Master of Science in Law, Digital Innovation and Sustainability

Department of Law

Course of Foodtech, Agriculture 4.0 & Green Emerging Technlogies

Towards a One Health Approach:
Water Management Optimization in Regione Veneto.
The AlmavivA case study.

Prof. Francesco Giordano

SUPERVISORS

Prof. Christian Iaione

CO-SUPERVISOR

Luigi Madaghiele

CANDIDATE

Academic Year 2022/2023

Table of Contents

Table of Figures

1. Introduction

Freshwater is a precious commodity, which is becoming scarcer and scarcer because of climate change. The latter is causing melting glaciers, droughts and floods which are becoming more unpredictable and frequent over the years, causing massive distress to the current systems of water collection and redistribution (Means, 2023). The main cause of water scarcity is identified in droughts, which occur when regular weather patterns are interrupted for long periods of time, altering - sometimes irreversibly - the water cycle. This is deemed to bring about loss of biodiversity, wildfires, soil erosion and ultimately desertification, having ultimately repercussions on ecosystems, animals and humans (Eslamian & Eslamian, 2016; Stahl et al., 2016).

Whilst droughts are a natural part of the weather cycle, human activities can strongly influence the effects it has on a region: modern intensive agricultural practices increase land's vulnerability and dependance on water. What is impressive is that even scientists themselves are unable to predict droughts' length and severity; yet, monitoring and early warning tools can minimize the environmental, social and economic effects of a drought, if mitigation actions are taken. Considering that the impact of climate change will worsen in time, mitigation is not enough: especially in a country poor of water security infrastructure as Italy, there is the need to invest in ex-ante adaptation measures, like the construction of reservoirs or the utilization of data to boost decision-making for water.

The Region of Veneto, together with all the North of Italy, if suffering from an unprecedented years-long drought which led to the declaration of water crisis by the Region (PNACC, 2022). The project brought as a case study by this Master Dissertation is being developed by Regione Veneto in partnership with AlmavivA S.p.A. (hereinafter, "AlmavivA"), software company specialized in digital solutions for the Public Administration supporting the ecological transition and its sustainable digital development . The "Water Scarcity" project, up to today only developed partially as a Proof of Concept (hereinafter, "PoC"), has as a purpose the development of a platform where data concerning freshwater availability are integrated and easily navigable, in order to be able to compare them with information on the water footprint of the agricultural and livestock sector and allow the competent public body to take decisions accordingly. This PoC is limiting, as the project is framed for a much bigger picture of data-driven support to decisions for improving and optimizing public water management, as well as digitalizing the whole water infrastructure of the Region (AlmavivA, 2023d). Furthermore, this project is to be embedded in a bigger strategical project, a One Health project, currently in its drafting phase but with enormous potential for serviceability (AlmavivA, 2023c).

The project originates from a simple assumption: due to legislative obligations or other duties of information, there is already enough infrastructure for the collection of all the data relative to weather, cultivations, livestock, air quality, and many other parameters that can influence the welfare of people, animals and ecosystems, and therefore the environment as a whole. The potential these data could unlock if integrated, also considering the possibility of adding up predictive models to the platform, is immense and could lead to numerous applications. Nonetheless, this requires work to standardize and automatize data collection, which remains a big challenge, as it will be with the governance of such data.

The aim of this Dissertation is to look into the current Italian and regional legislative framework, as well as the main actors and modalities of water management, to understand how "Water Scarcity" and its One Health evolution could improve compliance and water use. The technical specifications of the platform will be overlooked, as they are not central to the research objective.

To collect information on the project and understand comprehensively its impact on compliance and the potential data-driven enhancements in water management and disease prevention, there has been constant exchange of information with AlmavivA. The Professional Mentor supervising this Dissertation, and constant point of reference in the drafting process, is Dr. M.C., Senior Subject Matter Expert for "Agriculture" and "Environment". With his more than 20 years' experience in the agricultural sector, he now develops innovative solutions in the One Health area for the management of environmental matrices and Agriculture, through the design of complex and integrated digital ecosystems based on data driven solutions. Aside from the constant interaction and support, Dr. M.C. has been formally interviewed twice to support the research question. Moreover, a further interview has been conducted with M.A., Head of Geographic Information Systems (GIS) and Earth Observation Practice in the same company, which for the purpose of this research presented the functionalities of the state-of-the-art PoC, presentation from which Figures 7, 8, 9, 10, 11 and 13 have been retrieved. This allowed and enhanced the hands-on approach used in this Dissertation.

2. Scenario Analysis

2.1. Water and agriculture in climate change

The current world's population has surpassed 8 billions people, and it's expected to reach 9.7 billions by 2050, generating growing concern for food security (United Nations, 2022). Indeed it has been estimated that in order to feed them, taking also into account the growth in income per capita, food production should double in quantity by the same year (Fukase & Martin, 2020). Also including climate change in the picture, even in a scenario in which global warming is limited cost-efficiently to 1.5 °C, up to 300 million people could end up undernourished (Frank et al., 2017).

Eating is not the only basic human need affected by climate change, as there is another natural resource which is going to be scarcer and scarcer with the increase of climate change: freshwater. Indeed, the increase in mean annual air temperature is causing variations in regional precipitation, affecting rainfall pattern, river flows and sea levels. This is progressively incrementing the likelihood of droughts and floods and their associated impacts on groundwater recharge (Kurylyk & MacQuarrie, 2013; Stocker et al., 2014). As one may well think, the fluctuations in water availability lead to distress for industries, people and, more importantly, agriculture and livestock, which use about 70% of the total water withdraw (Chartzoulakis & Bertaki, 2015). It is impossible to think globally of water resources and water availability of a community without linking this concept to the climate conditions and the ecosystem of such people. Indeed, the vulnerability of water resources to global warming impact requires a highly specific and regional case-by-case assessment, in order to take appropriate mitigation and/or adaptation measures (Misra, 2014).

Such interconnected food and water crisis calls for immediate preventive actions of different kind, to both minimize the risks of food security and protect water, the essential component for life, and prevent other concatenated negative externalities on human life, animals, or the environment. Specifically, the agricultural sector's activities in the last decades have been characterized by a wasteful use of natural resources, and their optimization has become indispensable. Such a transformation is being boosted by technology and, specifically, by releasing the potential of data and communication systems.

Because of the high regionality of water management and geographic specification of water sources, the project developed by AlmavivA and Regione Veneto, thoroughly analyzed in Chapter 3 of this Dissertation, is built on the current Italian and regional normative framework and developed in partnership with the main bodies responsible for public water management. In order to research the impact of the project on compliance with the sectoral legislation currently in force and on the modalities of management and intervention of the water field by the responsible public bodies, it is necessary to carefully assess all their relevant characteristics.

2.2. The national and regional water legislative framework

The aggravation of the adverse consequences of the climate crisis led to an increase in legislative action in favor of the environment, its preservation, and intergenerational justice; yet, until recent times the Italian legislator was falling short of a constitutional basis to act in these fields. Indeed, the protection of "*the environment, biodiversity and ecosystems, also in the interest of future generations*" has been recently enshrined in Article 9 of the Italian Constitution after the 2021 amendment . The same amendment also revised its Article 41 on freedom of economic activities stating that these could not undermine public health or the environment, and empowering the government to issue laws with the objective of guiding and steering the economy to pursue social and environmental purposes (Servizio Studi del Senato, 2021).

While there is no rule at Constitutional level establishing public property of necessary natural resources such as freshwater, legislation concerning public properties is to be found in the Italian Civil Code. Indeed, Article 822 of Codice Civile enunciate that the rivers, streams, lakes, acqueducts, and other waters defined as public by the relevant laws belong to the Italian State. The legislation includes these commodities in the so-called "Demanio Naturale" (that is, Natural State Property), inasmuch as they are assets which by their natural aptitude satisfy public interests, and therefore they can only be State property. However, State water commodities do not include the totality of them: the water sources that generate a direct or indirect public interest are registered in a list, thus leaving out small streams and lakes that can be privately owned (Brocardi, n.d.).

Along with other policies of decentralization of powers, the Decreto del Presidente della Repubblica n. 616/77 delegated to the Regions the competence to regulate freshwater when it comes to conservation of hydric bodies, retaining the powers to issue declaration of public utility of a water source, to regulate on water usages, to identify watersheds and other less relevant competences. Moreover, the European Union concurs with the Italian State in the policy-making for water, as according to Article 4(2) of the Treaty on the Functioning of the European Union (hereinafter, "TFEU") they share competences on agriculture and the environment. Article 191 to 193 TFEU better define the modalities of regulatory intervention of the EU in the environmental field. Article 192(2)(b) reads "[…] *the Council* […] *shall adopt measures affecting quantitative management of water resources or affecting, directly or indirectly, the availability of those resources*;".

Although in the seventies and eighties norms aiming at the identification and management of watersheds have been enacted, the first comprehensive body of law in the freshwater field has been Legge n. 36/1994 (Legge Galli) " Legislation in the field of hydric resources". Such piece of legislation has been assessed by scholars as enlightened, as it introduced some concepts that we still use today. For example, it identified surface water and groundwater as a public good to be safeguarded for the enjoyment of future generations by: pursuing resource-saving objectives, ensuring a balance between the needs and availability of the resource (so-called water balance), and controlling the processes of withdrawal, transformation and derivation from watersheds ("Integrated water management") (Magnarelli, 2022).

Overall, environmental legislation in Italy has been rather fragmented until 2006, year in which the necessity for reorganization of internal laws and transposition of Framework Directive 2000/60/CE on Community action in the field of water policy ("Water Feamework Directive", WFD) arose. Such restructuring necessarily led to the abrogation of former Legge Galli in favor of Decreto Legislativo n. 152/2006 "Norms in the environmental field", which Third Part is fully dedicated to "*Norms in the field of soil protection and fighting desertification, safeguarding waters from pollution and management of water resources*". It establishes a framework of government and governance of river basins[1], by better defining the competences of the regions, establishing Basin Authorities ("Autorità di Bacino Distrettuali") and clarifying the content and modalities of drafting of the Basin Plan. Basin Authorities are non-economic public bodies, coordinated and directed by the Minister of the Environment and sharing the same competencies of the regions[2]. Basin Authorities are assigned to each one of the seven Water Basin Districts ("Distretti Idrogeografici") – subdivided in Water Basins - identified in Italy[3], and therefore they potentially have to interface with multiple Regions while performing their activities. Their main tasks are drafting, adopting and actuating the Basin Plan, which is "the cognitive, normative and technical-operational tool through which the actions and rules of use are planned and programmed, aiming at the conservation, defense and enhancement of the soil and the proper use of water, on the basis of the physical and environmental characteristics of the territory concerned"[4].

