Facing drought through collaboration in Milan: a lesson learnt and action points for designing climate resilient water management in European cities

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This case study has been developed as part of the **Water Resilience Experiment**.

An initiative of the

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About the Design Policy Lab
The Design Policy Lab investigates the relationship between design and policymaking. Active since 2016 within the Department of Design at the Politecnico di Milano, the Design Policy Lab is a research unit that operates in the field of "design for policy," dedicating itself to the investigation of the practices and processes that constitute policymaking, i.e., the design and implementation of public policies, through the disciplinary and cultural perspective of design.

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Milan's dock (La Darsena) (Credits: Wikimedia)

Abstract

This document presents a case study on how the Municipality of Milan and a group of its territorial stakeholders successfully collaborated to face a drought crisis that affected northern Italy in early 2022. Through a collective decision-making process, these stakeholders/actors united against the emergency and asserted the city's right to prioritise surface water use for food production. This mobilisation established a temporary collaborative water governance model that could identify and address the knowledge, regulatory, and operational gaps in urban water management exacerbated by the emergency. Called to look back at this experience, these actors supported the draft of action points for designing climate-resilient water management in European cities. These points are brought to the attention of future European Commission officials and local authorities as part of the following policy case study.

1. Introduction

This case study has been developed as part of the **Water Resilience Experiment** (WRP), an initiative led by the Joint Research Centre in 2024.
The WRP intended to investigate the topic of water in Europe by leveraging the first-hand experience and knowledge of actors in five European local contexts. The project engaged these actors through the work of five National innovation and policy labs.

As one of the labs committed to the WRE's mission, the **Design Policy Lab** of Politecnico di Milano worked with the Food Policy Area of the Municipality of Milan to engage a group of stakeholders that found themselves collaborating to address the severe drought crisis affecting agricultural production in the north of Italy in 2022.

The aim was to leverage these actors' experiences to develop lessons for climate-resilient water management that could be transferred to other European cities to foster positive change. This document presents this work as a case study developed through qualitative interviews and one focus group. The case study traces how, in 2022, the Municipality of Milan initiated a collaborative process and, together with other stakeholders, responded to the environmental emergency caused by the exceptional drought at that time.

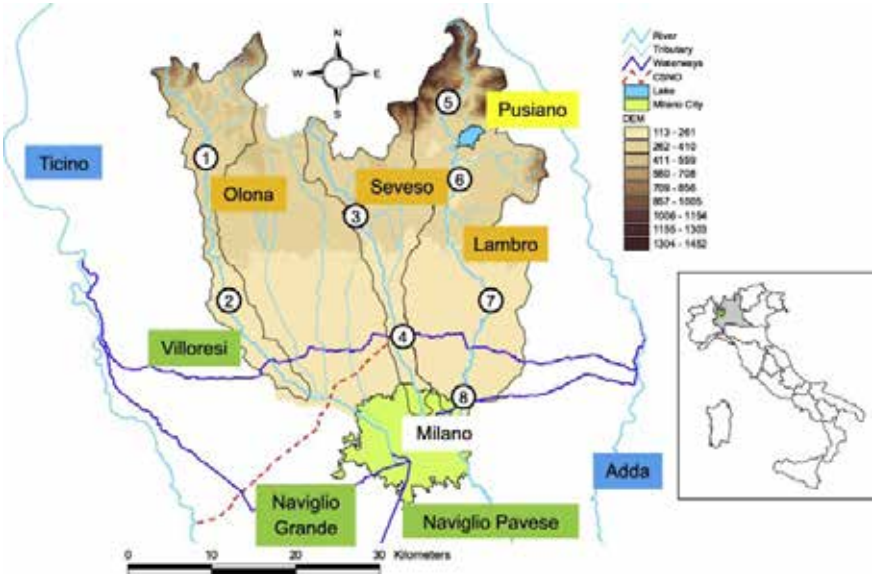
By leveraging these actors' knowledge, it was possible to outline action points for designing climate-resilient water management in European cities. These points, included in Section 6, are meant to guide the future interventions by the European Commission and inspire other local authorities about how to tackle future water-related issues, which will likely increase due to climate change.

