

**Enhancing the Resilience of
Water Governance Practices in Southern Italy**

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Abstract

Likely due to climate change, Southern Italy is rapidly drying as droughts become more frequent and severe. The region also faces significant problems such as persistent water leakages, infrastructure weaknesses, and water service disruptions. Overcoming the challenges posed by severe droughts and ensuring reliable water availability requires improving water management. This study identifies the main flaws in the water governance framework that hinder improvements in water management in southern Italy. The research involved a comprehensive literature review and interviews with Italian stakeholders and experts of the water sector. It was found that improving water management in Southern Italy will require addressing governance fragmentation, making large investments in infrastructure, and implementing long-term planning.

Keywords: Water Governance, Southern Italy, Climate Resilience

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Introduction

Italy ranks third in Europe for water availability, yet some regions still face severe challenges (Eurispes, 2023). In 2022, the country's water distribution network experienced 42.4% of losses. The highest levels of leakages were registered in Southern Italy, with some areas reporting more than 60% (Eurispes, 2023). Moreover, in situations of severe drought, the disruption of the water supply is a common procedure to lessen water stress. Therefore, despite Italy's high water availability, Southern regions face significant governance challenges. Additionally, these issues in regional water governance are further exacerbated by Southern Italy's geographic location, a climate change hotspot (Cadeddu & Zjalic, 2023). Declining rainfall patterns and increasing droughts are already exploiting water resources, with future conditions expected to be more extreme (Eurispes, 2023).

Therefore, the research question addressed will be: "How can water governance be improved to enhance climate resilience in Southern Italy?". This research is significant as it addresses the pressing issue of water governance in the context of climate change and Southern Italy, to contribute to more resilient and efficient management practices. In this study, the following regions are considered as part of Southern Italy: Abruzzo, Apulia, Basilicata, Calabria, Campania, Molise, Sicily, and Sardinia. These regions show similar climate and geographic characteristics, which contribute to a common set of governance issues.

To analyze this research question, Maarten Hofstraan's (2013) Framework of Water Governance, which includes the OECD's Multi-Level Approach (2011), will be utilized as a lens. This framework analyzes water governance with a comprehensive multi-dimensional approach, within the intricate interplay among diverse actors and institutions in this sector. It is a relevant framework as it acknowledges the complex interplay of water management and helps identify gaps and inefficiencies within this context.

This topic will be explored through an extensive literature review of legislation and investment trends in the water sector, alongside semi-constructed interviews with stakeholders and experts. The literature review will provide essential background information on the current state of the Italian Integrated Water Service, highlighting how past legislation has shaped the current state of governance, especially regarding the power balance among stakeholders. Additionally, financial aspects, such as the cost of water and national investment, are strongly tied to the state of the infrastructure.

Interviews will provide deeper insights, supplementing the literature review with perspectives from those directly involved in the governance. Stakeholders and experts from various backgrounds, but always involved in the water sector, will share through semi-structured interviews insights that go beyond the literature review, enriching the understanding of Southern Italy's water governance and potential improvements. The research design, data collection, and analysis will be outlined in the methodology section. Moreover, the validity, reliability, and ethical considerations will be explored.

The last sections, the results and discussion chapters, present and analyze the findings from the literature review and interviews. Moreover, limitations of the study will be highlighted, such as the decision not to include the agriculture and industrial sectors in the analysis. Finally, the conclusion summarizes the key insights and draws an overview of the water governance in Southern Italy.

Literature Review

Water has always played an essential role in shaping the socio-economic, political, and environmental landscape of nations. Italy's water management practices are put in place in an

intricate and complex territory, offering a perfect case study to understand how water governance could be enhanced.

Over the decades, Italian water governance has undergone significant transformations, influenced by both internal and external directives. The following literature review aims to provide a comprehensive understanding of the evolution of the Italian water management legislative framework, highlighting the key legislative milestones and the contemporary challenges that the system is facing.

Indeed, Italy's management practices in the water sectors have been challenged by disparities in investments and infrastructure development across the different regions, revealing a complex interplay of political, economic, and geographical factors. Moreover, the focus on water management and infrastructure development has been notably more pronounced in the Northern regions compared to the Southern ones: this exacerbated the disparities and stressed the country's water management landscape. This has resulted in a situation where the South lacks water management efficiency, infrastructure quality, and overall service delivery, compared to the North.

The review starts with a historical overview of the foundational legislation that underpins today's water management system and related investments made in water infrastructure development. The review further explores the current Integrated Water Service, the complex multi-level governance system that encompasses national, regional, and local dimensions, and an evaluation of the efficiency and stakeholder involvement of this system will be presented.

Background Information on the Italian Water Management System

The following sections will provide the necessary background on the Italian water governance system: a comprehensive historical overview of its evolution, highlighting key

legislation and investments. Specifically, the importance of the Merli and Galli Laws will be discussed. Lastly, the implementation of the latest directives, the European Directive of 2006 on water management will be explored.

Post-II World War

From Post-war onwards, funds used to finance water service projects came from the central administration and other Public entities: direct state investment, primarily managed by the Ministry of Public Works, historically focused on large infrastructure projects to universalize water services in the country. One of the most important examples of direct state financing is the Apulian Aqueduct (“Acquedotto Pugliese”), in Southern Italy. However, policymakers started delegating ordinary water service tasks increasingly to regional entities, reflecting Italy’s struggles with centralized management practices (Ermano, 2012). The Fund for the South (“Cassa del Mezzogiorno”) was established in 1950 to support the economic development of the South region with major investments (Svimez, 2011; Ermano, 2012). Despite the importance of these funds, the long-term importance of these investments was limited and left the development of Southern territories in a precarious situation. Law Number 598 was enacted as a facilitator for big municipalities to improve their water infrastructures: indeed, the Ministry would have provided financial contributions with interest rates inversely proportional to the population size of the municipality that requested the funds. However, this law favored larger municipalities over smaller ones, like those found in the South, because they faced higher interest rates (Ermano, 2012).

Construction works were funded by general taxation used by the Ministry and through subsidies granted to territorial entities. Until the early 1970s, per capita spending on health, sanitation, and water management investments steadily increased. Infrastructure development

was also supported by the Marshall Plan, with the European Recovery Plan, for about the following 20 years. Public investments peaked in 1967, then followed a decline to revive again in the 1980s, driven by new policies and higher awareness (Picci, 2002). Between 1928 and the II World War the South and North-East benefited most from public investments to fill the development gap, especially in the road and industrial sector, by the late 1970s, northern regions started receiving the majority of investments. After 1982, indeed, the amount of investments for Southern regions was less than the ones for North-east and North-west regions (Ermano, 2012).

The General Aqueduct Regulatory Plan, published in February 1963, provided updated and more comprehensive guidelines for infrastructure development, considering demographic and economic development. In 1977, more responsibilities were transferred by the State to Regions and Local Entities, to complete the process toward a stronger territorial autonomy (Ermano, 2012).

Merli Law

Law 319/1976, also referred to as Merli Law (“Legge Merli”), titled “Norms for the Protection of Waters from Pollution”, has been the first law to introduce awareness regarding topics related to poor management of water resources and their infrastructures. Indeed, it outlines regulations for water use, public water services, and wastewater discharges. The State is responsible for guiding, promoting, and coordinating activities related to water resources, implementing criteria for management assessment, and general water plan. Regions are taken to implement the national plans, ensuring compliance with the laws and regulations. Locally, public water services are managed by municipalities or inter-municipal consortiums (Gazzetta Ufficiale, 1976).

However, despite these new regulations to implement a more efficient management of water resources, the amount of investment in this sector gradually decreased. One contributing factor was the high cost associated with implementing innovative infrastructure, which may not align with short-term political interests despite their precious long-term benefits. Therefore, important infrastructure projects were delayed to future legislation and systematic problems were starting to emerge. To finance themselves, territorial entities exploited various channels, with two of the most important being the Cassa del Mezzogiorno and the Deposits and Loans Fund (CDP) (Ermano, 2012).

Galli Law

In 1994, Galli Law (“Legge Galli”) mandated a new approach regarding the management of water resources in Italy: the State introduced a more entrepreneurial approach to fighting issues in the local public administration. Indeed, this law was a targeted response to the increase of inefficiencies and corruption that were at their peak in the late 1980s and early 1990s. By raising tariffs, the State aimed to enhance revenues and bolster investments in infrastructure development (Gazzetta Ufficiale, 1994).

Galli Law introduced the concept of Integrated Water Service (“Servizio Idrico Integrato”) and established Optimal Territorial Areas (“Ambiti Territoriali Ottimali”) for water management: before the introduction of this law, drinking water supply, sewage, and wastewater treatment, were highly fragmented among numerous small municipal and provincial utilities (Gazzetta Ufficiale, 1994). This law sought to consolidate water service management. Details about the Integrated Water Service will be discussed in later sections, as they are nowadays an integral part of the current water management framework.