Figure 1. Map of the italian Basin Authorities.
Retrieved on Centro Italiano per la Riqualificazione Fluviale's [website.](website)

Following the relentless water scarcity of 2022 and 2023 forcing farming and industrial activities to limited water usages, and considering the bitter cascading consequences this could have on the economy and on society, the Meloni government promulgated Decreto Legge n. 39 of the 14 April 2023 on "Urgent provisions for contrasting water scarcity and for the enhancement and adaptation of water infrastructure". The aim of this Decree is increasing the resilience of the Italian water availability by improving its infrastructure and upgrading coordination among decision-makers. First, it sets up a Steering Committee for the water crisis,

[1] A river basin is defined as "the territory from which rainwater or meltwater from snows and glaciers, flowing to the surface, is collected in a given watercourse directly or by means of tributaries, as well as the territory that may be flooded by the waters of the same watercourse, including its terminal branches with the sea mouths and the sea shore facing it" (Art. 1, third paragraph, letter d) of Law No. 183 of 11/05/1989.
[2] Art. 63 D.Lgs. n. 152/2006
[3] Art. 64 D.Lgs. n. 152/2006
[4] Art. 65 D.Lgs. n. 152/2006

entrusted with the identification of short-term intervention and long-term coordination and monitoring functions[5]. Second, it prescribes the appointment of an Extraordinary Commissioner which is given power to act in derogation to every law but constitutional and criminal law, on the basis of the information received by the Permanent Basin Observatories on Water Use, to pursue the aims of the legislation[6]. Third, it establishes the above-mentioned Observatories, one for each Water Basin District (and consequently one for each Basin Authority). The Permanent Basin Observatories are a major introduction in the water management system, as they work for the collection, updating and diffusion of data concerning water availability and use in the Basin. Data are indeed a precious resource when it comes to the management of such complex systems, and the institutionalization of Observatories like this, which aggregate data from multiple public bodies is functional not only to the overall digitalization of Public Bodies but also, specifically, to data-driven decision making[7].

The attention to data and their exchange is not the only innovation this Decree introduced that is favorable to AlmavivA's Rural Smart Water Management project, which is going to be addressed thoroughly in the next chapter. The Decreto Legge, in its Article 4 comma 3, last sentence, reads as follows:

"*The regions report feasibility and management projects for water bodies' monitoring networks and related anthropogenic pressures, necessary for the purpose of assessments of the volumes of water that can actually be used for different uses and to complete the scenario of key interventions to maximize the effectiveness of integrated resource management and the resilience of water systems to climate change*"

Decreto Siccità specifically quotes tools that, through monitoring, are able to assess water availability and optimize the use of water resources considering the anthropogenic distress. The "Water Scarcity" project by AlmavivA, as it will be shown later, aims exactly at the digitalization of the water availability of a certain area, in order to release several different applications.

Regione Veneto, in particular, had already taken action to combat the same drought in its early days, declaring on 3 May 2022 the state of crisis[8], supported by the Council of Ministers only in July. The latter allocated almost 5 million euros for the cause, to be managed by the Civil Protection in conjunction with the Delegated Commissioner, which in this case is the President of the Region itself. The same provision reported the need to appoint an Actuator to draft a plan of intervention and coordinate mitigation efforts. The appointed Actuator was Dr. Nicola Dell'Acqua, former director of *Veneto Agricoltura*, public agency of the Region (Regione Veneto, 2022); one year later, Dr. Dell'Acqua has now been appointed Extraordinary Commissioner under the Decreto Siccità, and is now in charge of spending more than 5 billion euros for the whole nation, partially funded by the EU Recovery Fund (Il Post, 2023).

[5] Art. 1 D.L. n. 39/2023
[6] Art. 3 D.L. n. 39/2023
[7] Art. 11 D.L. n. 39/2023
[8] Ordinanza n. 37 del 3 maggio 2022

2.3.Reclamation Consortia: functions and responsibilities

Reclamation and irrigation Consortia ("Consorzi di Bonifica ed Irrigazione") are public economic entities of a private nature with associative character and more than a hundred-year-long history[9]. Each Consortium, administered by its members, coordinates public interventions and private activities in the fields of water defense, irrigation and environmental protection. Reclamation Consortia, whose area is defined with reference to river basins, ensure effective territorial supervision, coordinating public and private interventions for soil defense, water regulation, irrigation and environmental protection. They developed from a role strictly related to the drainage of swamps to become an agency aiming at land, soil and environment conservation and development.

The word "reclamation", in this context, indicates that set of activities of planning, execution, maintenance and operation of the hydrographic network, manufacturing, reforestation, hydraulic-forestry systems, water-supply and lifting plants, having the purpose of making safe the urbanized and productive territories which might otherwise be affected by floods or hydrogeological disruptions and of making the land cultivable and safe through irrigation. Reclamation activities, therefore, perform three functions integrated in a delicate balance: reclamation in a narrow sense as restoration of a swamp, reclamation that allows the rational development of the same land for both strictly agricultural purposes and for productive purposes of a different nature, and also conscious environmental protection (Russo, 2014).

The activity of irrigation, carried out by the Reclamation Consortia ensures greater income security for the agricultural world through the better distribution of water resources. This activity is carried out through the management of the irrigation network, composed by more than 18,000 km of channels and streams, some of which is for mixed use of land reclamation and irrigation (AlmavivA, 2023d).

The relevance of land reclamation is rooted in Article 44 of the Italian Constitution. In a judgement of 2002[10], the Constitutional Court noted that reclamation is configured as a "transversal" matter incident to different sectors. The Court continues by stating that, as a consequence, the State is competent to determine main principles on the issue and the Regions are empowered to legislate on the details. The main principles on reclamation are today established by Articles 857 to 865 of the Italian Civil Code setting up rules of property law, as well as Regio Decreto 13 febbraio 1933, n. 215, which on the other hand regulates the constitution, powers and governance of Reclamation Consortia.

There are 10 first-degree reclamation consortia active in Regione Veneto, recently established in application of Legge Regionale n. 12/2009, along with only one second-degree consortium, having mainly irrigation functions. The regional branch of the National Association for Drainage and Irrigation ("Associazione Nazionale Bonifiche e Irrigazioni", ANBI) for Veneto associates and represents the 11 Consortia. The section identified by the Consortia includes, with good approximation, almost the entire irrigated area considering the fact that only the mountain and foothill area are excluded. The Venetian Reclamation Union ("Unione Veneta

[9] Regio Decreto del 8 maggio 1904 , n. 368

[10] Corte Costituzionale, Sentenza n. 407 del 2002

Bonifiche", UVB) estimates the agricultural area managed by the consortia to be about 950 000 hectares, equal to about 80% of the land area where the Consortia are present.

Figure 2. Map of the Reclamation Consortia of Regione Veneto.
Retrieved from Consorzio di Bonifica del Veneto Orientale

2.4.Irrigation services management and water pricing policies

In Italy, circa 50% of agricultural production and 60% of the total economic value of agricultural products are derived from about 20% of the area on which irrigation takes place. In order to keep achieving these goals it is necessary to plan and optimize every process related to water resource management, with the objective of the formation of sufficient water resources and the proper management of these resources in order to reduce waste and make irrigation interventions more efficient and effective in due time (AlmavivA, 2023d).

Irrigation techniques can optimize consistently water usages. The most common irrigation system in Italy is the overhead sprinkler, used for 40% of the irrigated area, followed by run-off and lateral infiltration (31%), microirrigation (17%) and submergence (9%). It's impressive how the most efficient irrigation system, i.e. microirrigation, is mainly used in the South and Center, whereas the North district makes use of the irrigation systems with the lowest efficiency rate (submergence and run-off and lateral infiltration).

The following table shows the efficiency of different irrigation methods used in Italy:

Method	Maximum Efficiency
Submersion	< 25%
Run-off	40-50 %
Lateral infiltration	55-60 %
Overhead Sprinklers	70-80 %
Drip irrigation	85-90 %

Table 1. Efficiency of the Different Irrigation Methods in Italy. (AlmavivA, 2023d)

According to the Information System for the Management of Water Resources in Agriculture ("Sistema Informativo Nazionale per la Gestione delle Risorse Idriche in Agricoltura", SIGRIAN), irrigation systems practiced in the Veneto prefer the use of methods such as run-off (47%) and infiltration (28%), to the detriment

of sprinkling and localized systems capable of significantly reducing the volumes of watering used (AlmavivA, 2023d).
According to the Italian National Statistic Institute ("Istituto nazionale di statistica", ISTAT) 53% of irrigated farms are supplied only by collective irrigation, through the Reclamation Consortia, while the 18% of these are supplied by both collective irrigation and private derivation like wells. As far as concern Italian water management, indeed, a distinction must be made between integrated water service (aqueduct, sewerage and purification) for civil and industrial uses and the use of water for agricultural uses. It has to be kept in mind that the agricultural sector is supplied through the services provided by Reclamation consortia. This organization is peculiarly Italian and is not even contemplated in the Water Framework Directive (Coldiretti, 2012).
The issue of water pricing for irrigation purposes has long been debated, in particular whether, to whom, and to what extent to charge all or part of the operational and capital costs borne by the community for the irrigation networks infrastructure (Molle & Berkoff, 2007). Since the 1990s environmental costs have been added up to the previously mentioned ones, with a shared view among the scholars to allocate such costs on the demand side. This position that has been maintained by the WFD in 2000, and later in the integration of environmental policies within the Common Agricultural Policy (CAP) (Battilani et al., 2023). This is in line with the "polluter pays" principle which is taken from the EU in several fields, in order to better allot the resource to those who manage it better[11].
As water is a public natural resource essential for multiple uses, it is established that its pricing does not depend from the meeting of supply and demand as traditional economy would suggest. The WFD, indeed, places emphasis on the role of price as a preferential tool by which to achieve a better allocation of the resource. This means that when price is being defined, reference is made to the principle of full cost recovery, according to which users must pay a value given by the sum of the financial costs incurred in operating the resource, the opportunity costs due to the inability to allocate the resource for other uses, and the environmental costs of pollution and overexploitation of the resource (Giannoccaro et al., 2008). Considering the Italian subdivision of water management between agriculture and industry/human needs, it is possible to say that the foregoing is valid for both the administration methods.
The issue of water pricing is also strictly connected to the problem of choosing which method to use to price water. Water pricing methods can be of two kinds: indirect, which are the most widespread in the world, and direct. While the latter is usually strictly volumetric, the formers are based on an estimation depending from variables that are related to water consumption. The WFD shows a clear preference for direct methods of calculation for the recovery of water costs[12] because of their efficiency and transparency, and for their capacity of being better welcomed by clients. Nonetheless, such measuring would imply more capital and operational cost, thus increasing water price and the probability of private waters exploitation. Some even argue that even

[11] Directive 2000/60/CE, Article 9 "Recovery of costs for water services"
[12] Directive 2000/60/CE, Annex III "Economic Analysis"

having in place a smart metering system would not be enough to quantify costs inasmuch it is required to compensate costs in full, as it would not take into account the environmental and financial costs (Battilani et al., 2023). Overall, there is a trend towards the commodification of water, which is alerting environmentalists and those who want water to be a basic human right. Therefore, compensation for water uses is needed, but the pricing system should be as optimization-oriented as possible and with ethical safeguards in place. Data, and a complex software like "Water Scarcity", can support the management of water with the aim of its conservation and its optimal usage.

2.5.The potential of data-driven predictive models for the Public Sector

The unparalleled accessibility of extensive data is fundamentally altering the environment in which we live. Algorithmic decision-making tools are actively being experimented with, innovated, and adapted by researchers, businesses, governments, financial institutions, non-governmental organizations, and citizen groups to understand global patterns of human behavior and provide decision support to address issues of societal importance (Lepri et al., 2016).

