In particular, DRR can be co-constructed by actors that share diverse types of expertise. As explained by an expert frequently involved in resilience projects, co-constructing solutions to address disaster related risks appears very beneficial. Co-construction of solutions implies repeated interactions that provide the opportunity for DRR actors to understand each other's roles and values well:

"[Organizations] rely on us because we have some expertise and some data to bring. We bring technical expertise to them. When we deliver this expertise, it is clear that we increasingly co-construct the final product or service [with these organizations]. This is the way it is. Co-constructing things is a way for us to be sure that we will address the demands [from organizations]. It is a way to well understand what [organizations] need and to be sure that we well address needs and to understand how our services can be used for what action afterwards". [26_01_Op_07]

Co-construction offers DRR actors not only an avenue to know each other, but also an opportunity to understand how each actor contributes to a collective effort and develops an inclusive strategy for DRR. The absence of shared visions, by impeding such co-construction, restrains the development of trust that is necessary for data sharing. Because of siloed visions, actors tend to interact only with their closest counterparts, which can also aggravate fragmentation.

Lack of Trust

Our empirical findings suggest that cross-border cooperation requires dynamic and continuous engagement from every side of the border. Developing resilience is impossible without full participation of citizens and communities. Cooperation at borders requires trust and working on mutual trust, as suggested by both these two interviewees:

"If they need us, they have to trust us and if we want to work to help some other partners (...), we need to believe in it (...). And if we think that there is no trust, I think we should rather put the matter on the table and tackle it or clarify our intervention". [26_01_Op_07]

"Fundamentally, this is what we look for, trust, as it is essential to cooperation, which itself is essential in order to solve these problems". [18_01_Exp_11]

Interviewees suggest that trust is not accumulative but rather dynamic. This means that organizations need to keep testing their ties, for instance through collaboration on data. From this perspective data can represent a relevant resource and driving force to cooperation on DRR. However, settling and maintaining cooperative projects over time across a border is demanding for organizations, particularly because of politics and the potential legacy of conflicts at frontiers. Conflicts can also question organizations' participation into data sharing projects without

notice.

To illustrate this point, our archive analysis reveals that Greece and Turkey face common natural hazards such as earthquakes, extreme droughts, volcanic eruptions, mudslides, flash floods, forest fires and potential tsunamis in the Mediterranean Sea. Despite the need for bilateral cooperation to mitigate these risks, the relationship between the two countries is characterized by a strong historical antagonism that hinders risk and disaster reduction. Past cooperation agreements on DRR were endangered by the continuing political tensions. In the future, additional communication breakdown between Greece and Turkey would likely compromise DRR cooperation and data sharing.

Moreover, the interviewees highlight the fact that data has a contradictory effect on trust. On the one hand, data represents a valuable resource to collaborate on risks because, as mentioned earlier, one single organization (or country) cannot produce on its own all the data necessary to predict disasters. On the other hand, data can be also used to produce manipulative narratives. As explained by an interviewee:

“So data is not data. Data is information about something that happened or might happen and it's controlling narratives. So what I have seen and what the literature also says is that people is more afraid about the narrative than sharing the data. So is the data saying that I'm good at it? It's going to say that I'm under control, it's going to say that I'm not under control in the case, it's saying that I'm capable to do something. So it's about the narrative, the data more than the technicality of how to share data. The other part that is more technical, but it's not just technicalities is about data for itself. Although it's a narrative, it doesn't talk for itself and that's what a lot of actors are really afraid of sharing data because if you don't know the context in which the data was collected, for which purposes, you can quite easily misuse it or misunderstand it and it's almost super difficult to explain all the context. (...) [Data's] power is narrative (...) it doesn't tell the whole story”. [28_02_Exp_04]

In sum, data sharing calls for trust and is essentially collaborative. However, trust about data remains fragile at frontiers. In addition to persistent sources of defiance related to politics and conflict's legacy, data can be perceived as a major threat. Therefore, DRR actors need to overcome this fragility, which complicates cooperation and data sharing. From this perspective lack of trust represents a major barrier against data sharing.

Data Maturity Within the Ecosystem

Data maturity is of utmost importance to promote data sharing in cross-border regions. At the Italian-French border, the relationship between organizations and the concept of data is imperfect and uneven. DRR actors and organizations are not always properly trained in data tools and processes. Therefore, these organizations lack adequate tools to experiment and collaborate about data. As a result, some participants might collect data, but without any perspective on its future use and sharing. Unawareness of the importance of data sharing might lead to situations where data has been collected yet not shared before a disaster. As explained by an expert of border resilience:

“I think it's a question of knowledge and information, of being well-aware which type of data, how many different data, what means strategic data or operational data... I think, at the end of the day, what we have is a lack of knowledge, of how to handle data”. [14_02_Exp16]

Eventually, data collected without any perspective on its usage eventually becomes obsolete and irrelevant. Organizations need to update data on a regular basis to keep it relevant. At the cross-border scale, this means that interoperability between data sources and meta data should be constantly ensured. Even when updated, data needs to be kept in the data collector's “language”.

Interdependencies Between the Barriers

Our empirical data suggests that the four barriers outlined here interact and self-feed themselves. These interactions are more detailed in the following lines.

First, the fragmentation and the absence of a shared vision of DRR and data are mutually dependent. Fragmentation renders organizations ignorant about one another. Overcoming divides and rivalries - possibly inherited from past conflicts at the border - requires doubling efforts to identify synergies between data sources. In parallel, as outlined by the interviewees, the absence of a shared vision implies that organizations get closer to their closest partners. This attitude, in its turn, fuels fragmentation and the setting up of “bubbles” of actors rather than a diversified and transversal ecosystem.