Investments trend after Galli Law

After the approval of Galli Law, the late 90s can be considered as the beginning of a slow transitional period in management practices, during which local institutional practices were evolving, but the organization structure remained largely unchanged. According to research by Ermano (2012), the gross capital stock per resident in 1999 was comparatively greater in Southern regions than in Northern ones. This indicates the former had more infrastructure accessible per person than the latter. On average, investments relative to GDP made by the South were higher compared to the North. At first glance, this may appear to be a beneficial factor for Southern regions, but, as Ermano (2012) explains, this higher rate of relative investment caused several issues. Despite having more infrastructure in the South due to higher relative investment, the quality of the water service was, and is still, lower than in the North. This suggests that if the management practices are not appropriate, managing entities incur a “governance failure”, having more infrastructure is not enough.

Putnma’s (1994) work also emphasized society’s ability to make effective developmental decisions. In the North, with relatively lower resource investments relative to income-generating capability, a qualitatively superior infrastructure network was developed as a result of a more prudent resource allocation procedure. Furthermore, more infrastructure translates into higher ordinary management costs, which would be not bearable for the South's weak economic conditions. Therefore, without management costs the deterioration of infrastructure is inevitable.

After the 1980s, the upward trend of per capita investments reversed: there has been a consistent decline in water sector investments relative to income production. As Italy's GDP increased and the government had more economic resources to improve public infrastructure, fewer resources were spent on the water industry. This pattern might be explained by the already

completed infrastructure, which would have reduced the public spending only to ordinary maintenance. However, this can not justify the infrastructural components, which were also 100 years old, or the treatment plants, which had a lifespan of 20-30 years (Ermano, 2012).

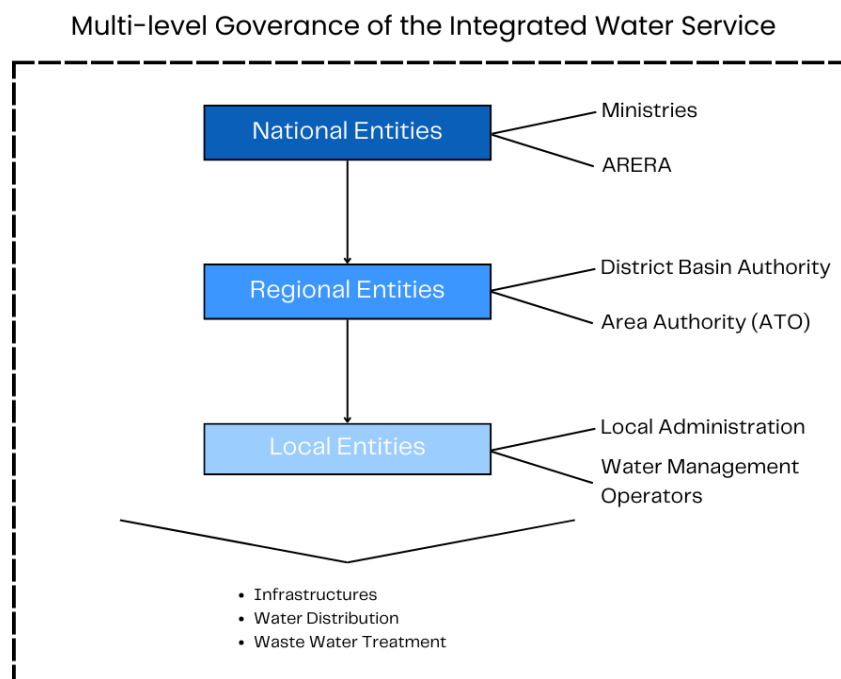
2006 European Directive

To address these ongoing challenges and modernize the framework of water management, the 2006 European Directive, known as Legislative Decree No. 152, has incorporated the past legislation regarding water management to update it and formulate new regulations: for example, the entire national territory has been divided into revised hydrographic districts. Each of them has a regulatory board, known as the District Water Authority: they adopt a District Water Plan to regulate the water supply of their region. This plan entails detailed tools for planning and implementing actions and guidelines on preserving, protecting, and improving the appropriate use of water, considering as well the preservation of the environment (Palminteri, 2016).

Italy's Integrated Water Service

After having explored the impact of legislation and investments that shaped Italy's water governance, the following paragraphs will delve into the current framework that defines the country's water management practices.

The Integrated Water Service is at the core of the legislative framework that outlines the various aspects of water management, from extraction to the distribution of water, at the national, regional, and local levels. This service represents the culmination of legislative efforts aimed at creating a cohesive and efficient water management system (see Figure 1).

Figure 1*Multi-level Governance of the Italian Integrated Water Service*

Note. The figure shows the three main levels of governance in the Italian Water Governance sector. At the national level, Ministries and ARERA can be found. Regionally, entities such as the “District Basin Authority” and “Area Authority (ATO)” entities manage water services regionally. At the local level, the service is operated by the Local Administration and additional (private or public) Water Management Operators. These bodies administrate the infrastructures, water distribution, and wastewater treatments. The figure has been constructed based on the overview provided in the following paragraphs.

In Galli’s Law, this framework has been described as the following: “Composed of the set of public services for the collection, conveyance, and distribution of water for civil uses, sewage, and wastewater treatment [...]”. Moreover, it highlighted the importance of an effective, efficient, and complying management of the system. As the previous section introduced, the current water

system framework has been shaped by several legislations (Gazzetta Ufficiale, 1994; Moretto & D'Alpaos, 2004). Italy's management system is characterized by a complex structure involving organized service and a multi-level governance system with various institutional actors. The territorial distribution considers both administrative boundaries and hydrological characteristics. In the following sections, these aspects will be analyzed (Utilitatis, 2023).

Governance of the Territory

As previously mentioned, the Integrated Water Service continues to be characterized by an organization system based on Optimal Territorial Areas, which are identified by the Regions and other Entities of the government.

Regarding the distribution of responsibilities among the several actors in the territory the structure is based on three levels: state, regional, and local.

At the State level, the Ministry of the Environment and Energy Security is responsible for areas governed by the State. Additionally, the Ministry of Infrastructure and Transports is involved in the process of decision-making.

At the regional level, regions' responsibilities are determined by the country's constitution: one of their primary responsibilities is the governance of their specific territories, which are defined by the Optimal Territorial Areas (ATO), and managed by Area Authorities. These districts, based on the country's hydrogeological features, identify seven main districts. Each district is further divided into Optimal Territorial Areas by the Regions, within which public services are organized for efficiency. Currently, Italy has 62 of them, categorized by size and region. Some are regional, others supra-provincial, provincial, or sub-provincial (Utilitatis, 2023).

Locally, the entities are responsible for "organizing the integrated water service, selecting the management approach, setting and adjusting user fees, delegating management with its oversight [...]". Furthermore, they have to protect the assets of the integrated water service, develop and revise the Financial and Administration Plan, supervise access to and confirm the status of water installations, make sure operators meet their obligations, and take action in cases of non-compliance. The local authorities must adhere to the local regulations put in place by the governmental Entities. Failure to meet this obligation results in the exercise of substitute powers by the President of the competent Region (Utilitatis, 2023).

Moreover, the ARERA (the "Regulatory Authority for Energy, Networks, and the Environment"), established in 2011, plays an essential cross-level role in overseeing and regulating aspects related to tariffs and quality in water services as outlined by law. ARERA has the authority to establish benchmark costs, create models for economic and financial plans, set indicators and minimum quality standards, and develop tender documents and standard contracts (Utilitatis, 2023).

However, there are broad differences in how the Optimal Territorial Areas implement the principles of unified management outlined by ARERA and the State entities: indeed, many entities in Optimal Territorial Areas show delays and/or critical issues, leading to a fragmented scenario. This represents one of the main challenges to overcome to improve the sector and will be discussed in further detail in the following sections.

Public and Private: Ownerships and Responsibilities

One of the distinctive features of this system is the collaboration between public and private entities in water management. While public entities, typically municipalities or regional authorities, maintain ownership and overarching responsibility for water resources, private

companies often play an essential role in service provision, operation, and maintenance (Moretto & D'Alpaos, 2004).

Often, public entities set the strategic direction and are responsible for planning and ensuring compliance with national and European directives. On the other hand, private companies are contracted to manage and put into practice what the legislations outline: for instance, the water supply, distribution, metering, and wastewater treatment.

Concession agreements are central to the Italian Integrated Water Service: the stakeholders operate under these contracts, which outline their roles, responsibilities, performance standards, and contractual obligations. They provide a legal framework for public-private partnerships and define the scope of services, duration of the contract, and financial arrangements.

The Ronchi Decree (2006) puts in place additional regulations regarding the management of “public” services by private companies. This decree addressed various aspects of public service management, including the management of water services. The provision of services can be delivered after public tenders, through joint ventures between public entities and private companies. The private partner must hold at least 40% ownership in the joint venture and the selection of this private partner is done through a public selection process to ensure transparency and competitiveness. On the other hand, some municipalities and regions have opted for in-house provision, which is publicly managed, rather than through private companies (Mommo, 2009).