2. Context: Milan and its system of surface waters

Milan is the second most populous city in Italy and capital of the region of Lombardy, in the north of the country. The municipality is located in a relatively small administrative area of about 182 km^2, in which 1.417.597 inhabitants reside. The urban area of Milan, however, far exceeds its official boundaries. Travelling outward from the centre, one sees the outer neighbourhoods quickly merging with the peri-urban belt surrounding the city, leaving space for an area where the countryside gets interpolated by an urban conglomerate of about 130 municipalities. These medium and small towns constitute Milan's province, whose inhabitants almost double the population residing in the city centre.

This highly urbanised territory also features one of the most important hydraulic nodes in Italy, which spans across the city centre and the hinterlands for approximately 1.300 km^2 (Ravazzani et al., 2016). Among the central elements of this node are the main rivers that, from the great lakes to the north of Milan (*Lake Como* and *Lake Maggiore*), cut across the territory and end in the south in the *Po River*. The other major rivers are the *Ticino* and *Adda*, bordering Milan's province to the east and west, while three smaller rivers (*Seveso, Olona, Lambro*) go through the municipal area (Img. 1).

Over the centuries, these water courses have been funnelled through a complex system of artificial canals, used for navigation, irrigation, and to contain floods that had, historically, been frequent in the area (Gambini et al., 2024). While many of these canals were closed over time, many still exist and characterise the identity of the city and its surrounding territory. For example, *Naviglio Grande* and *Naviglio Pavese*, which originate in the *Darsena* dock in the city centre, are two canals still visible in Milan today.



Img. 1. The hydraulic node of Milan (Ravazzani et al., 2016).

Given these main water flows, Milan's hydraulic node then spreads into many medium and small canals (img. 2) governed by a complex system of actors. For simplification, we can divide it into two main groups[1], regulated by different types of subjects:

The *Main Hydric Reticulate* (*Reticolo Idrico Principale*) and the *Minor Hydric Reticulate* (*Reticolo Idrico Minore*) include all the large and small water courses in the territory: the first is managed by the Region; while the second is managed by the Municipality of Milan or by the individual municipalities for each of their portions

The *Consortial Water Network* (*Reticolo Idrico Consortile*), instead, is managed by the "*Reclamation and Irrigation Consortiums*" (*Consorzi di Bonifica ed Irrigazione*), public economic bodies regulated by Regional law, and which bring together several private and public stakeholders. For example, the *EST Ticino Villoresi Reclamation and Irrigation Consortium* has the primary task of regulating, distributing, and controlling water for irrigation and productive uses across several artificial canals (e.g., *Villoresi, Navigli*).

In 2022, this highly complex system would be put to test by an unprecedented drought.

Img. 2. Milan and its province are irrigated by an historic system of small and medium artificial canals that funnel water into the territory (Photo Credits: The Design Policy Lab).

1. According to the Municipality of Milan *Territorial Government Plan* (2012), cf. **link**

3. The 2022 drought emergency in Milan

In the early months of 2022, the regions of northern Italy, specifically those located in the Po River basin, faced a severe drought. Between December 2021 and February 2022, the amount of precipitation (rain and snow fall) in the area was about a quarter of what is usually expected (Toreti et al., 2022). The lack of rain highlighted the scarcity of all the sources that would normally feed the surface water system in the territory around Milan (e.g., snow basin, river and lake reservoirs).

Scarcity implied competition over this fundamental resource, which had to be regulated within the constraints of an environmental emergency response. For example, the Lombardy Regional Council and other environmental authorities (e.g., the Po River Basin) agreed on when and how water should be flooded into the artificial canals through dams, excluding actors in the north Milan area. These decisions highlighted conflicting interests in the water management system of this area, regarding how much of the water coming from the lakes through the major rivers (e.g., Ticino), should be flooded into the complex system of artificial canals of territory through the opening and closing of dams.

Land consortiums in charge of major artificial channels and dams would tend to safeguard the production of hydroelectric energy by not letting water flow into the canals.
On the other hand, farmers in the territory remained in need of the water supply they would regularly receive for irrigation of their crops on a weekly or bi-weekly basis, coming from the smaller arteries of this system. In particular, blocking water in the dams was threatening the agricultural production of Milan's peri-urban territory,
where 30 to 40 farmers were cultivating mostly maize/corn and rice.