Second, fragmentation prevents organizations from building trust which, in turn, aggravates fragmentation. Cross-border areas are characterized by their plurality of equipment and processes. Making it interoperable might not

be doable, at least in the brief term, thus preventing actors from understanding each other's methods and mistrusting it. As a result, each actor tends to rely on his own practices, fueling the existence of siloes and fragmentation.

Third, data immaturity impacts both the existence of shared visions and of trust. Of course, not understanding what data is and how it can be used makes it impossible for a common vision of the potential use of data to emerge. At the same time, as they perceive data as a "niche" matter far from them, actors under-experiment with it, yet it is precisely experimentation that makes it possible to build trust. Two other interactions implying data immaturity can be imagined, but still need some more evidence. First, we might think that the lack of shared visions deters organizations from acculturating to data: as they don't have a common goal they wish to reach, they are not encouraged to support the costs of training. Second, lack of trust in other participants' might persuade organizations to keep distant from their data and more generally from data "literacy". In short, solutions to one barrier shouldn't be considered independently from those to the other ones. Even when a shared vision is reached, it must be accompanied by a behavioral adaptation (tools, language, etc.) that will lighten fragmentation. What's more, these technical/practical issues are not sufficient: the relational dimension of trust seems to be fundamental. Eventually, these "ease" in relationships between actors should reflect in an ease in the relationship with data, made possible by a process of data acculturation.

DISCUSSION

Data sharing has been identified by institutions and scholars as a major driving force to DRR. Data sharing at borders does not seem effective yet at multiple borders. The nature of the barriers against data sharing for DRR at borders remains partially known. For this reason, this research addresses the following research question: "*What are the barriers against data sharing for DRR at borders?*"

Our empirical findings outline four major barriers, namely i) visions of data and territories that do not meet, ii) elements of fragmentation particularly heightened at border, iii) the paradoxical building of trust about data at borders and iv) insufficient development of data acculturation. In this section, we first detail the expected contribution of the research. Then we infer some theoretical insights from our findings. Finally, we briefly present some practical contributions from the first findings.

Expected Contribution From the Research and Avenues for Future Development

The research is still in progress. In the future months, we intend to pursue the analysis of the collected data to propose a comprehensive model of the barriers against data sharing for DRR at borders. Ideally, the comprehensive model will help induce recommendations for organizations at the Italian-French border to strengthen data sharing and cooperation for DRR. As mentioned herein, this research is part of a wider project that aims at the development of a sustainable data ecosystem at the Italian-French border. The results from the research will be used as a scientific basis to design a governance plan for the ecosystem.

Theoretical Insights: DRR Ecosystems and Data Sharing

Our findings outline the importance of fragmentation between the Italian-French border. This finding echoes previous research on borders (Kratke, 1999). However, this work goes a little further by exploring the implications of cross-border inconsistencies on data sharing. So far, the literature has outlined that data sharing at borders confronts a lack of interoperability, divergent vocabularies, norms and equipment (Liverani et al., 2018). Those are the elements we referred to as "fragmentation" in this paper. However, the literature has more rarely explored some deeper root causes of operational issues, such as the absence of common perspectives on territories and data. This research aims at providing a comprehensive view on these root causes. By doing so, we hope to better help organizations address invisible yet powerful barriers against data sharing at borders.

Also, the literature has explained how organizations can gather in ecosystems to organize and govern data sharing for DRR (van Esch, 2021). By doing so, they can develop many to many – rather than one to many – connections. Not only they enlarge the spectrum of usable data. Also, they can mutualize resources to host data and invest into infrastructures. Our empirical findings outline fragmentation, lack of trust and lack of data maturity as serious obstacles to data sharing, which could even block any initiative to govern data sharing. Developing ecosystems at borders require the tackling of issues that are not inherent to the ecosystems itself, but rather related to the cross-border settings they have been developing in.

Practical Implications

Our research also outlines the importance of shared efforts to build trust between actors: they cannot be designed in a top-down fashion. More precisely, our preliminary results suggest the need for a bottom-up, inclusive and practical leadership on data sharing. As empirical findings suggest, DRR actors across the border need to dismantle issues that can undermine cooperation on a very regular basis.

Also, our research suggests the need for cross-border DRR actors to overcome fragmentation and the lack of trust through the design of rules to share data. Future development of this research will focus on how to integrate fragmentation and lack of trust into a governance plan. Practically, this means the need to identify which rules can aggravate fragmentation of views on data and which rules can, on the contrary, contribute to a unified vision of data sharing. Similarly, there is the need to identify which rules can undermine or foster DRR actors' trust towards each other about data.

CONCLUSION

This research aims at better understanding the nature of the barriers against data sharing for DRR at borders. Based on a qualitative research design, it has been exploring the case of Italian and French data sharing for DRR at the border. This research is still in progress but outlines four persistent barriers that need to be tackled: i) the lack of shared visions of yet common environments, ii) the persistence of elements of fragmentation, iii) the fragility of trust in relation to data and iv) lack of familiarity with data. While still preliminary, these findings suggest the need for DRR actors to increase their knowledge of data usage but also its barriers at borders. Also, it suggests the need to incorporate such knowledge in the design and maintenance of data governance between two or more countries.

While the literature advocates the creation of ecosystems to ease data sharing (European Commission. Joint Research Centre., 2021), we alert on the limitations of “by-the-book” solutions to do so. Adoption of frameworks and tools without considering the features of the cross-border region that hosts the ecosystem can be misleading. On the contrary, at borders, DRR actors need to collaboratively construct a specific vision of DRR and data. This implies the need to overcome siloed visions, fragmentation, lack of trust and underdeveloped capabilities in relation to data. In its future development, this research aims at providing a more comprehensive understanding of the barriers against data sharing for DRR at borders.

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