It is not surprising that not only businesses, but also public sector actors are turning to machine learning-based algorithms to solve complex problems beyond the capacity of human decision-making, also due to the vast quantities of relevant data available to mine and train algorithms with as well as increased analytical and technical capabilities. Indeed, the notion of data-driven public administration is composed by two interlaced processes: the use of big quantities of disparate types of data and more advanced methods to analyze such data, which return back to existing administration processes (Broomfield & Reutter, 2021).

Public entities can benefit more than privates from data science, since they gather a lot of data in many different categories (such as geography, traffic, social security, energy, etc.). When these data are combined or augmented with information from smart devices and other sources, including discussion boards, social media, or data from the private sector, these are referred to as Big, Open and Linked Data (BOLD) (Janssen et al., 2015), and are fully capable of generating good-quality analytics. However, when they are integrated by Artificial Intelligence (AI) techniques they can unlock predictive potential, and in such case take the name of Big Data Algorithmic Systems (BDAS) (Janssen et al., 2020). While there is no universally accepted definition of AI, it is widely accepted that it refers to the study of how to teach computers to perform activities that, at the moment, can only be performed by people or that are normally believed to be the domain of human intellect. In this sense, AI methods and tools provide enormous promise for the public sector and can aid in the identification of fresh data patterns for more accurate forecasting. When utilized carefully, these technologies may help decision makers not just make better decisions and run more effectively, but also change their structure for the better (Harrison & Luna-Reyes, 2022).

Notwithstanding the enormous potential of data-driven support to public decision-making, this kind of digitalization is to be taken with caution, as it may cause unforeseen consequences. As a matter of facts, there have been numerous instances of excessive bias leading to corrupt, ineffective, or unfair procedures and outcomes, particularly when it comes to issues of power in resource distribution, fairness, justice, and other public goods. In the UK, while carrying out cancer screening an algorithm many "false positives" were found, leading the Health Secretary to blame the algorithm used. In many other cases there have been many examples of predictive algorithms negatively targeting black people due to racial biases (Andrews, 2019; Douglas Heaven, 2020). As a consequence, the shift toward data-driven algorithms requires impartiality, evidence-based decision-making, and a better knowledge of our resources and habits. While the data collected for this case study are not personal data, and therefore are easier to manage, the development of every data driven project needs to engage in bias control activities (Ntoutsi et al., 2020).

The data driven approach taken by AlmavivA for the development of "Water Scarcity" is the one described in Figure 3. Data ingestion is both from public databases and field information collected through IoT sensors or satellite (publicly available). Once the data are validated, they can be integrated and put at use.

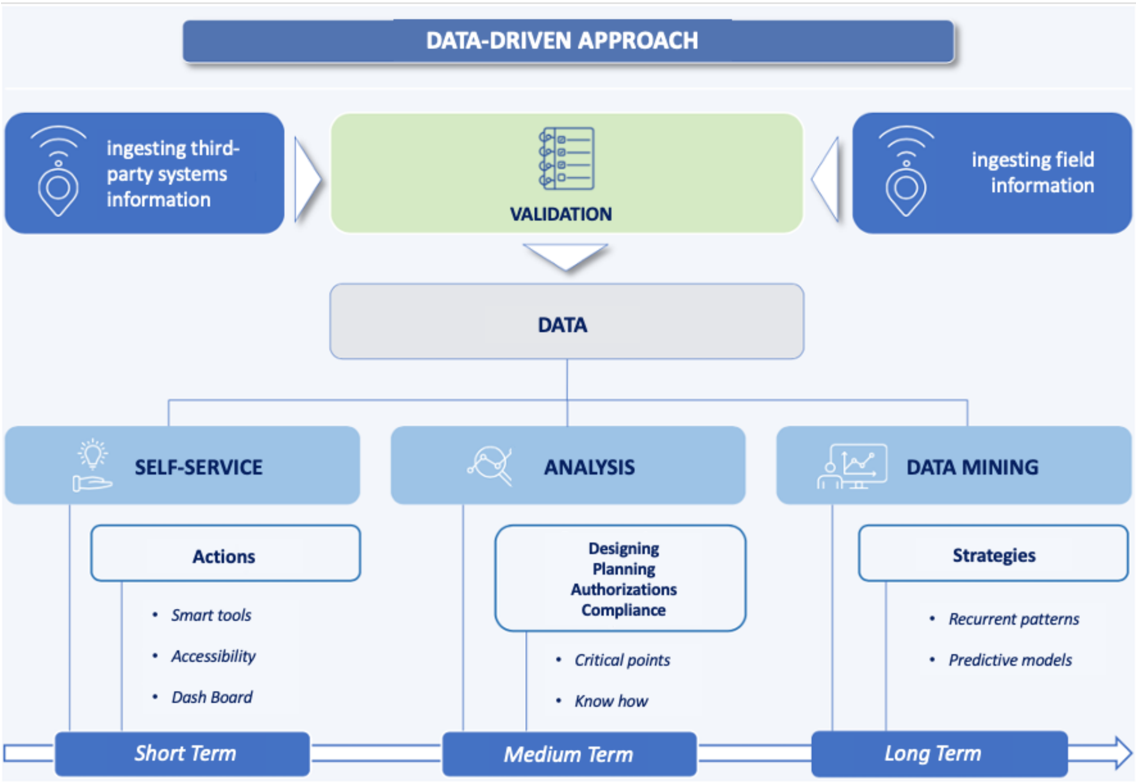

Figure 3. AlmavivA's Data Driven Approach.
Retrieved from "One Health - One Earth, un approccio innovativo" (AlmavivA, 2023c).

The main function they plan to develop is the creation of a platform that integrates and visualize the relevant data, to create an interoperable constantly updated dashboard. In the medium term they will integrate services that compare the formerly mentioned data with compliance principles and authorizations to support the identifications of critical points. The development of predictive models trough data mining will only unfold in the long term, where the most urgent functions have been run-in (AlmavivA, 2023c).

3. The "Water Scarcity" project

3.1. The One Health paradigm

The more humans transformed and used natural capital from the industrial revolution onward, the more we altered the natural regenerative balance of the Earth, causing negative consequences not only for the ecosystems and for animals, but for the human population itself. As the interdependence of our actions with the external world was better and better understood, and as its backfire was more and more felt, the human race is trying to face such complexity, trying to make up for its mistakes without overly compromising their welfare. Nonetheless, some examples of backlashes have already caused massive distress to the human's socio-economic systems like COVID-19, avian influenza, desertification, floods and bushfires. Understanding such links and preventing disastrous impacts is one the most important challenges of our time, also recognized by international organizations, which refer to such efforts with the umbrella term "One Earth".

"*One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals, and ecosystems. It recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and interdependent.*

The approach mobilizes multiple sectors, disciplines, and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the collective need for healthy food, water, energy, and air, taking action on climate change and contributing to sustainable development. (OHHLEP, Jun. 2022)"

This is the most authoritative definition of One Health, provided for by the One Health High-Level Expert Panel (hereinafter, "OHHLEP"), set up in May 2021 by four global partners: Food and Agriculture Organization (FAO), the World Organization for Animal Health (OIE), the United Nations Environment Programme (UNEP), and the World Health Organization (WHO). The fact that four international organizations had to come together to establish such a task force demonstrates the necessity of a multi-sectoral approach to aggregate different competences and "*design and implement programmes, policies, legislation and research*"[13] (Bronzwaer et al., 2021). This definition is the most comprehensive of those retrieved: the common denominator of all the ones analyzed are both a declaration of mutual dependence among all the biosphere's main actors and a call for action to achieve a higher degree of health for all of them by acknowledging a systemic approach and leveraging transdisciplinary exchanges and collaboration through co-creation (Devos et al., 2022).

Also the Sustainable Development Goals, established by the UN in 2015, cumulatively embody the main concept of One Health, which envisions healthy people living sustainably on an habitable planet. SDG 2 "Zero Hunger", SDG 3 "Good Health and Well-Being", SDG 6 "Clean Water and Sanitation", SDG 12 "Responsible Consumption and Production", SDG 14 "Life Below Water" and SDG 15 "Life on Land" (UN, 2015) are all Goals that the One Health approach aims to pursue. Nonetheless, such a transdisciplinary and multi-objective

[13] This sentence has been extracted from the former WHO definition of One Health, published in 2017.

effort presents technical, institutional and professional challenges. Indeed, some sectors can be underrepresented, legislative schemes are disjointed, budgets and decision-making are compartmentalized and purpose-bound, as well as legal frameworks. Adding up the absence of multisectoral coordination mechanisms, the implementation of One Health strategies and programmes at local, regional, national and international level is not an easy task. One Health requires reiterated institutionalization, backed by appropriate investments in stakeholders' awareness, cross-sectoral competences, joint workforce training, effective governance and appropriate legislation, as well as community engagement (OHHLEP, Oct. 2022).

The concept of One Health broadened in time, OHHLEP themselves convene that environmental considerations, socio-economic factors and cost and benefits have not been sufficiently considered in the development of One Health interventions, policies, legislative frameworks, programmes or strategies. In particular, the environmental sector (which includes natural resources and wildlife management, biodiversity conservation, pollution and waste management, etc…) is very often neglected in favor of more human-centered projects, as the environmental determinants for health are not clear to professionals using a One Health approach. Furthermore, while the One Health Agenda is carried on by International and National institutions, there are some scholars who emphasize the need of acting locally. Indeed, Maino stresses that "*the local level is well-suited for screening and monitoring emerging challenges*", and need to work in conjunction with private companies which have the knowledge and capacity of developing integrated One Health solutions (Maino, 2022).

The "Water Scarcity" project extensively dealt in this Chapter is a first stepping stone redirecting the path towards a One Health approach that appears to be more balanced. Indeed, AlmavivA will describe their own approach to the matter as "One Health – One Earth", defined as "*an integrated, multidisciplinary, and unifying approach based on the correlation between different sectors to sustainably balance human health, animal welfare, and ecosystems*" (AlmavivA, 2023c). They recognize air, water and soil to be intertwined by strong interactions, and the necessity of a multi-disciplinary approach. Due to the drought emergency of the last year, the complex interactions of a One Health approach have been narrowed down to put water at the center of a data-driven solution meant to exploit and combine all the relevant public data on water and what influences its collection and redistribution. Regione Veneto had the urgency of not being able to meet the necessities of all the water consumers as usual, and needed the development of water management optimization measures. It's due to this that the "Water Scarcity" project, only recently conceptualized, is focused mainly on water, the essential component for the life shared by humans, animals and ecosystems. According to AlmavivA's expert Dr. M.C., the "One Health - One Earth" project is currently in its drafting phase, will be ready by the end of 2023, and it will be ready for implementation only after two or three years[14].

Consequently, this Dissertation looks into the first steps of this years-long development process, to analyze the benefits it could bring to the management of the current drought situation.

[14] Interview to Dr. M.C., Q8, 12 September 2023.

3.2. The Italian water crisis: the perspective from Regione Veneto

The amount of renewable water resources in Italy corresponds to about 116 billion m³, with the actual usable water volumes estimated to be around 52 billion m³. The main user sectors of the resource are agriculture (about 20 billion m3), human needs (9.5 billion m³) and manufacturing (5.5 billion m³) (PNACC, 2022). Italy is considered to employ only the 30% of their renewable water sources, well above the 20% indicated by the goal of a resource-efficient Europe for 2020 (European Commission, 2011). As a result, the Organization for Economic Cooperation and Development (OECD) has classified Italy as a country subject to medium to high water stress.