4. From issue to response: the role of the Municipality of Milan and their partners

This critical situation led several farmers located in the city's peri-urban territory to contact the city's **Food Policy Area**, asking for support. The Food Policy Area, an office internal to the Education Directorate in the Municipality of Milan, includes among its duties oversight of municipally-owned land for agricultural use.
About 15 farmers lease agricultural land from the Municipality and work with the city's administration (for example, they supply food that is used in the system of school canteens). In early 2022, these farmers contacted the Food Policy Area, warning that the drought was threatening their production—already alarmingly below expectations before the summer season.

Made aware of how the emergency was impacting Milan's agricultural production, the Food Policy Area firstly organised a roundtable with affected stakeholders to understand the cause of the crisis and how to collaborate in everyone's best interest. The roundtable included *representatives from various departments of the Municipality of Milan, the ETV Villoresi Land Reclamation Consortium, the manager of the Ticinello Canal, and the main farmers union.*

In this process, Act No. 36 on Water Resources, also known as *Galli's Law*[2], was taken as a reference for deciding on how to respond. Galli's Law is a 1994 act advancing principles for urban water regulation with national and regional scope. Article 1 of the Act states that water represents a public good whose use must be regulated according to "*principles*

2. Cf: **link**

of solidarity." For stakeholders, this Article gave way to deciding that priority was to be given to small Milanese farmers' production requests. Therefore, the city asserted its right to prioritise surface water use for domestic and irrigation purposes.

Following that determination, the group decided that the city should intervene on the Ticinello, an artificial canal flowing directly from the Darsena dock into the farmers' territory. To act urgently, the *Municipal Operations Center* (MOC), managed by the *Civil Protection Department*, became involved. The Civil Protection Department summoned professionals with the technical competencies necessary to regulate the canal's opening. A principle and intervention protocol was established. The MOC notified the regional authorities that, at need, the water from the Darsena would be let into the Ticinello canal, ultimately irrigating the fields.

This action, combined with the monitored rotation of water use among all farmers in the basin, saved the 2022 harvest for all farms irrigated by the Ticinello canal, which went through the crisis with only a 20% production loss, instead of the 60% loss suffered by other farmers in the region.

5. The emergency's aftermath: what the crisis left

Overall, the mobilisation of stakeholders — from meeting to decision and action — took no longer than a week. This action not only achieved an important short-term impact but also allowed the Municipality of Milan to learn about the hydro-geographic peculiarities of this territory and its related highly complex water management regulation and governance system, previously known only to irrigation experts and managers. The emergency management response resulted in a network of relations that was missing within the territory. While water regulatory bodies already existed in the city, they were not fit for this specific emergency because they were not connected in an open, dynamic conversation with the relevant stakeholders, e.g., trade associations, farmers, and public authorities.

Further, this experience led to changes in the surface water monitoring procedures, which are today still checked daily by the Food Policy Area through updated bulletins published by the *Regional Environmental Agency, ARPA*. Thanks to new funds coming from the *National Recovery and Resilience Plan* (NRRP), several infrastructural interventions for water are being financed in Milan's urban area (e.g., intervention on another artificial canal called Vettabbia) or are in the design phase (e.g., a new basin to store water).

6. Looking forward: open points for a climate-resilient water city

Almost two years later, as part of the research developed by the Design Policy Lab for the Water Resilience Experiment, the actors involved in the emergency had the chance to reflect on the circumstances that brought them together. Upon invitation by the Design Policy Lab and the Food Policy Area (Municipality of Milan), representatives of the organisations involved in the actions presented above were gathered for a focus group held at the Department of Design of Politecnico di Milano in April 2024, entitled "*Water Resilience Experiment: A Common Experience of Water Resource Management*" (img. 3).

After having gained an initial understanding of the dynamics of the emergency through an interview with the Food Policy Area director, the Design Policy Lab designed the focus group with a two-fold goal:

1) gathering the viewpoints of stakeholders involved in the drought crisis, listening to their direct experience and integrating it into the case study;

2) enabling collective reflection on the crisis to identify critical issues for collaborative water management and potential opportunities for the future.

Three speakers opened the meeting: Ottla Arrigoni (EU Policy Lab, JRC) explained the Water Resilience Experiment's goal and rationale; Dr Andrea Toreti (Disaster Risk Management Unit, JRC) presented the results of a JRC report on the drought crisis in northern Italy in 2022; and Andrea Magarini (Food Policy Area, Municipality of Milan) briefly introduced the case addressed in the focus group.