Local entities have to evaluate the quality, economic, and technical aspects of the service before delegating any public service. This evaluation must consider various factors such as service quality, infrastructure investments, public finance situation, costs for local entities and

users, expected outcomes, and previous service management effects on public finance (Utilitatis, 2023).

Evaluating Progress, Issues, and Stakeholders' Involvement

Following the detailed explanation of the integrated system in the previous sections, the next paragraphs will examine the identified problems and lack of resilience as highlighted in the literature.

Indeed, while the local governance process of the Integrated Water Service has been largely completed across Italy, some areas still face challenges due to fragmented management, high inefficiencies, and infrastructural problems. This is particularly evident in the Southern regions of Italy, where the implementation of unified and efficient water management systems has been slower compared to the Northern and Central regions. In the following sections, statistics regarding the state of water management in Italy will be discussed, with a detailed attention to the Southern regions.

Water Availability, Stress, and Climate Change

Italy is a country characterized by a temperate climate with abundant rainfall. Thanks to its geographical conformation, the country experiences some of the highest rainfall levels in Europe. Moreover, behind Sweden and France, it is the third country with the greatest water availability, thanks to the high amount of surface water (e.g. reservoirs, lakes, and rivers) (Eurispes, 2023). Moreover, according to recent data provided by ISTAT (2023), the National Institute of Statistics, Italy has been for the last 20 years the first European country in terms of absolute quantity of freshwater withdrawn for drinking water from surface or underground water bodies.

However, in the years 2020 and 2021, rainfall levels were significantly lower compared to the preceding years. During 2020, all regional bigger cities experienced a decline in rainfall, compared to the period spanning from 2006 to 2015. Furthermore, this reduction in precipitation was not evenly distributed across the country, with certain regions notably more affected by the decrease in rainfall than others. Cities such as Naples, Catanzaro, and Catania, all located in Southern Italy, saw significant reductions in precipitation levels in 2020, recording decreases of -423.5 mm, -416 mm, and -359.7 mm respectively. It is important to note that the 30-year forecasts predict a continual rise in drought occurrences, particularly during summers and in Southern regions, alongside a potential decrease in precipitation of up to 30% compared to 1981 averages (Eurispes, 2023).

Indeed, climate change is an exacerbating factor while analyzing water governance practices, which significantly strains regional water sources and management systems. Especially when Italy is considered a vulnerable hotspot for climate change impacts. The country is experiencing rising temperatures, an increase in extreme weather events, such as frequent and prolonged droughts, and melting glaciers (Mercogliano et al., 2020). In Southern Italy, projections from 2021 to 2050 predict global warming of up to +2°C during the summer months (June-August) under the high emissions scenario (RCP8.5). This region is expected to face a decrease in summer rainfall and an increase in the number of consecutive days without rain (Brunetti et al., 2004).

Rising temperatures and reduced rainfall are leading to more frequent and intense droughts, depleting reservoirs, rivers, and groundwater aquifers. Moreover, the years 2016 and 2022 were classified as the hottest years ever recorded in Italy, with a higher number of heatwaves: Southern regions like Sicily experienced record temperatures of 48.8°C in 2021,

putting many cities under emergency alert (*Italy Climate Resilience Policy Indicator – Analysis - IEA*, n.d.).

Average temperatures and prolonged droughts are particularly relevant because their fluctuations and intensity directly affect the availability of water resources, since when the average temperature increases, there is a greater evaporation of water from the soil. If this circumstance is combined with a decrease in precipitation, weak infrastructures, and failures in water governance, it creates the ideal conditions for generating water crises.

High levels of Leakages

Water losses in the country's distribution network reached 42.4% in 2022, resulting in a loss of 3.4 billion cubic meters of water. This indicates a slight increase from 2020, where the loss was recorded at 42.2%. Nonetheless, this underscores the presence of inefficiencies in water infrastructure and governance. This amount amounts to 157 liters per inhabitant per day: the volume of water lost in 2022 would satisfy the needs of 43.4 million people, approximately 75% of the Italian population, for a year (ISTAT, 2024).

Loss trend is highly variable throughout the whole country, however, it is evident the significant disparity between the Northern and Southern regions. In 2022, the highest total losses were registered in Sardinia (52.8%), Sicily (51.6%), and the Southern Apennines (51.6%). In Southern territories, Basilicata, Abruzzo, and Molise reached the highest level of leakages, with over 60% of water introduced. The trend is increasing in 13 regions out of 21 (ISTAT, 2024).

At the municipal level, data reveals that 57% of Italian municipalities experience water losses exceeding 35% of the volumes introduced into their networks. Nearly half of these municipalities report losses surpassing 55%. Among provincial capitals and metropolitan cities, only five municipalities demonstrate water losses lower than 25% and they are all in North or

Central Italy. On the other hand, ten municipalities suffer losses exceeding 60% and they are mainly in the South (Eurispes, 2023).

Furthermore, 87% of the population residing in Sicily and Sardinia live in provinces with losses equivalent to at least 45% of the water introduced, in contrast to the 4% in the Northwest. In addition, 18 out of the 20 Italian provinces with water losses higher than 55% are in the Center and South of the country (Eurispes, 2023).

Discrepancies in Governance and Compliance

Water service management in Italy is considerably variable in the whole country, due to the different effectiveness and efficiency of the entities entrusted with the distribution of the service. In metropolitan cities, where the investment is higher and the governance is stronger, the leakages linked to infrastructure are limited. On average, regional capital municipalities have a lower water dispersion compared to the national average. Once again, the losses are significantly higher in municipalities in the Center-South compared to the North.

The management of water services is fragmented: the number of providers remains high, but there is a slight decline. In 1994, before the legislative reforms, there were a total of 7,836 providers (Mazzola, 2024; UTILITATIS, 2024).

In most parts of the country, the water service is integrated into the national grid and managed by industrial operators (a total of 5,933 municipalities). However, at least 1,465 municipalities directly manage at least one aspect of the service (water supply, sewage, and wastewater treatment). This represents 19% of Italian municipalities, totaling approximately 7.6 million inhabitants (13% of the national total). Moreover, fifteen municipalities are entirely devoid of the service, with approximately 65 thousand people residing in these areas (0.1% of

the population), relying on self-supply methods such as private wells (Mazzola, 2024; UTILITATIS, 2024).

The 80% of municipalities that directly administrate the water services are located in the South, where approximately 7.1 million inhabitants reside. These differences in management strategy translate into different investment capacities, which can slow down the modernization of water infrastructure, leading to unbalanced service delivery throughout the country. It is important to note that there has been stable growth in investments by industrial operators, due to higher sector regulation. Indeed, investments have risen from 33 euros per inhabitant (2012) to an average of 70 euros in 2023. The European average for water investment is approximately 82 euros per inhabitant. However, where the service is distributed by a local authority, the investments are on average only 11 euros per inhabitant. Additionally, the average expenditure per inhabitant in Southern regions is 8 euros, compared to 17 euros in the Northeast. This data is severely below the European and national averages (Mazzola, 2024; UTILITATIS, 2024).

Furthermore, Southern regions experience the greatest impact from disruptions in potable water supply. In 2021, 15 cities (provinces and metropolitan areas) implemented water rationing measures: an increase of 4 municipalities compared to 2020. These measures involve restrictions on potable water on the whole municipal territory, during certain hours of the day or assigned slots, during every day of the year, or seasonally. For example, in Cosenza (located in the South), the measure was implemented every day of the year, during specific time slots, and on alternate days. In 2021, across the Southern region, similar measures were adopted in nearly all major cities of Sicily, some in Calabria, and one in Campania. The implementation of rationing measures for selected districts in the municipal areas affected 12 capital cities, marking an increase of 5 from the previous year, all situated in the Southern regions. This resulted in more

than a doubling of both the duration of the measures and the proportion of the resident population impacted (ISTAT, 2023).

Some Southern cities have water suspension or reduction almost everyday of the year, with different supply rotations for almost all residents. For instance, in the city of Caltanissetta, 62.4% of the residents had limited or no access to water for 61 days. Disruption of the service happens also in bigger cities: Catania experienced a 14-day service interruption, in 2020. This pattern often happens in summer, in the most vulnerable months for climate reasons (ISTAT, 2023).

The disparities in governance and compliance within the country's water management system are severe, and particularly evident in the pronounced differences between Southern and Northern regions. The Italian Integrated Water Service is disorganized, which leads to unbalanced service delivery and deepens the vulnerability of an already challenged system.