In particular, in the latest years Italy is witnessing the effects of the climate crisis increasingly with time, harshly impacting on the availability of water for human-related use (agriculture, animal farming, industry, human needs). Until April 2023, Italy has been suffering from a severe years-long drought accompanied by comparably higher temperatures.

While in the following months it has been recovering, returning to close-to-normal conditions, the heat waves and massive floods of this same year contribute to worsen the Italian water availability. This taking into account that Italy collects only 11% of rainwater (Benenati, 2023), percentage that stakeholders are pushing to increase with a set of small artificial basins (Paoloni, 2022).

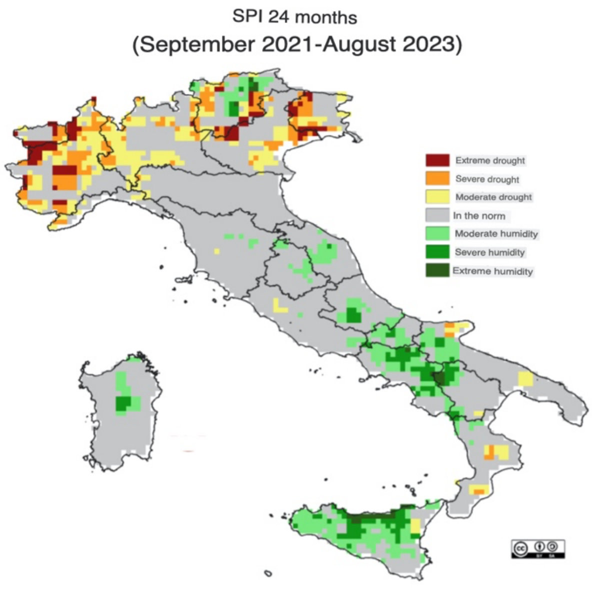

Figure 4. Standard Precipitation Index (24 months). Retrieved at CNR's Drought Observatory.

Another event causing the loss of water for human usages is the melting of glaciers. Mountains tall enough to host glaciers are named "water towers" for their capacity of providing water to the valleys and plains exactly in the period in which humans need water the most, that is, summer. The Alps in northern Italy are very relevant for human consumption, as their contribution in the Pianura Padana Basin can go up to 50-60% of the total water basin (Almaviva, 2023). In these mountains "peak water" – the phenomenon according to which average river flow is increased by a surge in water deriving from melting glaciers – has already been reached and it also dried up because the ice withdrew up to a point where it's impossible for it to melt. In addition, from January to May 2023 the Alps area has been characterized by a raise in temperature among 1.2°C and 2°C higher than average (1991-2020 baseline). Such a raise in temperature brought about an extreme reduction in snow precipitation, which fell between 30% and 40% compared to the median for the 2011-2021 period (Joint Research Centre & European Commission, 2023).

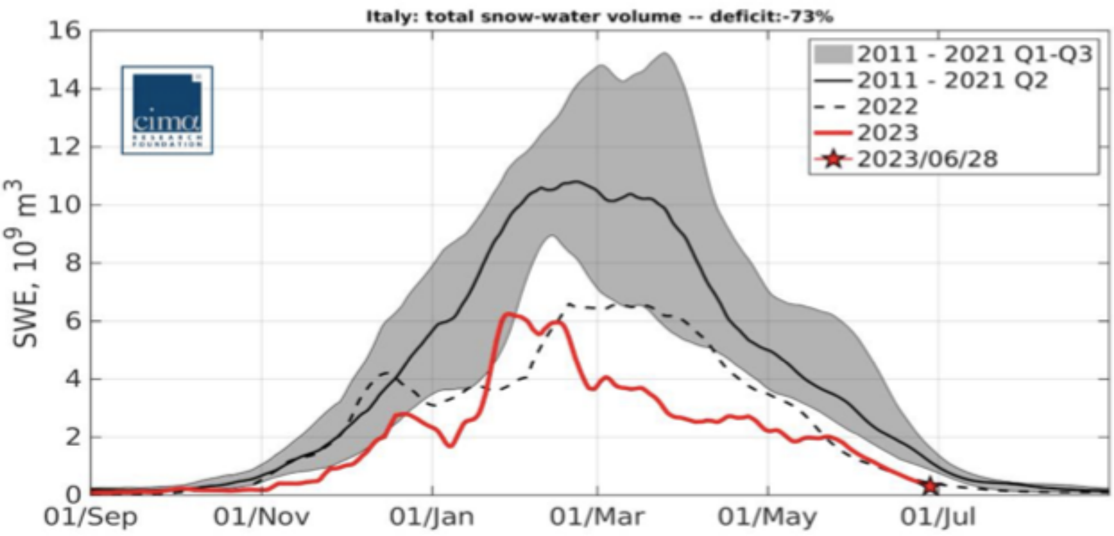

Figure 5. Graph of Snow-Water Volume performance.
Retrieved from the JRC Technical Report "Drought in Europe" – June 2023.

Therefore, as it's shown in Figure 5, the regions most affected by Water Scarcity issues are Piemonte, Veneto, Friuli-Venezia Giulia and Trentino-Alto Adige. The focus of the case-study studied in this chapter is going to be Regione Veneto, which notwithstanding some months of relieve is still hit by severe-to-extreme levels of drought. For example, only 3 millimeters of rainfall fell in the Veneto region in February 2023, 96% less than the historical average for the month. Furthermore, all rivers are registering critically below-average flow values, with extreme cases such as the Adige, which registered values around 50mc/s, below the critical threshold of 80mc/s, below which the salt wedge begins to rise (AlmavivA, 2023d). This is a phenomenon whereby due to low river water pressure, sea water is able to enter rivers, rising them and infiltrating the aquifer. As a result, the groundwater becomes saline and no longer usable for irrigation or human needs. As far as concerns aquifers, the absence of noteworthy precipitation for long period of time brought about levels below or similar to the absolute lows for the last 20 years, with a trend toward the worsening of this situation. As expected, this has been causing preoccupation also among the political representatives of the Region.

On Feb. 24, the Veneto Region's Agriculture Councillor, Federico Caner, had a meeting with regional representatives of the Veneto Reclamation Consortia (Consorzi di Bonifica) and the regional section of the ANBI. He announced the need to define a strategy for the use of irrigation resources and address drought: "*The lack of irrigation water puts at risk the 7 billion of Veneto's agricultural production's revenues, many of which are excellence products. To manage this emergency as well, we need to have interlocutors, norms and resources that guarantee support and coverage of the needs of Veneto*". Of the same opinion is the Councillor for the Environment and Soil, Gianpaolo Bottacin who stated: "*Drought is an issue that worries us. In fact, if we read the data for the last four months, rainfall was 21% lower than the historical average, so the same* *water crisis as last year is coming again if the weather situation does not change. We are preparing to deal with the evolving situation with infrastructural interventions as well: we have done a great deal of work to define all potential water storage situations and quantified the funds needed to create the plan of reservoirs in which to store the water resource for irrigation use, which will then have to be implemented*" (Regione veneto, 2023).

The following Table represents the expected climate changes and main probable effects on river ecosystems for the Veneto Region according to the PNACC.

Type	**Expected climate variation for the period 2021-2050**	**Expected effects**
River ecosystesms in the Padano-Veneto basin	• Increase in average annual air temperature by about 1.5°C • Increased winter precipitation • Reduction in summer precipitation • Increase of days with air temperatures above 29.2°C	• Increased frequency and duration of dry spells in the summer period • Increased precipitation and consequently increased risk of flooding in winter • Increased acute effects of eutrophication in summer periods and increased risk of anoxia. • Increased concentration of pollutants, in shortage of load • Severe disturbances to the macrobenthic community associated with exceptional flood events

Table 2. Expected climate change effects in Regione Veneto. (PNACC, 2022)

The foregoing calls for the need to implement complex and articulated interventions to manage the issue related to the optimal supply and distribution of water resources, monitoring and optimizing consumption, including through innovative technological solutions such as those offered by Precision Agriculture and remote control systems in the context of Agriculture 4.0.

3.2. AlmavivA's multi-functional Proof of Concept

The necessity for improvement of water management led Regione Veneto to get in touch with AlmavivA because of its expertise in working with the public sector in the digital innovation and sustainability sectors. As seen above, plenty of irrigation water is wasted due to inefficient irrigation practices. Thus, they convened that it was a priority to define a number of solutions that could enable optimal use of the water resource so as to significantly reduce wastage and increase the availability of water for agriculture to ensure that farms (and not only them) have the necessary quantities for production.

IT technologies are now mature and highly performant, and can enable real-time data acquisition from a wide range of tools (IoT sensors, satellite and drone imagery, GIS, Big Data, etc…), as well as the analysis, processing and management of public information present in the agricultural domain. While AlmavivA is mainly a company working in the innovation field, it has worked many years in agriculture: this allowed them to come up with a project that answered to the water issues of Regione Veneto in a small time and in an effective way: the "Water Scarcity" project.

The following Table illustrates Regione Veneto and AlmavivA's partners in the project and their respective role or the information they need to provide to support it.

Actor	Entity	Information provided
Regione Veneto	**ARPAV**	Meteorological variables (e.g., Daily minimum temperature at 2m (°C), Daily maximum temperature at 2 m (°C), Relative air humidity at 2m daytime average (%), Relative air humidity at 2m nighttime average (%), Wind speed at 2m daily scaled average (m/s), Daily total radiation, (kJ/m2)), hydrometric variables, water table elevation, pedology, etc…
	IZSVe	Livestock production data
	AVEPA	Graphical Farm Dossier and Graphical Cultivation Plan
ANBI		Administrative limits of the Consortium, number of member companies, managed territory, distribution network
Università di Bologna		Scientific support
AlmavivA SpA		IT Platform and Service System
BM Technologies		Leak Detection and Hydraulic Modeling

Table 3. "Water Scarcity" Partners list (AlmavivA, 2023d)

The solution proposed to the Region's administration in March 2023 involved the implementation of a system that provided, at the territorial level, the elements for the following functions:

1. Determination of overall Water Balance:
   - 1.1. The determination of the water footprint of territories and farms
   - 1.2. The estimation of potential water uses of the livestock sector
   - 1.3. The monitoring and estimation of the available water resource at the territorial and consortium level
   - 1.4. The planning and management of corporate water needs
2. Hydraulic engineering:
   - 2.1. Digitalization of consortium networks and Hydraulic Modeling (survey and digitalization of canals and hydraulic infrastructure)
   - 2.2. Monitoring of flow rates, channel levels, accumulations, water tables
   - 2.3. Simulation of operational scenarios and optimization of the consortium water network
   - 2.4. Hydraulic and quality measurements of irrigation water
3. Support in determining areas where to build new reservoirs
4. Use of unconventional resources (wastewater reuse)
5. Control of unauthorized water withdrawals

The following Gantt Chart has been designed on the basis of a project schedule provided by AlmavivA using ProjectLibre, an open-source project management software.