Img. 3. The focus group "Water Resilience Experiment: A Common Experience of Water Resource Management" (Photo Credits: The Design Policy Lab).

After the opening remarks, the Design Policy Lab researchers presented **four design opportunity areas** to spark a discussion among participants. These inspirational areas were meant to invite participants to consider what happened while also adopting a forward-looking perspective and proposing points to be addressed for future water management in Milan in light of the climate crisis. For grounding the discussion, each area was substantiated by several examples of good practices in Europe.

Design Opportunity Areas

Area 1. Defining the "new normal" of climate change for water and constantly acting on it

Area Description. Cities and territorial actors connected through water networks need to transition from emergency protocols to *climate change-driven* structural and temporary interventions.
For instance, this shift could be realised through nature-based solutions that develop climate resilience in water management systems.

Source: **link**

Connected example. Rotterdam's climate change adaptation programme focused on using nature-based solutions in combination with 'grey' solutions, implementing multi-level interventions in architecture and urban design to protect the city from flooding. These solutions range from adaptive *'flood-proof'* buildings, such as the Nassauhaven Floating Homes, to solutions for capturing rainwater, as in the Benthemplein Water Square, or that slow down drainages through roofs and green facades, such as in The Dakpark.

Nassauhaven Floating Homes (Photo Credits: Public Domain Architects)

Area 2. Adopting innovative methods, protocols, and tools for monitoring water

Area Description. Water's complexity as a socio-ecological system requires new ways to constantly monitor its status. For example, through a digital platform based on data analysis and forecasting, capable of visualising the system's criticalities and opportunities (e.g., the presence of urban biodiversity).

Source: **link**

Connected example. MAGES is a real-time control and forecasting system for water and sewage management in the Paris metropolitan area that resulted from a long process initially meant to control localised flooding during cloudbursts. The system is based on real-time deterministic modelling of sewage and water storage facilities, 23,000 calculation points, and an optimisation process for forecasting a management scenario.

Area 3. Translating collaborative water governance into stable water management systems

Area Description. Climate change compels local authorities to ask how current water management models can evolve towards ones based on collaborative governance, and how these can be translated from governance to policy tools.
For example, can we imagine a 'red line' for water issues at the city level? Who should be answering it and responding by acting upon infrastructural elements (e.g., dams)?

Source: **link**

Connected example. *Amsterdam Weerproof* started in 2014 as Amsterdam Rainproof, with the aim of creating a rainproof city and raising awareness about climate change. From 1 January 2024, the network Amsterdam Weerproof, freely coordinated by a team of community managers, has become part of the networked approach of the Amsterdam Municipality's Climate Adaptation Programme. This change is reflected by increased management and interactions among the Waternet promoters and the Municipality of Amsterdam.

Amsterdam Weerproof (Photo Credits: Amsterdam Weerproof)

Area 4. Promoting water ecosystems for collective action at the city level

Area Description. Cities' water ecosystems should be manifested through communication and promotion tools that make their actions, dialogues, and relations public and open for intervention. For example, we can imagine a communications platform that lists current interventions and allows citizens to propose new ones.

Source: **link**

Connected example. The Horizon Europe OTTERS project aims to promote marine and freshwater management transformation by involving citizens through co-design and citizen science campaigns for monitoring marine and river environments. One of OTTERS's objectives is to accelerate the creation and adoption of technical, legal, and ethical standards for citizen science methods and to assess their effectiveness not only from the technical and scientific perspective of data collection but also concerning the impact on citizens' behaviour in their epistemic relationship with the aquatic environments.

7. Action Points

Strengthened by their local knowledge of Milan's water management system, and further hardened by the learning gained through the drought emergency, the focus group's participants engaged in a rich discussion that referenced the design opportunity areas presented and the related examples.
Their discussion was summarised into a series of **action points for designing climate-resilient water management in Milan**.