Theoretical Framework of Research

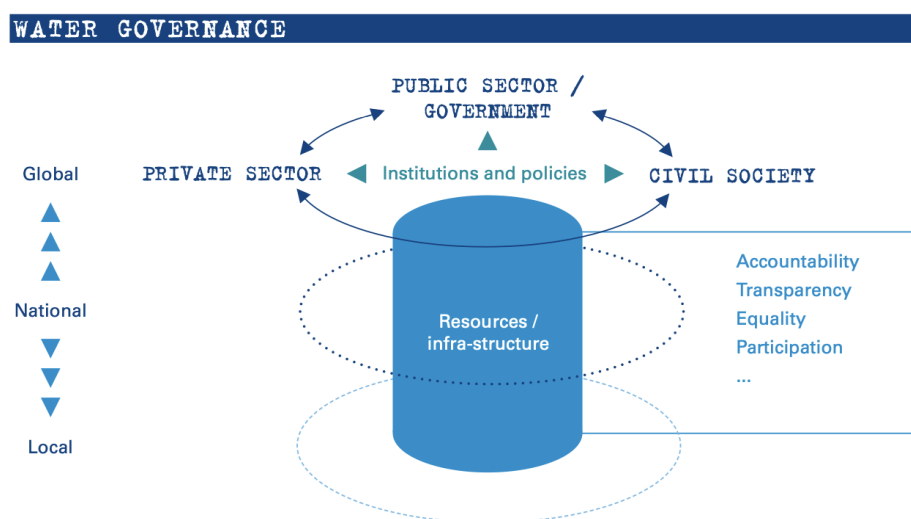
This study builds upon Maarten Hofstraan's (2013) Framework of Water Governance and OECD's Multi-Level Approach (2011), which dissects and analyzes the definition of water governance and the intricate interplay among diverse actors and institutions in this sector. This framework is particularly relevant to analyze the research question of this study as its goal is to acknowledge the multidimensional nature of water management and identify gaps and inefficiencies within this context.

Hofstraan (2013) articulates this analysis through a comprehensive multi-actor approach to water governance (see Figure 2): stakeholders engage at local, national, and global levels. Institutions, through their policies, act as intermediaries between the private sector, the government, and civil society, exercising control over vital water resources and infrastructure.

Indeed, Hofstraan (2013) defines efficiency as a situation in which “governance maximizes the benefits of sustainable water management and welfare at the least cost to society”. Indeed, efficient management of these dynamics can lead to the establishment of transparent, equitable, and resilient water governance. Therefore, updating the water governance towards a “resilient way” means reaching an efficient level of practice. This framework’s lenses and dimensions have been employed to structure the literature review, the research design for the interviews, and the analysis of the findings.

Figure 2

Water Governance Framework (Hofstran, 2013; OECD, 2011)



Moreover, the “Three-Layer Model of Water Governance”, presented by Hofstraan (2013) provides three different lenses: the content layer (encompassing knowledge and experience in the water sector), the institutional layer (encompassing stakeholders and legislation), and the relational layer (comprising coordination, participation, and ethics). This model serves as a structured framework to comprehend and tackle the complexities inherent in

water governance, emphasizing that an effective governance model must efficiently address all layers. These layers will be developed based on the participants' inputs and leveraging their backgrounds and expertise.

It is important to note that, for this study, the terms “water management practices” and “water governance” will be used interchangeably. The first usually refers to the specific actions and strategies used to manage water resources, instead the latter covers the broader policies, regulations, and institutional frameworks that lead these practices (Dukhovny, 2009). However, in the context of this study, the distinction between these two domains often blurs. Moreover, they are both essential to understanding the challenges and opportunities for improving climate resilience in Southern Italy. This interchangeably is intended to analyze the water narrative in the region and should not pose a limitation.

Methodology

In the following chapters, the methodology employed to investigate water management practices in Southern Italy will be delineated. The approach undertaken to capture the multifaceted and broad dimensions of the absence of these practices will be outlined. As mentioned in the previous sections, the research is built upon a literature review and in-depth interviews with key stakeholders in the water management sector.

Research Design and Data Collection

A qualitative research approach has been employed to address the research question: the chosen approach is considered to be the most suitable as it enables a comprehensive analysis of stakeholder involvement in the sector and facilitates insights that would not be achievable through a purely quantitative approach. Indeed, the experts interviewed provided valuable perspectives that hardly can be found in already existing literature either solely by a quantitative

analysis. Therefore, this highlights the importance of the chosen research design in revealing multi-perspective dimensions on the subject.

For the literature review, reports, publications, and official documents were selected based on their relevance to the research question and their ability to provide valuable information into the condition of the current water governance and stakeholder involvement, both nationally and regionally. These sources were chosen to ensure a comprehensive understanding of the topic from a historical and legislative perspective, while also identifying gaps in existing literature that could be addressed through the interviews. In specific, multiple reports published by the Italian National Institute of Statistics (ISTAT) have been employed to provide the reader with official and reliable statistics regarding water governance.

Interviews were conducted for the second phase of the research process with the aim of including a diverse and inclusive range of experts from various backgrounds. This was intended to facilitate a detailed and comprehensive analysis of the issue within the sector. Indeed, the participants can be classified as involved in the “Public Sector”, “Private Sector” and “Civil Society”, at “Global”, “National” and “Local” levels outlined in the Water Governance Framework (Hofstran, 2013; OECD, 2011). There are no representatives of the “Global” level, as the purpose of the study would have necessitated a broader scope, shifting the focus away from Southern Italian regions. Its absence is not a limitation of the study but reflects the specific focus of the research and adds a more detailed analysis of national and local dynamics. Furthermore, the “Civil Society” category has been replaced by a category of “Academics”, with a background in Italian water governance, who have been involved in the study. This category includes professors and researchers involved in the sector of water governance, political science, and engineering. This choice has been motivated by the fact that the study is interested in addressing

the inefficiencies from the governance side, and the involvement of civil society would have enlarged its scope.

Participants were selected through purposeful sampling: their background had to be relevant to the research question. There were no strict requirements, but preference was given to individuals with several years of experience in the sector of water management. Additionally, a solid understanding of water governance, particularly concerning the situation in Italy's southern regions, was required. The recruitment process took place online, utilizing resources available on company websites and networking platforms. To include academics, an examination of multiple publications was undertaken. Authors whose work was of interest with the thesis topic were contacted to participate in the study. Refer to Appendix A for the list of the participants involved in the study, along with their corresponding backgrounds and expertise.

Participants were initially approached via email (refer to Appendix B), wherein they were provided with the scope of the study, the purpose of their possible participation, and any additional practical information. This first communication served to establish contact with the participant and understand if the interest in joining the study was reciprocated. Once the communication was established, the day and time for the interview were set.

Interviews were semi-structured and took place online. The introduction of the interview guide (refer to Appendix C) was common to all participants, as well as the first questions. Indeed, the first questions aimed to understand the participants' insight regarding water governance in the region. The questions were structured to cover a range of topics, including but not limited to water resource management, climate change and resilience, legislation, stakeholder engagement, and challenges faced in the field of water governance. Furthermore, questions were tailored to align with the participant's expertise. For instance, if a participant's background was

in public administration, the questions were specifically delved into that area. To achieve this, an analysis of their role, background, possible publications, and involvement in projects was carried out before the meeting.

It is pertinent to note that the language used to contact the participants and conduct the interviews and the forms were in Italian. This was a deliberate choice to ensure effective communication and capture their responses accurately. Moreover, if English had been chosen as the primary language, the language barrier could have posed a significant limitation for the study. English proficiency among the target participants might have been limited, thus reducing the risk of miscommunication.

In total, ten interviews were conducted: the results, which will be discussed in the following sections, cover a wide range of topics. High data density was observed, where certain information or themes were present across multiple sources or responses. Therefore, the sample size can be justified as sufficient for capturing the situation within the water governance sector.

Throughout the recruitment process, challenges have been encountered. Despite sending out a significant amount of invitations to experts in the sector, the response rate was about 50%. Nevertheless, due to the extensive effort to include a diverse range of perspectives, the final number of interviews should not pose a limitation to the study, as it adequately serves its purpose.

Data Analysis

The interviews were conducted online and lasted approximately 30 to 60 minutes. Each of the interviews was recorded for data analysis purposes: the participants were informed through the Inform and Ethic Consent form (refer to Appendix D) at the beginning of the meeting. The interviews were first transcribed in Italian and then in English. During the

translation, cohesion in the terminology was ensured to facilitate the coding and presentation of the results. Accuracy, consistency, and completeness were guaranteed throughout the edits of the transcripts, with cross-checking translations with transcripts and published literature. An academic and certified software was utilized to record, collect, and transcribe the data. It facilitated the process of transcription and accuracy of the study.

After the interviews were transcribed and translated into English, they were deductively coded: the information provided by the experts was analyzed, grouped into themes, and linked to the Water Governance Framework (Hofstran, 2013; OECD, 2011) and literature review. Themes were defined based on recurring patterns: for instance, taking into account similarities, frequency, and causation relationships in the collected data.

Validity, Reliability, and Ethical Considerations

Ethical considerations were taken into account when structuring the study. The study has been approved by the supervisor of the project, Dr. Raúl Cordero Carrasco, and by the Ethics Committee of Campus Fryslân.