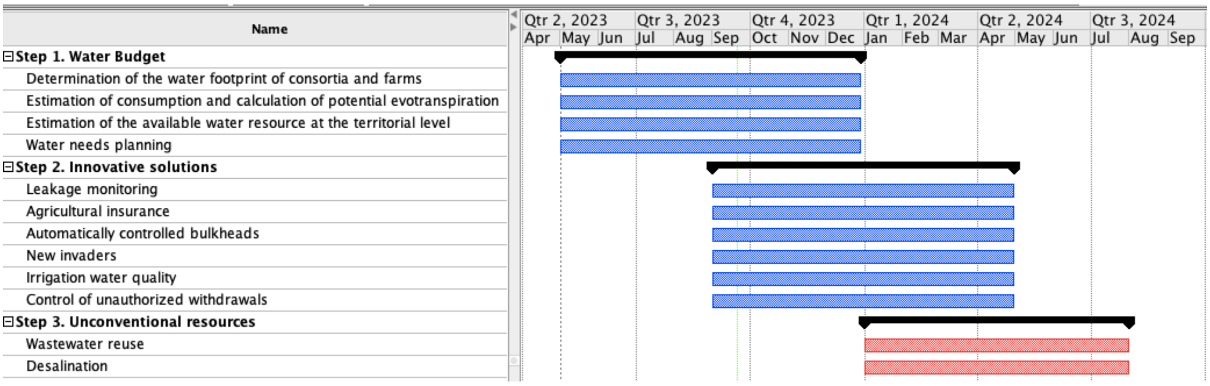

Figure 6. "Water Scarcity" Gantt Chart.

Up to September 2023, the timetable has been respected and Step 1 of the project (points 1.1. to 1.3. of the former list) has been almost delivered in full by AlmavivA as a PoC to Regione Veneto, which is going to be accurately described in order to analyze how agricultural and water management knowledge is combined with data and is enhanced by it.

While is true all the data that AlmavivA is including and will include in the project are publicly available, it is also rightful to say that some of them are only available after specific request, and others even after the placing of IoT sensors (in combination with the digitalization of the water networks provided in point 2.1.). Therefore, also according to the interviews with the company's expert, automatizing data collection and smoothing out potential issues that might arise due to data formatting and license authorization. Moreover, the digitalization of the Consortia's network plays a big role in the overall functioning of the project.

If agriculture and livestock are the main water consumers in Italy and hard to calculate, it's different when it comes to manufacturing and human needs, as these data are domain of the potable water distribution, which with the use of already developed software are able to collect aggregate information on the water use of these two sectors.

Figure 7 is the main page that appears when one opens the PoC, which has been examined under the guide of the Head of Geographic Information Systems (GIS) and Earth Observation Practice at AlmavivA. The legend on the left suggests that in this snapshot is possible to view monitoring stations of different kinds and the Basins with respective Reclamation Consortia. Moreover, a physical map is currently shown rather than a political one, which is instead found from Figure 9 onward.

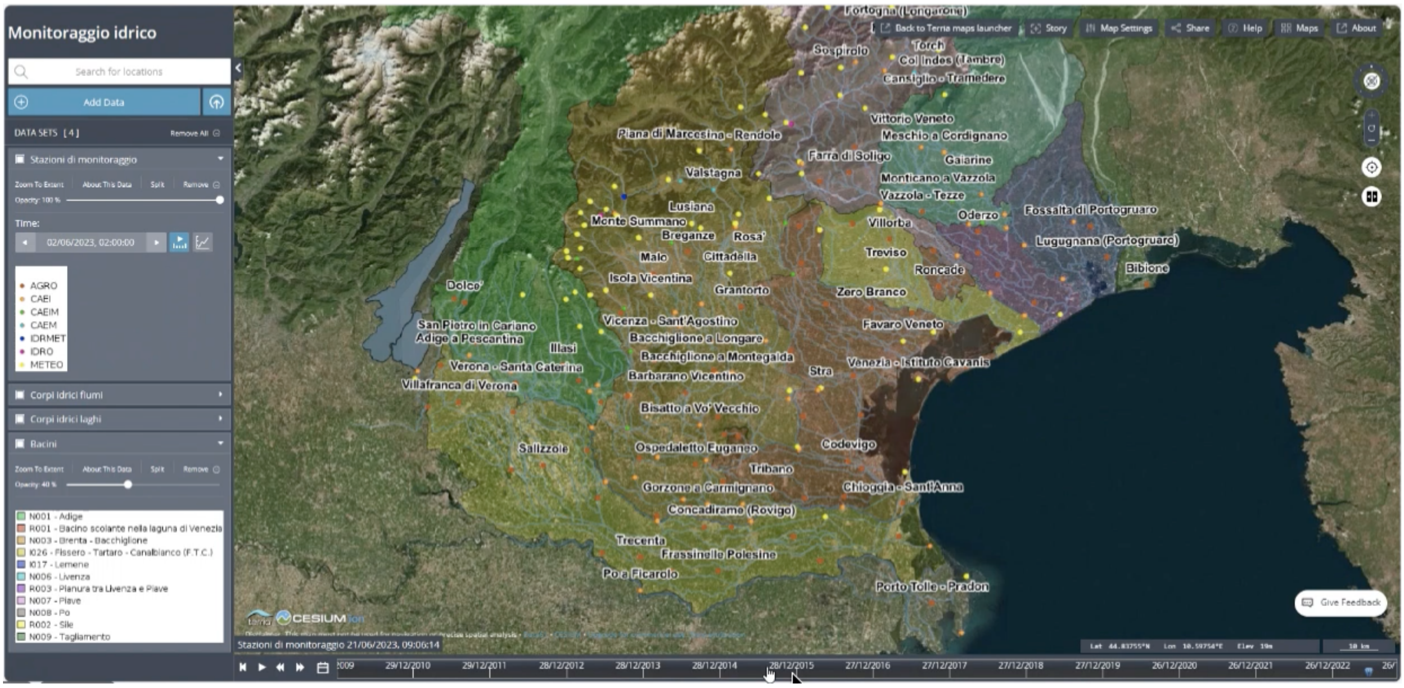

Figure 7. Proof of Concept GIS. Physical map with consortia and monitoring stations.

In the moment in which one of the data collection stations is selected, it is possible to check all relevant metadata and the progress of the data they measure. Indeed, many datasets acquired by AlmavivA have also their data history, which could be used for basic types of predictions.

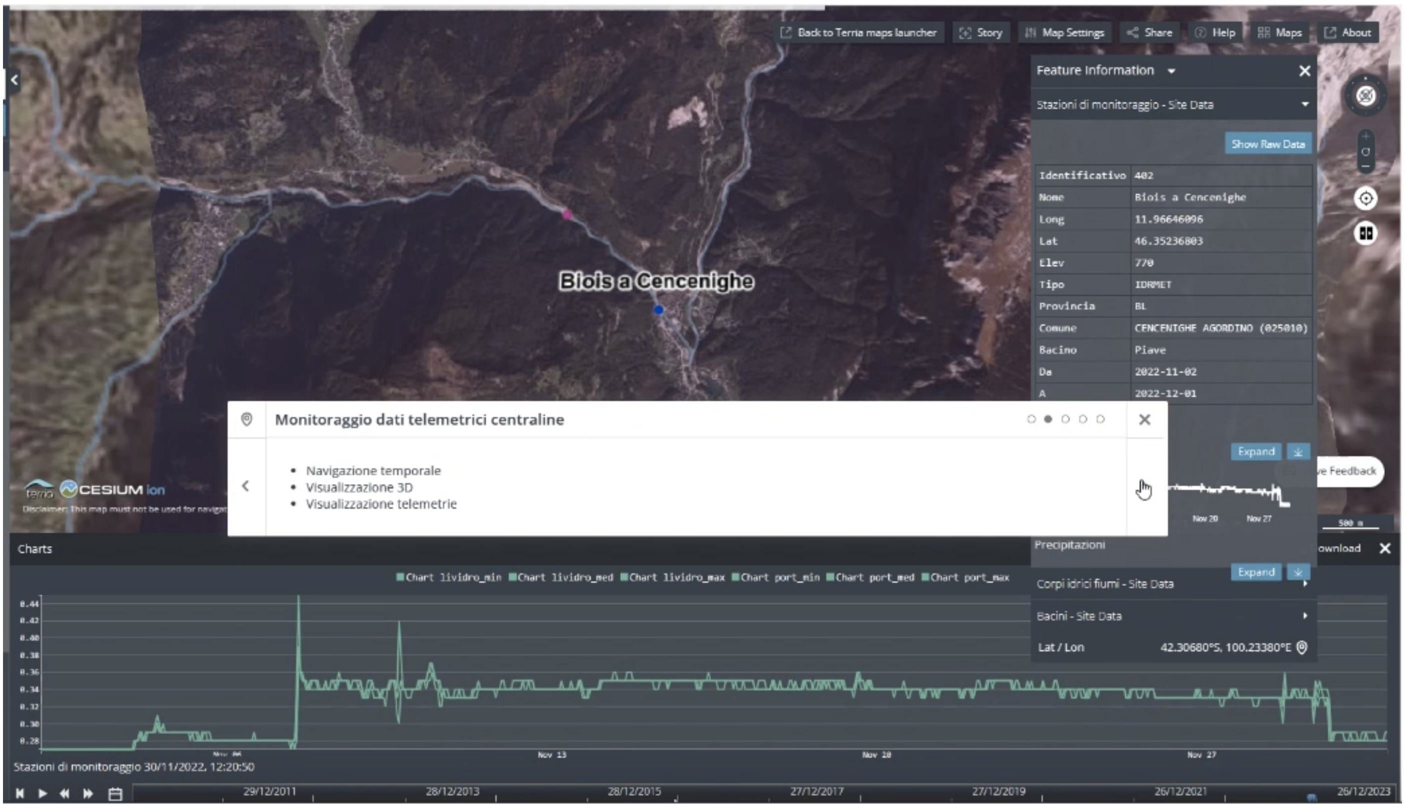

Figure 8. Proof of Concept GIS. Single selection of a monitoring station with metadata and progression.

3.2.1. Determination of the water footprint of territories and farms

In general, the calculation of irrigation water requirements of cultivated fields is not an easy task. It depends on the availability of accurate data on the available water, the agricultural species under cultivation, the planting and type of irrigation on site, geolocation and characteristics of the plot, whether these are physical, elevation and soil characteristics, and available meteorological and agrometeorological data for the physical location of the land. A future projection of rainfall weather forecasts, or a standard projection model, and also an up-to-date measure of the amount of water available for use by crop plant roots is also essential for a proper needs analysis (AlmavivA, 2023b).

All of these categories of data are widely available in public databases ("Sistema Informativo Agricolo Nazionale" – SIAN, "Organismi Pagatori Regionali" - OPR, Regions themselves, etc.), which can provide a detailed knowledge of national agriculture and its productions and can provide the set of elements of territorial reality that are essential for understanding the needs of the agricultural sector.

As far as concerns the type of cultivations and irrigation in a specific plot, the Graphical Farm Dossier (Fascicolo Aziendale Grafico) and the Graphical Cultivation Plan (Piano di Coltivazione Grafico) is where to look for such data. They are tools adopted at the national and EU level by the Agricultural Administration (AGenzia per le Erogazioni in Agricoltura - AGEA, OPRs) for the application and control of EU financial aid to agriculture. Through these databases it is possible to define with absolute certainty the productive destination of an area. The graphical component of the database allows for a spatial representation of an overall view of crops requiring irrigation water, their spatial distribution, the period, altitude, etc…, and thus, a key piece of information for planning the distribution of water resource and quantifying the potential needs of farms.