AP.1. Water-centred networks and collaboration can fill existing gaps in city water management systems and should be supported

A participant from the Food Policy Area outlined how *the drought emergency allowed these actors to meet for the first time in an unprecedented setting*. The network quickly identified the city's knowledge, regulatory, and operational gaps on water that needed to be addressed to solve that aspect of the emergency. Through that setting, the Municipality, represented by its Food Policy Area, could investigate and learn about the complex system of stakeholders affected by water and take action to preserve its citizens' interests amidst the crisis. This experience resulted in new relationships and monitoring protocols, but also generated unique knowledge of urban water management. As shared by one participant, *a city Manifesto for water is currently being developed.* Water-related actions are part of the city's plan for reducing pollution and mitigating climate change[3]. The group agrees that *water should be regarded as an essential element in mitigating higher temperatures induced by climate change in the city*. Solutions are needed on several aspects, for example, *saving rainwater from being wasted in the drainage systems or controlling groundwater's temperature when it flows into the hydraulic system*. Urban networks of stakeholders concerned with the topic of "water" should be supported in proactively designing, implementing and maintaining solutions that are better addressed by collaborative governance.

AP.2. Coordination, dedicated roles and competencies are needed in the current water management systems

The focus group agreed that *the complexity of Milan's water system, both at the physical and legal-administrative level, makes it challenging to oversee it and regulate water use for the public good*. Legal rights of water use are, in some instances, very out of date, having been issued decades ago, and keep being renovated to privates subjects under the same conditions of the past. A lack of an overview of these water rights results in a lack of coordination and regulatory capacity. Attempts have been made at the municipal and regional levels to map this system, but much work is still needed.

This situation makes it easier for individual actors to pursue their self-interest against the community's. *According to one participant, the regional system of water consortiums is highly fragmented and stricter control would be needed to avoid inequalities*. The group agrees that water is a precious element for agriculture and several other industries in the territory (for example, livestock). In the words of one participant, *conflicts of interest on water, typical in other parts of the world, will be increasingly faced in this territory due to climate change conditions*. Water systems

3. Plan "*Milano Cambia Aria*" (Milan Changes Air), available at this link.

should be acknowledged as unique, fragile socio-ecological systems increasingly affected by climate change, therefore representing a unifying policy problem requiring coordination and dedicated roles. The group commented positively on examples of establishing local authorities with a mandate to oversee water safeguarding, e.g., the "Berliner Wasserbetriebe" agency[4]. *Together with public bodies dedicated to water, local administration will increasingly need competencies focused on water for urban climate resilience, which are largely missing today.*

AP.3. Transparency of information on water can facilitate adaptation and collective action

The complexity of Milan's provincial water system makes it hard to regulate it and to quickly adapt to its changing conditions. *Solutions that enhance information and transparency should be encouraged.* Water systems data and information, in a broad sense, may be transmitted to the regional council and environmental agencies for environmental monitoring but can also reach the wider public. An example was shared in the group: the ETS Villoresi Land Reclamation consortium, which manages several dams and artificial canals in the territory, had developed its own freely downloadable app for sending information on the consortium's activities and receiving notifications on the state of water in the territory. *This type of information tool may be useful as it allows a single stakeholder (e.g., farmers) to acknowledge the situation and act accordingly.*

AP.4. Loss of local knowledge on "water care" should be addressed, as it leads to systemic issues and decay.

In the course of the conversation, it was often remarked how the complex water system of Milan and its province, although peculiar from a geographical and environmental point of view in Europe, is largely connected to a history of anthropisation of the territory dependent on agriculture. The system of canals and rice paddies (in Italian "*marcite*"), which historically characterises the southern part of the Milanese territory, depends on the capillary control of water flows in the territory by individual farmers. *One participant emphasises how, even today, this "care of water" results in constant intervention on canals and sluices. Although often informal and self-regulated, this bottom-up work is often crucial to prevent flooding of small towns or unequal water flow between agricultural properties.* As generations change, this knowledge of "water care" is being lost, resulting in land degradation and associated social costs. Therefore, *it seems necessary to incentivise the care of agroecosystem services in the territory with specific incentives.*

4. Find out more at: link

8. Conclusions

Rather than reporting a series of issues in the water management system of Milan and its province—which are certainly already well known to experts and discussed in greater detail elsewhere—the “Water Resilient Experiment”, throughout its Milan’s chapter,shed light on an existing system of institutional and human capabilities that are already operating on water in a “climate resilience” perspective.

This system (and other similar ones) identifies an affordance useful for designing climate-resilient water management in European cities. The brief research presented here showed that such designing efforts ought to be encouraged, not only because they align with the new climate normality, but also as they work in synergy with a contemporary social awareness that water represents a fundamental public resource.

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This case study can be downloaded at:
www.designpolicy.eu/water-resilience-experiment

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