Participants were asked to sign the Inform and Ethic Consent form (refer to Appendix C), where details regarding privacy, limitations, and possible risks were presented to them. As explained in the form, there were no clear risks in participating in the study. Moreover, participating in the research did not offer direct benefits to the participants. However, it has been stated that their involvement might contribute to advancing knowledge in the field of water management, potentially benefiting future communities or individuals.

To ensure the validity of the findings, they have been contextualized and linked to the literature review, in the discussion section. This not only validates the results, but it enriches the

analysis by providing a broader understanding of them in the context of the water governance framework and published literature.

Findings

In the following sections, the findings derived from interviews with key stakeholders involved in water governance in Southern Italy will be presented. The data collected provide insights into the various causes of water inefficiencies, which cause the Italian Integrated Water Service not to be resilient towards climate change.

The results are divided into three sections, which are the recurring themes found from the interviews: the first section will explore the role of the different types of water management models and their efficiency in transforming water governance practices into resilient ones. The second section will explore the recurring topic of climate change and adaptation. The third and last section will delve into the challenges that impact infrastructure and investments in this sector.

As outlined in the preceding paragraphs, the results are thematically organized to address the primary research question: "How can water governance be improved to enhance climate resilience in Southern Italy?". Further elaboration on the findings will be provided in the discussion section.

Water Management Models and Governance

The first recurring topic identified was the role of water management models in enhancing the resilience of the water sector in Southern Italy: this will be discussed in the following sections.

Governance Fragmentation

All the participants discussed the fragmentation of Italian water governance, with a greater focus on the Southern regions. Participant 2 explained the data collection and governance structures for water management have become fragmented, leading to inefficient communication among stakeholders. Participant 3 pointed out that this fragmentation has its roots in the region's history and is particularly noticeable at the local governance level. Participant 4 acknowledged the issue of fragmentation at the sector's level, among industrial, civil, and agricultural stakeholders, highlighting the need for collaborative efforts and cohesive strategies for the resilience of the region. Participant 10 stated that the Galli Law, drafted in 1994, was the first Italian legislation aimed at reducing the number of local water service operators. Although some reduction has been achieved, data still show higher numbers in Southern Italy, impacting efficiency.

Private and Public Management

Private and Public management of the sector has also been a recurring theme, and the discussion of whether one or the other is more appropriate and efficient has been discussed. However, there was no consensus among participants. Participant 1 argued that it would be more appropriate a public management of the service to ensure equitable access to water, as a public good, and transparency. Participant 3 highlighted the importance of efficiency over ownership: it has been argued that the focus should be on efficiency rather than public or private ownership of the service. Participant 2 explained that the collaboration between private entities and the public sector (such as local and regional institutions) could enhance the efficiency of the management of water sources, especially when the latter is lacking. Participant 4 further emphasized that private management models could offer greater benefits to the governance, as they present

themselves more reliable to the public and investors, and therefore more suitable for investments. Participant 9 explained that historically the South lagged in private investments, compared to the North, due to a lack of willingness to update governance practices.

Regulatory Fragmentation

Fragmentation has not only been identified among stakeholders involved in the governance but also regarding the legislations and directives on water services. Participant 1 explained that the multitude of policies does not directly reflect efficiencies in water governance, especially if compliance with those directives is not ensured. This Participant emphasized that the overlapping laws from various levels lead to confusion and delays in implementation. Participant 6 also observed that this legislative fragmentation often leads to limited compliance and accountability. Without a transparent and clear regulatory framework, where the roles and responsibilities of stakeholders are well identified, it is challenging to hold them accountable.

Role of Supra-administrative Entities on Compliance

The role of supra-administrative entities such as regions and the state should be enforced to provide better guidance to local bodies. Participant 2 highlighted the importance of having an efficient and fluid bureaucracy managed by supra-administrative entities. However, despite this challenge which still leads to inefficiencies, there is optimism for improvement. Participants 1 and 4 reported that governance is particularly exacerbated by the fragmented authority structure and conflicts arising from stakeholder ownership. This issue also leads to a lack of compliance with European directives and Italian water laws, as Participant 3 outlined. This challenge must be faced to transition to a resilient model of water governance. Additionally, the function of central Regulatory Bodies (such as ARERA, the Italian Regulatory Authority for Energy, Networks, and Environment), which ensure efficiency where local governance may fall short, is essential.

Participant 7 illustrated the positive example of the Puglia region, where regional water management is unified under a single entity, Acquedotto Pugliese. This entity is overseen by an additional authority, streamlining decision-making and maintenance of efficient processes.

Role of Local Institutions

According to most of the participants, local institutions are the ones most exposed to the lack of compliance with the regulatory frameworks, as Participant 5 specifically pointed out. Participant 8 explained how basin and district authorities have not planned adequately to prevent and mitigate the impact of climate change. This traces back to historical roots: indeed, as Participant 9 illustrated before the 1990s, water management was highly localized, with occasional state and regional interventions. Water distribution was also highly irregular, and its depuration was not commonly practiced by local institutions. Particularly in the South, management models adopted by these institutions were not favorable for significant investments. Furthermore, it is widely understood that when local institutions hold too much power in water governance, making it fully public, it can lead to inefficiencies.

Participant 10 also highlighted the role of local institutions in disparities in satisfaction levels with water services, noting lower satisfaction in the South, and stressed the need for efforts to balance water service quality and satisfaction across regions.

Interregional Coordination and Multidisciplinary Governance

Coordination among supra-administrative entities, local institutions, and overall governance has emerged as a key solution to enhance resiliency and efficiency: Participant 1 acknowledged the interconnected nature of water management and the importance of an interdisciplinary approach in this sector. Participant 2 advocated for a non-political body to manage water issues across sectors, with a multi-level perspective. Indeed, it has been pointed

out that politics can be misleading and counterproductive, often leading to decisions that prioritize short-term gains or political agendas over equitable water management. Participant 7 reported that, especially in facing climate change, interregional cooperation is essential. Apulia provides a notable example of effective coordination. Since 1999, regulations have facilitated equitable water transfers between neighboring regions to reduce water stress during periods of droughts.

Participant 10 advocated for straightening the data collection through a common framework involving supra-administrative entities and local institutions. The collection of information such as domestic populations, tourism trends, and water consumption is essential for a comprehensive understanding of demographic data. Indeed, tourism seasons negatively impact water stress if local governance lacks an interdisciplinary approach to the tourism industry. Therefore, inadequate monitoring leads to miscalculations, especially in areas where water services are managed publicly and locally.

Climate Change Adaptation and Resilience

The second recurring theme highlighted by all the Participants is the issue of climate change and its profound impact on the regions of Southern Italy. The need for governance to address these challenges, facilitating a transition toward a sustainable and resilient governance model, has been stressed in the following sections.

Governance Emergency Approach to Climate Change

Participant 2 highlighted a failure to adequately address the impacts of climate change, particularly the rising frequency of extreme weather events. Droughts, to be precise, are pointed out as one of the most pressing issues that weaken water stability. Participant 7 explained that the decision-making process during emergencies, such as extreme droughts, becomes challenging

due to the involvement of multiple stakeholders, each with their own area of expertise. This leads to fragmented, non-targeted, and short-term solutions. Participant 6 also pointed out that the deficit in adapting to climate change exacerbates issues like drought, which leads to resource shortages and reliance on water transfer from regions with more resources (the case of the Apulia region has been previously mentioned).

Transition to Long-term Vision Governance with Structural Solutions

A long-term vision must be implemented to strengthen the resilience of the water sector in the face of instability brought by changes in climate patterns. Participants 1 and 2 stated that the lack of political stability and long-term vision, especially at the local level, hinders the delivery of good water governance for citizens.

Participants 6 and 3 mentioned the importance of finding alternative solutions to reduce water stress: for instance, institutions should implement a higher diversification of water resources, and adopt new collection methods. In this case, new technologies can provide an efficient solution. Moreover, Italy, which currently falls short in its wastewater recycling efforts, could prioritize its utilization through the adoption of recycling methods.

Infrastructure and Investment Challenges

Infrastructure for the water service is directly related to the efficiency of water management models and their readiness to face changes in climate patterns. The following sections present participant's views on addressing these challenges.

Weak Infrastructure

All the Participants mentioned the key role that a strong infrastructure system plays in effectively managing water services. Moreover, they all recognized the disparities in water infrastructures between Northern and Southern Italy.

Participants 2 and 10 highlighted the historical infrastructure disparities, pointing out that unequal infrastructure investments over time have resulted in weak and outdated systems. Moreover, Participants 3 and 4 noted that low past investments in integrated water services, with a historical focus on agriculture rather than potable water, have left infrastructure outdated and ill-prepared for current needs. Furthermore, the existing infrastructures were built without considering climate change as a concern. As a result, institutions now address this issue by completely restricting and rationing water.