Another very important component for the determination of field's water footprint is evapotranspiration (hereinafter "ET"), the combination of water lost through evaporation (from the soil to the atmosphere) and transpiration (from plant leaves to the atmosphere). AlmavivA chose the Penman-Moneith Model to calculate ET, developed by FAO, which relies on atmospheric data (humidity, air temperature, etc…) and a crop coefficient.

The Irrigation Needs Estimation Model is the output of this information component and provides a general assessment element of potential demand at the spatial level. AlmavivA plans to extennd their own "Rural2Digital" platform, which already collects and processes all available information to represent agriculture phenomena (although for rating and insurance purposes) (quote website), to include also such Model. The Model developed is still in development, but up to now is able to assess precipitations, irrigation, evapotranspiration, runoff, percolation and infiltration, capillary upwelling and water available to the roots, in order to estimate water need for the specific crop.

So far, evapotranspiration has been considered just for corn and soybeans, which overall amount to the 80% of water consumption in Veneto. Thus, the Model only runs on those two crops for now. It goes without saying that once the needs of each farm are defined, it is possible to obtain the needs at the consortium level to determine the potential irrigation water needed at the area level. Furthermore, the use of Sentinel-type satellites will enable improved estimates and monitoring of water needs.

While the Model is still not completely elaborated, the PoC has begun integrating the data currently available. Indeed, the platform is capable of showing the precipitations by month and Municipality measured in both rain days and millimeters. It is also possible to split the screen with a moving bar, showing two different time frames at the same time, to visually compare them, as in Figure 10.

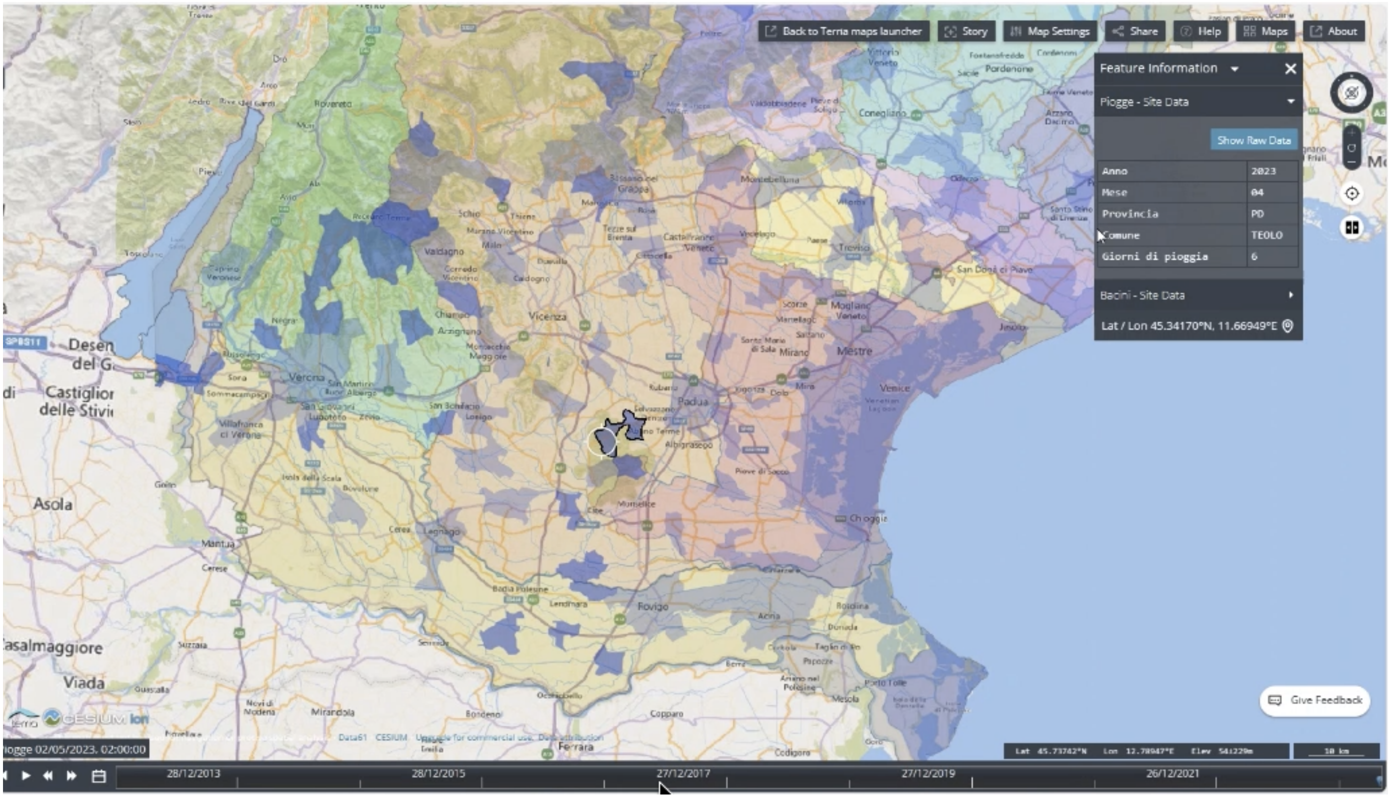

Figure 9. Proof of Concept GIS. Precipitations by Municipality per month.

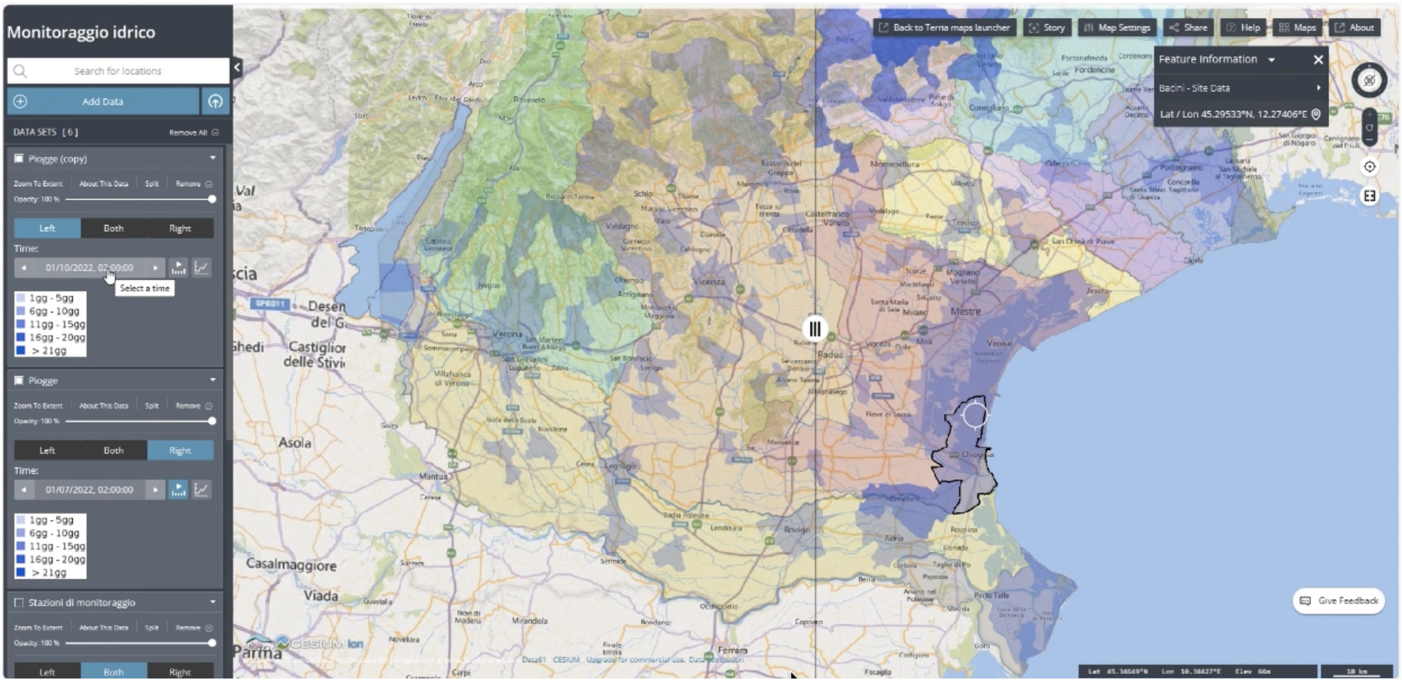

Figure 10. Proof of Concept GIS. Precipitation by Municipality in two different time frames.

3.2.2. Estimation of potential uses of the livestock sector

Livestock water requirements represent the amount of water needed by a farm animal for proper subsistence in life and for the maintenance of all the conditions that enable its best performance from a productive point of view, whatever the purpose of the farm itself. It is therefore important for the purposes of benefit to the animal and corresponding economic practice to anticipate and provide for the water needs of the animals concerned. The main activities involving livestock water consumption to take in consideration are animal drinking, barn and animal hygiene, summer air conditioning (where applicable) and water waste.

There are several Models to calculate livestock water consumption according to the bibliography.

- *Empirical method*: this method is based on knowledge of the amount of water consumed by animals according to their species and environmental conditions. Livestock water requirements can be calculated by multiplying the average daily water consumption by the amount of animals present.
- *Water needs-based method*: this method is based on analyzing the relationship between the water consumed and the maintenance and production needs of animals. Water needs for different animal categories are calculated based on weight, age and production level (categories).
- *Water balance method*: this method considers both the water consumed by animals and the water lost through respiration, sweating, urine and feces. It is a more accurate method than the previous ones but more complex to apply.
- *Simulation of water balances*: this method involves simulating water balances at the open system level, taking into account rainfall, evapotranspiration and the amount of water consumed by animals. This is a complex method and requires the availability of meteorological and soil data (Manuale tecnico operative zootecnia).

AlmavivA is striving to implement the latter, as they already have access to soil characteristics and meteorological data. Indeed, livestock water requirements is sensitive to the following parameters: location of the barns/animals, number of heads, animals presence period, animal features (age, weight, activity, physiological stage, health status, productive orientation), type of animal feed (can contain more or less water), farming technique, environmental microclimate and also water characteristics themselves. Yet, collecting all these information is complex, costly and time-consuming, and AlmavivA opted to implement either the first or second Model illustrated above, depending on the data available for each species, for their PoC. Therefore, livestock water requirements are then calculated by multiplying the average daily water consumption by the amount of livestock present, improved on a daily basis with respect to a number of conditions, the primary of which is season (hot/cold-relative humidity level).

Dr. M.C. reports that these data are public because, following the "mad cow" disease outbreak in the 1990s, all EU Member States began to manage livestock and collect information relative to them to monitor conditions and prevent further diseases. In the case of Italy the obligation to collect data is entrusted to the Istituti Zooprofilattici Sperimentali (IZS), one of which is partner to the project.

Such information on livestock heads, once inserted in the PoC, can be visualized as shown by Figure 11. In this case, the expert operating the software selected to show the number of cows by Municipality, and when the municipality is selected more metadata are shown. Of course, as said above, the number of animal heads is only functional to the purpose of the project when combined with bibliographical data on their water consumption, contributing to the calculation of the critical areas (shown in the Figure with different colors), that will be better dealt with in the next paragraph.