All participants stressed the importance of updating infrastructure to adapt to changing weather patterns and water distribution in the face of Italy's climate change vulnerability. Participant 2 emphasized the crucial role of artificial reservoirs, especially in the context of climate change, but noted that many existing dams are outdated and incomplete, requiring better maintenance and expansion.

Participant 6 added that aging infrastructure, which indeed was built in xxx, combined with governance and financial challenges, slows down necessary updates and maintenance efforts.

Low Investments and Tariffs

All the participants underscored the importance of sustainable interventions supported by high investments.

Participant 6 pointed out a trend in lower investments in the South, which has led to inefficient networks, despite the aid of public investments from European (e.g. PNRR) and National funds in improving water networks. Indeed, continuous investments are necessary to address these disparities, as Participants 8 and 5 highlighted.

Participants 4, 5, and 7 pointed out that there are serious economic and infrastructural issues as a result of the low water tariffs, especially in smaller southern towns where management is very localised and public. Indeed, if the collected tariffs are too low, there will be no financial margins to update and maintain the infrastructure and the water service. Additionally, without adequate funding for maintenance, it seems unrealistic to build new infrastructure to face climate change. Moreover, public funds and continuous investments, including those from the National Recovery and Resilience Plan (PNRR), are crucial but often inadequate or not adequately allocated.

The inclusion of private stakeholders in contemporary management techniques, according to Participants 9 and 2, may help smaller and medium-sized organisations draw in more capital and improve their appeal to investors.

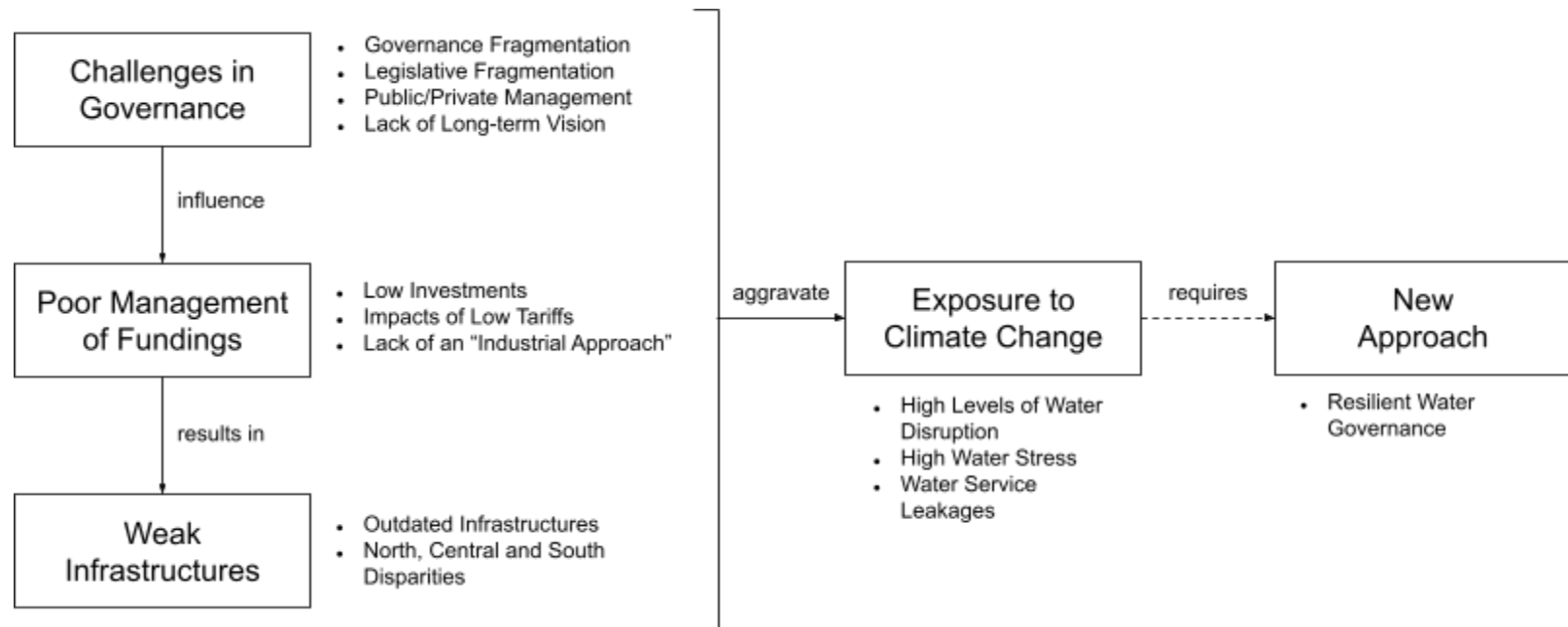
Lack of Human Resources

An issue is also associated with the lack of human capital to ideate and create infrastructure projects in Southern Italy, as Participants 2 and 3 explained. Indeed, there is a shortage of skilled professionals in water management and research. Participant 2 specifically explained that the allocation of EU and national funds has been hampered by this barrier.

Discussion

In the following sections, the results will be presented and discussed concerning the literature review and the Water Governance Framework (Hofstran, 2013; OECD, 2011).

Based on this research, Figure 3 has been drafted to understand the concatenation of elements that impact the inefficiency of the water system in southern Italy.

Figure 3*Barriers, Implications, and the New Approach to Water Governance in Southern Italy*

Note. Figure 3 illustrates the concatenation of the findings from the literature review and the interview, emphasizing the impact and importance of barriers on water governance and their exacerbation of climate change vulnerability in Southern regions. Each box is developed in subtopics, which reflect key components found in the analysis. The ultimate goal of this interconnected analysis should be the transition to a resilient approach in water governance (which, in the figure, is connected with a dotted line to indicate that the transition is yet to occur). This figure was drafted based on the findings and discussions presented in this study.

At the beginning of this research, it was stated that the current water governance in Southern Italy is not resilient enough to face climate change. This has led to the current inefficiencies affecting citizens and will likely result in even more problems in the future, as described in the literature review. Additionally, it has left the Southern regions in situations of extreme water stress and vulnerability to the consequences of climate change. Therefore, based on the Water Governance Framework (Hofstran, 2013; OECD, 2011), this water governance can be defined as “inefficient”. Table 1 addresses the barriers and implications through the Three Layer Model outlined in the Framework (Hofstran, 2013; OECD, 2011).

Table 1

Three-Layer Model of Water Governance Framework: Barriers and New Approach

Three Layer Model	OECD Analysis	Barriers	New Approach
Content Layer	Policy, Capacity, Information	Legislative Fragmentation	Stronger Framework for Data and Information Collection
		Lack of Human Resources	Enforcement of Supra-administrative Entities
Institutional Layer	Administration, Fundings	Governance Fragmentation	Stronger Consolidation of the Local Governance
		Poor Management of Finances	Adoption of an Industrial Approach
		Short-vision Approach	Improvement of Management of Finances
Relational Layer	Objectives, Accountability	Lack of Compliance	Long-term Approach
		Lack of Stakeholder cohesion	Stronger Multidisciplinary and Coordination

Notes. The table is based on the framework of Water Governance (*Hofstran, 2013; OECD, 2011*). Barriers and their implications, as well as the key elements of the new approach, have been presented in the discussion section.

The research question “How can water governance be improved to enhance climate resilience in Southern Italy?” will be addressed in the following sections. First, the barriers to effective water governance and their related implications will be presented. Then, a new approach to water governance, incorporating the updated practices to transition to a resilient model, will be presented.

Barriers and Implications

The main barriers identified have been in the governance, the challenges in the management of financial resources, and the poor infrastructures.

Water governance has been described as fragmented, especially at the local level. This fragmentation results in an already complex multi-level governance structure being further burdened by the involvement of numerous smaller bodies in managing water services. Participants have identified this as a significant issue to the correct functioning of the Integrated Water Service. In particular, when this happens locally, with public smaller entities managing the town’s water service, a completely integrated water service can not be ensured. Supporting this evidence, the literature review, as mentioned above, explains that 80% of the municipalities that locally administer water services are in the South (UTILITATIS, 2024). Furthermore, the legislation framework regarding the water service has also been described as multiple and fragmented. This could be a cause of concern when entity compliance is not enforced: Alberton and Domorenok (2012) explain that the implementation of the European Water Framework

Directive in Italy has been problematic due to institutional resistance and political influence. Indeed, Italy is now facing high fines from the European Union for the inadequate collection and treatment of urban wastewater: most of these conglomerates are located in the Southern regions, where local entities have not been able to correctly dispose of wastewater, without following the European common directives. This affects over six million people across seven regions (European Commission, 2016).

This fragmented and inefficient governance structure is further complicated by conflicting stakeholder interests and approaches. Indeed, often stakeholders present different contrasting views on the ways water governance should be administered. This frequently results in a short-term approach to project development, which in turn leads to a lack of long-term vision, consistency, and sustainability in the water management system. The lack of cohesion is also particularly evident in the decision-making process during emergencies. Each stakeholder, motivated by their sectoral interest and expertise, may disruptively interfere with one another.