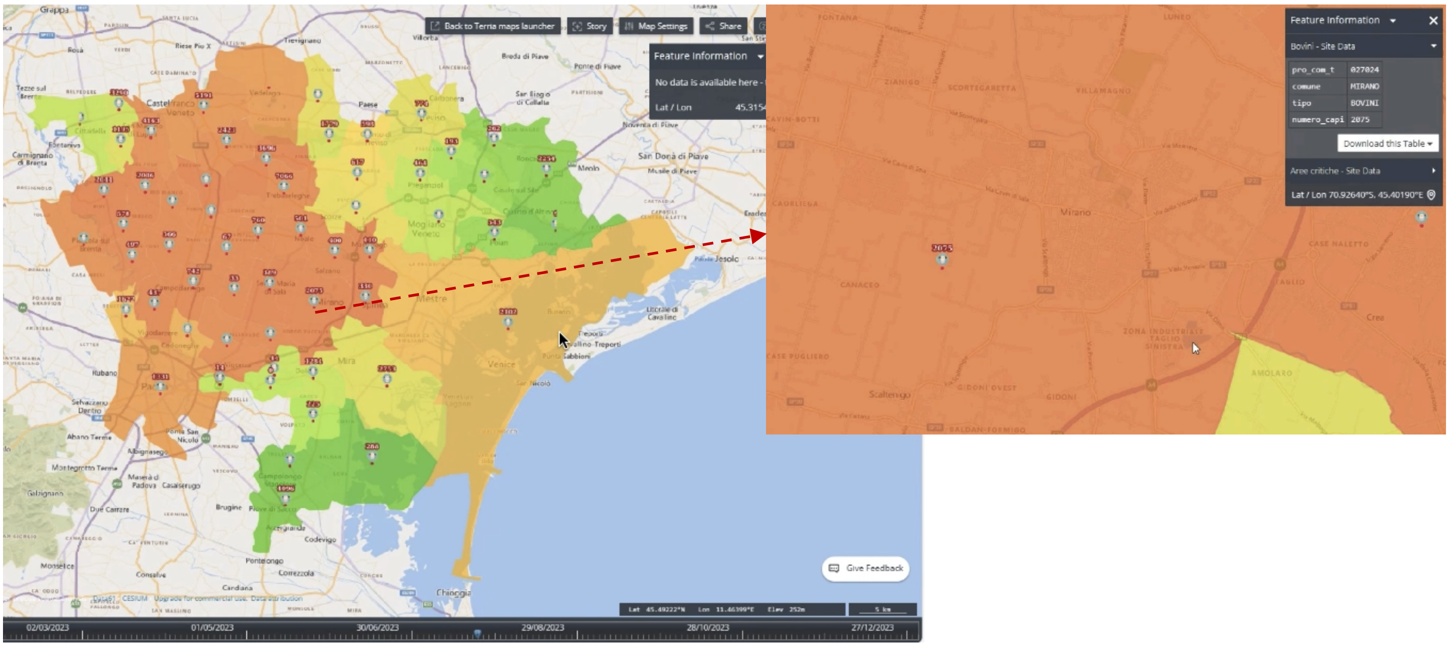

Figure 11. Proof of Concept GIS. Visualization and selection of livestock heads by Municipality on Critical Area map.

It already starts to be self-evident of how agricultural and livestock data-driven projects like AlmavivA's "Water Scarcity" are just one step away from unlocking enormous potential not only for managing the use of natural resources, but also for predicting responses of human and non-human life and ecosystems to human activities, to ensure the health and welfare of all living entities. Indeed, possessing constantly updated meteorological, cultivation and animal farming, and water data is the prerequisite to the creation of comprehensive One Health software with multiple applications.

3.2.3. Estimation and monitoring of the available water sources at territorial and Consortium level

Appraising the quantity of water available in real time in a certain area requires knowledge of river levels, reservoir filling and analysis of historical and recent rainfall, amounts of snow in the mountains, assessment of soil moisture, and other meteorological data. Furthermore, assessing it in real time (or daily) is consequent to the assessment of water needs of the main consumers of the resource, all these data are necessary for the Models described above and therefore put AlmavivA in the best conditions to also estimate water availability in an area.

This time, AlmavivA relied on a Water Availability Estimation Model based on hydrological models (e.g., HBV-EC Model, WaSiM, LARSIM, etc…), which is the tool providing the available quantities of water at a certain date for a given basin/sub-basin.
Hydrological simulations can be carried out not only to know the current water quantity, but also to predict future water levels. Information required to put such complex systems to work are the flow rates in the various branches of the hydrological network (including the minor network), maps of hydrological conditions in the basin such as soil moisture, evapotranspiration and soil temperature. All of these, in conjunction with anthropogenic use of water, is used to evaluate different scenarios of water resource management and land use.

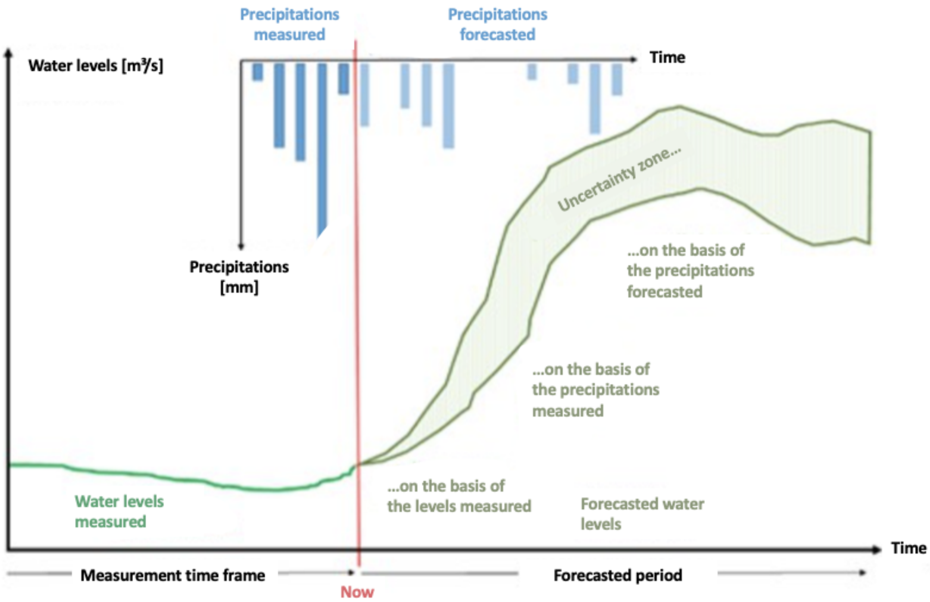

Figure 12. Water Availability Estimation Model graphically explained. Retrieved from "Rural Smart Water Management" (AlmavivA, 2023d.)

Especially as far as concerns water scarcity, having both a Needs Estimation Model and an Availability Estimation Model allows for verification of whether the expected quantities are met by those actually available and, if necessary, prioritization among different farms/crops.
Graphically, the PoC represents the comparison between the two Models through a scale of colors going from red to green, the red areas being those in which the water needed by the four categories of water consumers is severely close to water availability. Of course also this function is time-sensitive and, similarly to the precipitations function, is able to estimate where critical areas will be identified in the near future.
Unfortunately, estimation of water availability is not available for all Veneto's consortia, as the acquisition of flow and channel level data requires a dynamic sensor system for continuous surveying. Whereas some consortia already have them in place, others do not, and this is one of the obstacles to break in the years of the realization of the project. Nonetheless, AlmavivA will leverage their partnership with BM Technologies to engage in activities of engineering hydraulics (listed under point 2.), to digitalize the network of the consortia and allow the monitoring of their infrastructure, as well as enabling leakage detection and water quality

controls. All of this is possible with the utilization of IoT devices which integrate sensors suitable for these activities.

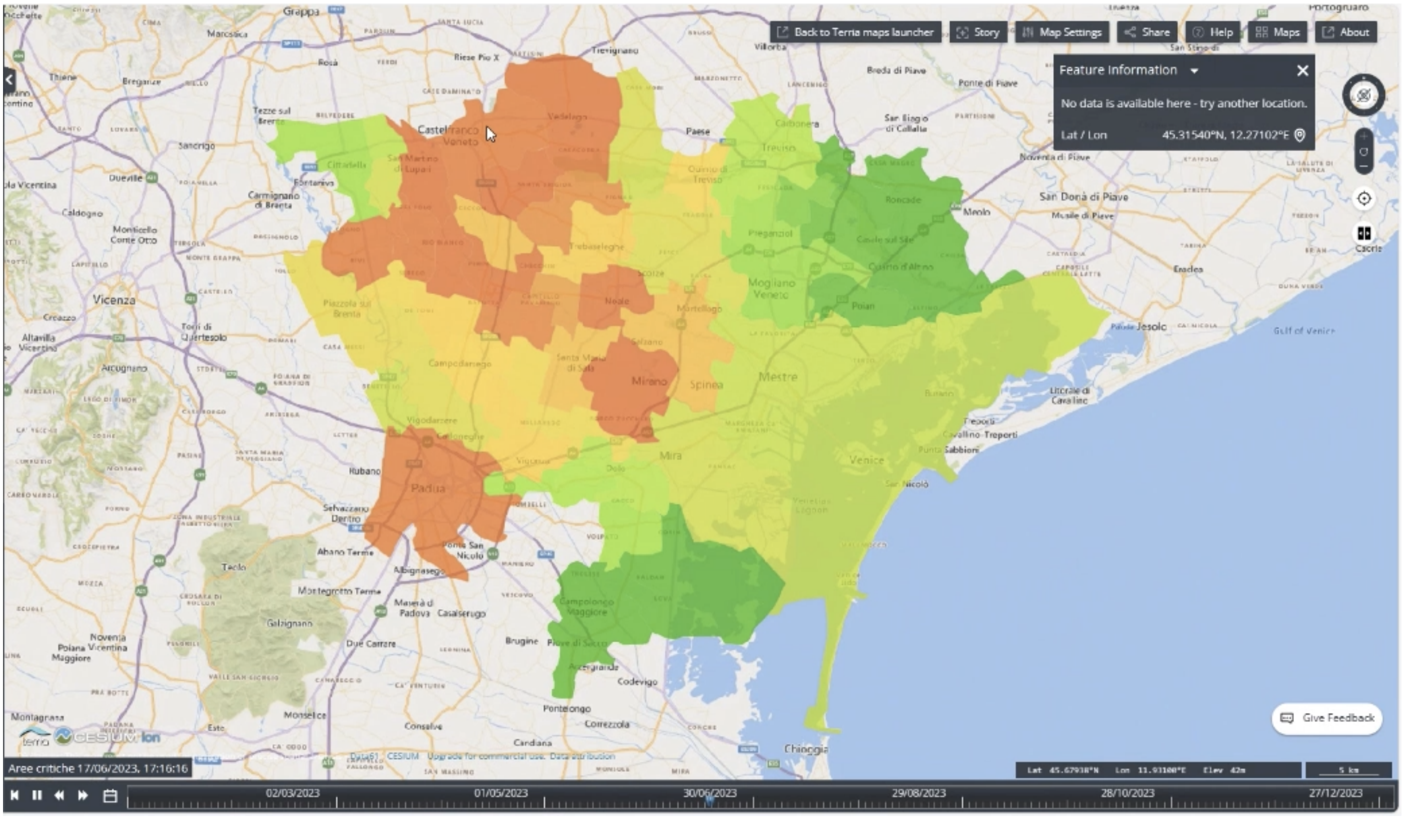

Figure 13. Proof of Concept GIS. Critical Areas map by Municipality.