The management of finances and investments is directly impacted by governance issues, and a further barrier to the adoption of a new, resilient strategy is the management of tariffs. Since the surge in interest in developing adequate water infrastructure in Italy, after the II World War, Southern Italy has experienced a persistent trend of low investments (Ermano, 2012). While historical causes should be taken into account for a comprehensive analysis of the issues, they should not prevent understanding why there has not been an increase in the efficiency of fund allocation. Indeed, findings have shown that the trade-off of maintaining low tariffs can be significant and adversely affect water governance. Italian cities rank among those with the least expensive water prices (Barba et al., 1997; Locken, 2021). Moreover, tariffs are significantly

lower in towns where water is managed by publicly owned water utilities, as opposed to mixed or private utilities (Romano et al., 2013, 2016).

Therefore, considering that Italian tariffs are lower compared to European standards and that Italian water governance lacks resilience, this led to the understanding that there is a discrepancy between the availability of funding, the methodology for calculating water prices, and the need for maintaining and upgrading water infrastructure. Indeed, when the collected tariffs are too low, there are no financial margins to update and maintain the infrastructure for the water service. However, despite the low cost, families in southern regions perceive water costs as already too high for the delivered service, indicating a disconnect between the actual tariff and the public perception (ISTAT, 2022).

Furthermore, it appears impractical to build new infrastructure to face the challenges of climate change. This leads to the discussion of infrastructure vulnerabilities: the current infrastructures in Southern Italy, due to the causes explained above, are outdated (Lo Storto, 2022). This results in regional and local entities restricting and rationing water to lower the water stress. Moreover, Lo Storto (2022) highlights that the average efficiency gap between North and South is 9.7% and in the worst-case scenario 24.9%.

PNRR, which stands for the Italian National Recovery and Resilience Plan ("Piano Nazionale di Ripresa e Resilienza"), is Italy's way of implementing the Next Generation EU program launched by the European Union. This plan involves substantial investments in the "Green transition", which also includes sustainable improvements in water service (Council of Ministers, 2021). However, due to the "performance-based" mechanism, funds are allocated only when the country or the organization can demonstrate its ability to achieve the previously outlined goals. However, participants highlighted that smaller entities often struggle to access

these funds because they might be unable to appear sufficiently reliable to financial institutions when seeking loans for infrastructure development projects.

All these barriers directly affect the current water service and make it more exposed to the effects of climate change: data regarding the high level of leakages, low water security, and high water stress have been collected and presented in the literature review.

New Approach

Entities involved in water governance should implement a new approach to transition to a fully resilient Integrated Water service.

First, the role of supra-administrative entities, specifically the ones at the national and regional level, should be enforced to provide better guidance to local entities and ensure compliance with water legislation. Supra-administrative entities should also take higher charge of collecting data and information to carry out better provisions regarding the implementation of practices given climate change. This could be done by implementing a common framework for the collection of data regarding demographic and water resources. Moreover, national and local authorities should identify areas where local fragmentation is most pronounced and consider merging the responsible local authorities. This consolidation could lead to improvement in the Integrated Water Service but should be evaluated from case to case to provide the best output (Bruno et al., 2015). Furthermore, there should be a stronger multidisciplinary governance approach among regions in the South and North, enhancing coordination and sharing best practices to address regional disparities in water service quality. This approach would guarantee a more equitable allocation of resources and services across the country in addition to resolving the operational inefficiencies.

Second, local entities should implement a more industrial approach to managing water service: this applies when the tasks related to water delivery are more efficient, with less production time, reduced costs, and fewer anomalies. However, this does not translate into complete private management of the resource: indeed, public management can also achieve greater efficiency by optimizing processes, leveraging new technologies, and adopting better practices in resource management (Plaut, 2000).

Third, continuous and increased investment are necessary to bridge the gap between the North and the South and to upgrade the infrastructures' resilience and directly the national Integrated Water Service. However, mechanisms must be adopted to ensure a more efficient allocation of resources and to develop a long-term vision for implementing these practices. While imposing higher tariffs might seem like a valuable option, it would inevitably lead to political and social resistance. This is because an increase in investments resulting from higher tariffs would not immediately translate into an improved service quality for citizens, but it would take years to be put into practice. Essentially, citizens would be paying more for the same level of service quality in the short term until the long-term vision is fully realized. Barba et. al (1997) also explained how improved management of resources and a realistic price of water would make new technologies affordable.

In conclusion, the transition to a fully resilient water governance model requires a multifaceted approach that addresses governance structures and stakeholders' involvement, with a greater emphasis on the financial management of funding. This will establish a long-term vision to address present and future challenges.

Limitations and Implications for Further Research

Limitations of this research should be acknowledged. First, this research did not include the governance of water used in the agricultural and industrial sectors, as this would have required a longer and more expansive study. Agriculture is closely linked to the geography and specific usage patterns of each region, so it was decided not to include it because it would have shifted the focus of the analysis.

Second, the research focused on Southern Italy; however, this is a large area which includes numerous regions. Therefore, the analysis aimed to identify common inefficiencies across these regions. Readers should be aware that each region may face unique challenges linked to local and regional governance. Therefore, a more detailed understanding of each region could further enhance in the future the governance of the territory

Further research should be conducted to investigate the multidisciplinary nature of water governance, including issues related to the use of water for the agricultural and industrial sectors. Moreover, a local or regional assessment of governance practices could be carried out to provide a more comprehensive and detailed understanding of the local and regional barriers and related implications. Additionally, a study with an alternative and broader focus could include participants from the “Civil Society” category of the Water Governance Framework (Hofstran, 2013; OECD, 2011).

Conclusion

In conclusion, this research has examined the multiple and complex aspects of water governance in Southern Italy. Specifically, the focus has been placed on the critical need for a transition to a resilient model capable of addressing the pressing challenges posed by climate change. Indeed, the current water governance structure, which is characterized by severe

fragmentation, inefficient financial management, and poor infrastructure, has been shown to exacerbate water stress, service disruptions, and vulnerabilities in the regions.

Therefore, the research question - “How can water governance be improved to enhance climate resilience in Southern Italy?” - has been answered through a comprehensive literature review of the current governance structure, including past legislations, investment trends in the water sector, and evaluating the progress, issues, and stakeholders involvement. Moreover, the semi-structured interviews with experts in the sector provided deeper insights into the practical implications of governance issues, further supporting the literature review’s argument that there is a need for updated practices.

This study highlights the necessity for a new approach to water governance that includes an enhanced role of national and regional entities, which should strengthen the guidance and compliance of local entities. This would include a better data collection framework, the consolidation of fragmented local authorities, and stakeholders’ cohesion in the decision-making process. Moreover, local entities should implement an industrial approach to water service management, through the adoption of more efficient procedures and the adoption of new technologies. This new approach does not necessarily mean a privatization of water and related managing entities, but rather the implementation of improved management practices within the public sector. In addition to improving infrastructure resilience and implementing a realistic approach to water pricing that achieves a balance between affordability and the need for sustainable investments, this would close the gap between the Southern and Northern/Central areas.

The measures, presented in the discussion section, aim to foster a long-term vision of water governance, with a more integrated and resilient approach that can effectively mitigate the impact of climate change and ensure the long-term efficiency of the service.

The limitations of this research, which should be explored in further studies, include its focus on Southern Italy and the exclusion of agricultural and industrial water use. Indeed, the exploration of the multisectorial nature of water governance and regional assessments to enhance local governance practices are important.

Hence, it should be acknowledged that the transition to a fully resilient water governance model in Southern Italy requires a multifaceted approach that addresses barriers and their related implications. This will establish a long-term vision to tackle current and future challenges, ensuring sustainable and efficient water services for the region.

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Appendix A

Table 1

List of Participants, their Background, Role and Level of Expertise

N. Participant	Background	Role	Level
1	PhD in environmental policy and economics (at an Italian university)	Academic / Civil Society	National
2	PhD in Civil Engineering and Architecture, specializing in Hydraulic Infrastructure Engineering and Water Governance (at an Italian university)	Academic / Civil Society	National / Local
3	Honored graduate in civil engineering (at an American university), MSc (at an American university). President of a major Italian federation for public services in water, environment, electric energy, and gas, representing companies at national and European institutions.	Public Sector / Private Sector	National / Local
4	PhD climate dynamics (at an Italian University), Earth System Science Fellow (NASA), Manager in the private and public sector, Author of a book regarding the role of water in society, Professor at a British University, former member of the World Economic Forum and OECD.	Academic / Civil Society	National
5	CEO of a major metropolitan water company in the North of Italy, former commissioner at a national public services federation, and former CEO of a regional potable water company, in the South of Italy.	Public Sector	National / Local
6	Head of Strategic Planning and Sustainability for a major private services federation's Southern Italy project, and consultant for private firms in Water regulation, water economics, and environmental regulation.	Private Sector	National/Local

7	Project Manager and Commissioner for Water Use in a region in South of Italy, PhD in Civil Engineering (expertise in hydraulic engineering)	Public Sector	Local
8	National Extraordinary Commissioner for the Adoption of Urgent Interventions Related to Water Scarcity Phenomenon, Former commissioner for regional Environmental Protection.	Public Sector	National / Local
9	Professor of Applied Economics (at an Italian University). Expert in water economics, sustainable management, and water governance.	Civil Society	National
11	Technologist at the National Institute of Statistics (Istat), responsible for the National Civil Water Census.	Public Sector	National

Note. The first column highlights the number of participants, which will be mentioned in the findings section to refer to the concept expressed by them. In the second column, the background of the participants is presented, for instance, whether they are professors or managers in the governance sector. The “Role” and “Level” columns link the Participants’ expertise to the Water Governance Framework (Hofstran, 2013; OECD, 2011).

Appendix B

Email Sample for Participants

Dear “Name and Surname of the Participant”,

I am Edoardo Ferrari, a third-year student of the BSc Global Responsibility & Leadership at the University of Groningen, in the Netherlands.

I am contacting you with the aim of inviting you to participate in an interview as part of my thesis, entitled "Enhancing Water Management Practices in Southern Italy." Your experience in the water management sector offers significant value to enrich the research in this field.

The research focuses on analyzing water management strategies in the Southern Italy region, with particular attention to the challenges posed by climate change and opportunities to improve the region's resilience. I would like to discuss your involvement in the sector and gather your perspective. I believe that your expertise would help me further develop my thesis.

I am available for any clarification and look forward to your response.

Best regards,

Edoardo F. Ferrari

e.f.ferrari@student.rug.nl

Appendix C

Sample Interview Guide

“Enhancing water management in Southern Italy: a multi-perspective analysis on Stakeholder Engagement”

Objectives

- Assess the impact of climate change on water resources availability and quality in the region.

- Identify the key weaknesses and vulnerabilities in water management systems in Southern Italy, especially those linked to possible governance failures.
- Understand how stakeholders, including government agencies, local communities, and private companies can collaborate to improve water management practices.

Key themes: water management, public and private governance, Southern Italy's resilience

Section A (Introduction):

- a. Can you provide an overview of your role and responsibilities as a local/regional policymaker in the water management sector?
 - i. Can you elaborate on any collaborations or partnerships between your office and other stakeholders, such as government agencies, local communities, or international organizations, aimed at improving water management in Southern Italy?

Section B:

- a. How would you define the current status of the Integrated Water Service in Italy?
- b. What are the key weaknesses and vulnerabilities in the current water management systems within your jurisdiction?
 - i. Are these weaknesses uniformly distributed across the region, or do certain areas face more significant challenges?
 - ii. Could you provide insights into the specific challenges faced in Southern Italy regarding water management?

- c. How have possible governance failures contributed to exacerbating these weaknesses and vulnerabilities in water management?
 - i. Have political considerations influenced decision-making processes regarding water management, potentially sidelining scientific evidence or community needs?
- d. (What challenges does your office encounter in enforcing and ensuring compliance with existing water management regulations?)
- e. How do you evaluate the resilience of water infrastructure and governance mechanisms in light of emerging challenges such as climate variability?
- f. From your perspective, what strategies can be employed to strengthen partnerships between the public and private sectors to address water scarcity and quality issues in the region?
- g. How do you view the role of technology and innovation, such as advancements in monitoring systems or water treatment technologies, in addressing the current challenges faced in water management in Southern Italy?

Section C:

- a. Can you share insights into how climate change has influenced your policy-making approach in regulating water management over recent years?
- b. How do changing weather patterns, such as increased frequency of droughts or extreme rainfall events, affect water resources within your jurisdiction?
- c. What specific challenges does climate change pose to maintaining the quality and quantity of water resources, particularly in urban areas?

Appendix D

Ethics Informed Consent (University of Groningen, Campus Fryslan's Format)

Title: Enhancing Water Management Practices in Southern Italy

Dear [*Participant's Details*],

Thank you for your interest in participating in this research. This letter explains what the research entails and how the research will be conducted. Please take time to read the following information carefully. If any information is not clear kindly ask questions using the contact details of the researchers provided at the end of this letter.

WHAT THIS STUDY IS ABOUT?

Changes in climate patterns pose a serious problem for global populations. The Mediterranean region, including Southern Italy, which will be the focus of the following study, can be identified as a particular hotspot of vulnerability. Especially under the weight of a rapidly changing climate, traditional water governance may be put under further pressure and pose serious challenges to the resilience of the region. To mitigate the effects of poor governance and climate change, a stronger and more effective approach to water management represents a crucial area of focus. Therefore, the research question is:

“How can Southern Italy enhance its water management strategies to mitigate the impacts of climate change and improve the resilience of the region?”

You have been invited to participate in this study due to your direct involvement in the water management sector, as your expertise holds significant potential to enrich the research in

this field.

WHAT DOES PARTICIPATION INVOLVE?

You will be free to respond in any manner you prefer, drawing upon your expertise, supporting data, presentations, or case studies. The interview is expected to last from 30 to 90 minutes, although we can schedule it according to your availability. Feel free to ask any questions at any point during the interview.

After the interview, you might be asked some follow-up questions, via email or with an additional online meeting.

DO YOU HAVE TO PARTICIPATE?

Your participation in the interview is entirely voluntary. You have the freedom to decide whether to participate, and you can withdraw from the study at any time without facing any consequences or needing to provide a reason.

ARE THERE ANY RISKS IN PARTICIPATING?

There are no significant risks associated with participating in this study.

ARE THERE ANY BENEFITS IN PARTICIPATING?

Participating in the research study does not offer direct benefits to you. However, your involvement may contribute to advancing knowledge in the field of water management, potentially benefiting future communities or individuals.

HOW WILL THE INFORMATION YOU PROVIDE BE RECORDED, STORED AND PROTECTED?

Unless requested by you, the information you will provide, your role in the water management practices, and your details will be acknowledged in the Capstone project and during the presentation of the results. This ensures transparency regarding the research's reliance on sector experts. Should you prefer anonymity, we will respect your wishes and discuss appropriate measures. Data will be stored in compliance with GDPR rules of the University of Groningen, with access restricted to myself, Edoardo Francesco Ferrari (the researcher), and Professor Raul Cordero Carrasco (the supervisor). The Capstone project will be publicly accessible on the University of Groningen website, and all recordings will be destroyed after 5 years, upon completion of the research.

WHAT WILL HAPPEN TO THE RESULTS OF THE STUDY?

The Capstone project will be publicly accessible on the University of Groningen websites, and a presentation will be held in June to present the results of the study. The Capstone project will be evaluated by Professor Raul Cordero Carrasco and an additional anonymous supervisor.

If you don't request otherwise, the results will be shared with you, and you'll receive an invitation to participate in the final presentation.

ETHICAL APPROVAL

This research study has received ethical approval from the Campus Fryslân Ethics Committee, University of Groningen. The researchers are committed to upholding relevant ethical standards throughout the study.

INFORMED CONSENT FORM

Participants are kindly requested to sign the informed consent form, indicating their intention to participate while retaining the right to withdraw at any time.

WHO SHOULD YOU CONTACT FOR FURTHER INFORMATION?

Researcher: Edoardo Francesco Ferrari (e.f.ferrari@student.rug.nl)

Supervisor: Professor Raúl Cordero Carrasco (r.r.cordero.carrasco@rug.nl)

Ethical Committee: (ethics-cf@rug.nl)

If you wish to file a complaint, you can contact my supervisor and/or the Ethical Committee.

INFORMED CONSENT FORM

Title of the study: Enhancing Water Management Practices in Southern Italy

Name participant: [Participant's Details]

Assessment:

- I have read the information sheet and was able to ask any additional questions to the researcher.
- I understand I may ask questions about the study at any time.
- I understand I have the right to withdraw from the study at any time without giving a reason.
- I understand that at any time I can refuse to answer any question without any consequences.
- I understand I will not benefit directly from participating in this research.

Confidentiality and Data Use

- I understand that my individual information will be available to anyone who will be able to read the project and that my name might be published.
- I understand that the information provided will be used only for this research and publications directly related to this research project.
- I understand that data (consent forms, recordings, interview transcripts) will be retained on the Y-drive of the University of Groningen server for 5 years, in correspondence with the university GDPR legislation.

Future involvement

- I wish to receive a copy of the scientific output of the project.
- I consent to be re-contacted for follow-up questions by the researcher.

Having read and understood all the above, I agree to participate in the research study: yes / no

Date

Signature

To be filled in by the researcher

- I declare that I have thoroughly informed the research participant about the research study and answered any remaining questions to the best of my knowledge.
- I agree that this person participates in the research study.

Date

Signature