3.2.4. Designed solutions left out of the Proof of Concept

Albeit these functions have been excluded from implementation in the PoC, this section will discuss respectively point 1.4. "The planning and management of corporate water needs", point 3. "Support in determining areas where to build new reservoirs", 4. "Use of unconventional resources (wastewater reuse)", and 5. "Control of unauthorized water withdrawals" anyway, both for contextual purposes and to analyze what function they could play in the extension of this project to a One Health project.

The service that is closest to being implemented is the scheduling of irrigation for farmers. Irrigation scheduling at the field scale is determined by applying a complex mathematical model based on the daily water balance of the soil-plant-atmosphere system aimed at telling farms when to irrigate and how much water to use. This allows farms to act promptly and in case of real need without wasting water resources and utilities costs (water, energy, labor time) and for consortia, in case of water scarcity, to activate specific rotation mechanisms according to the real needs of each farm.

The Model takes into account various data and information needed to estimate the exact volume of water requirements, including: soil moisture (e.g., sensors, satellite data), crop water stress status (NDVI indicator calculated through Sentinel open source satellite data), crops affected (Farm Dossier), crop phenological stage,

data relating to the aquifers and water flow through soil layers (the surface layer, occupied by roots, and layers below).
Therefore, in order to have the necessary information, data must be collected and processed daily from different sources: meteorological data (rainfall and evapotranspiration), information related to soil pedology, and crop parameters. The Scheduling Model will provide direct guidance to farmers on when and where to irrigate. Information is planned to be communicated through a push messaging service and/or through a dedicated mobile app. In this way, producers receive immediate and easy-to-use information from which they can deduce whether or not to activate the irrigation system and, if so, in which plot they should act.

As mentioned at the beginning of the chapter, Italy has proven not to perform well when it comes to the use of renewable water sources. The construction of impermeable farm reservoirs allows the collection of stormwater for irrigation purposes, represents an important solution for water supply in agriculture. The idea is to create a network of reservoirs spread throughout the territory to conserve water and distribute it when needed for agricultural purposes, with a major impact on farm income and the environment. Regione Veneto already allocated funds to the construction of these infrastructure, which construction has been called for by Coldiretti for years (TGR Piemonte, 2023). The institution of an Extraordinary Commissioner for water with powers to take over in case of delays is beneficial to the “small lake project” presented by the association to the government, which has been warmly welcome (IlPuntoColdiretti, 2022).
AlmavivA plans to identify spatially and geographically the most suitable areas for rainwater harvesting by looking at historical rainfall data per Hydrographic District. Zoning is then carried out, to precisely define where is actually possible to realize them, also considering proximity to other water sources (purifiers, desalinators, etc…).

If droughts and the consequent shortage of water for irrigation threatens to jeopardize a substantial part of agricultural production, the use of every available resource to meet the demand for water from the agricultural sector is essential. Relevant legislation at the national and EU level considers the reuse of wastewater as one of the tools with which to implement rational and sustainable water resource management and is one of the main steps on the path from the open to the closed water cycle. Under Directive 91/271/EEC, the Urban Waste Water Treatment Directive (UWWTD), collection of wastewater, as well as its secondary treatment, is mandatory for all the urban areas of more of 2000 people. The European Commission has been sanctioning Italy since 2004 for incorrect application of the UWWTD, launching four infringement procedures and heavily sanctioning the inadequacy of the treatment plants and inappropriate wastewater treatment (Calleri, 2021).
In Italy, wastewater reuse is allowed by Art. 99 para. 1 of Decreto Legislativo n. 152/2006 and its minimum standards of quality of irrigation purposes are established by Regulation 2020/741 on “*Minimum requirements for water reuse*”. Wastewater cannot in any case be reintroduced as drinking water, or go in contact with raw

edibles. Nonetheless, its water is rich in nitrogen and phosphorus and, if certified as safe, can be an important resource for agriculture. Another benefit of water reuse is that the outflow from the treatment plant is constant. This section of AlmavivA's project involves the reconnaissance and geo-referencing of all the sewage treatment plants in an area, estimation in terms of water outflow and the presence or absence of certification of the quality of the wastewater produced by them. A series of specific continuous water monitoring sensors need to be in place to continuously determine water quality and in case of abnormalities send push notifications to the staff in charge of controls. Also in this case, the comprehensiveness of this project enables other complex planning activities like combining water availability and quality of the sewage treatment plant and the type of local agricultural enterprises to verify the usability of wastewater in relation to the type of crop, exploiting the Cultivation Plans already knows. As a consequence, depending on the quality of water that farmers have available, it's possible to develop AI planning tools to improve the profitability of a crop over another.

The crisis of the last two years caused unprecedented water scarcity in traditionally water-rich geographical areas, which created panic among farmers, resulting in abusive withdrawals from waterways and lake environments, abusive withdrawals from wells and detour of riverbeds for abusive capture. In the Italian legislation is Article 17 para. 1 of Regio Decreto n°1775 of 1933 to rule the cases in a public water withdrawal is considered unlawful. With the exception of private rainwater collection and underground extraction for domestic uses, in absence of a concession, every other public water derivation or use is deemed unlawful by law.

As Dr. M.C. mentioned in an interview, water for irrigation in the Italian northern regions is managed by the consortia on a rotational basis. This implies that each field is allowed to have its own sluice gate open for a certain period of time, and farming companies pay not according to the net water quantity they consume, but on the basis of the time water flows is available for them. Abusive behaviors, in practice, could be the forcing of the gates or the use of motor pumps to seize water from the Consortia's channels or from rivers. Therefore, in view of the damage caused to Consortium facilities (sluice gates, canals, etc.) and other farmers, stronger and more effective protective actions are needed.

In order to protect agricultural production and ensure a fair distribution of available water resources, as previously described, AlmavivA's proposed solution is the following. The Irrigation Needs Estimation Model described above calculate the water needs of a specific field at a specific time in specific conditions for the specific cultivation. The data platform, therefore, is able to estimate expected soil moisture taking into account soil characteristics: through the same platform, satellite images from the open source Copernicus constellation can be analyzed to compare expectations with actual soil moisture and thus identify the possible use of unauthorized irrigation.

4. Results

	Situation Before Water Scarcity	Water Scarcity Function	Innovation Brought	Beneficiaries and Value Created
1.	General overview: ▪ No quantification of water needs for farming ▪ Approximate knowledge of water availability ▪ Full knowledge of industrial water consumption ▪ Full knowledge of water consumption for human needs	**Water Balance** Leveraging the additional water intake of points 3. and 4.	Overall knowledge of water needs by parcel and water availability by area	Consortia: ▪ Irrigation Optimization ▪ Decision support for overall management of reservoirs and streams
1.1.	Scattered data: ▪ FAG and PAG ▪ Pedological data ▪ Meteorological data ▪ Evotranspiration Models ▪ Cultivations bibliographical information ▪ Satellite data	**Farming Water Footprint** Through the newly developed *Irrigation Needs Estimation Model*	Estimation of water needs at parcel level for specific cultivation	Consortia: ▪ Knowledge of water needs both at parcel and Consortia level for the Water Balance Farmers: ▪ Reduction of costs
1.2.	Scattered data: ▪ IZS Livestock data ▪ Livestock water consumption bibliography	**Livestock Water Use** Through the *Empirical or Water-Needs based Model*	Estimation of water needs at company level for purpose-related number of animals	Consortia: ▪ Knowledge of water needs both at company and Consortia level for the Water Balance Farmers: ▪ Reduction of costs
1.3.	Scattered data: ▪ Meteorological data ▪ Pedological data	**Water Availability** Leveraging the infrastructure in place because of point 2	Awareness of current water availability and prediction of future scenarios, also considering anthropogenic use	Consortia: ▪ Decision support for overall management of reservoirs and streams
1.4.	Scattered data: ▪ Pedological data ▪ FAG and PAG ▪ Cultivations bibliographical information ▪ Meteorological data	**Corporate Water Needs** Leveraging the Water Balance estimations of the former points 1; 1.1.; 1.2.; 1.3.	Activation of a Scheduling Model providing farmers with indications on when and where they have to irrigate.	Consortia: ▪ Irrigation optimization Farmers: ▪ Increase in profitability ▪ Reduction of costs

Table 4. Results Table.

2.	Scattered data: ▪ Reservoirs accumulation (lakes, dams, aquifers) ▪ Topography	**Hydraulic Engineering Operations** Digitalization of the distribution networks of the Consortia as a whole, mapping withdrawal points and including water quality IoT detectors	Simulations of operational scenarios (leak detection) and early warning system of poor water quality	Consortia: ▪ Waste reduction ▪ Guarantee of adequate water quality distribution ▪ Irrigation Optimization ▪ Decision support for overall management of reservoirs and streams
3.	Scattered data: ▪ Topography ▪ Map of water reservoirs ▪ FAG and PAG ▪ Funds allocation from Regione Veneto (PNRR) for new "small lakes"	**New Reservoirs** Leveraging knowledge of water needs due to the former points 1.1. and 1.2.	Optimization of the zoning of the new distributed system of reservoirs for rainwater reuse	Consortia and Farmers: ▪ Increase in total water availability Farmers: ▪ Increase in water security Regione Veneto: ▪ Strategic advantage
4.	Legislative references: ▪ EU Dir. 91/271/EEC ▪ EU Reg. 2020/741 ▪ D.Lgs. 152/2006, Art. 99 para. 1 ▪ Infringement procedures by the EU Commission Scattered data: ▪ Cultivations bibliographical information ▪ Treatment plants water outflow	**Unconventional Water Use** Leveraging the water quality IoT sensors of point 2.	Improved performance in the use of renewable water sources directed at the creation of synergies between water specificities and crops nutritional requirements	Treatment plants: ▪ Improved plant management Consortia and Farmers: ▪ Increase in total water availability Farmers: ▪ Increase in water security ▪ Increase in crop profitability Regione Veneto and Italian State: ▪ Improved compliance mechanisms ▪ Reduction in compliance fines
5.	Legislative references: ▪ RD 11 dicembre 1933 n. 1775, Art. 17 para. 1 ▪ Unfit water withdrawal quantification systems Scattered data: ▪ Satellite data ▪ Pedological data ▪ Cultivations bibliographical information ▪ Meteorological data	**Unauthorized Withdrawals** Leveraging the soil moisture calculation developed also for point 1.1 and the digitalization of the water networks of point 2.	Comparison between estimated soil moisture with the satellite live soil moisture capture to detect beneficiaries from unlawful withdrawals and where the withdrawal took place	Public Authorities: ▪ Digitalization of crime detection ▪ Reduction in surveillance costs Consortia and Farmers: ▪ Increase in total water availability

Table 4. Results Table.

Table 4 groups together the results of the enquiry carried out in this Dissertation, and it's structured in the following way: every row, on its left side, presents a number which corresponds to the number assigned to a function of the "Water Scarcity" project in the list presented in paragraph 3.2. ; on the top of the table, on the other hand, from left to right it is possible to find "Situation Before Wager Scarcity", "Water Scarcity Function", "Innovation Brought" and "Beneficiaries and Value Created". They are positioned in this almost chronological order to stress the change that AlmavivA wants to bring forward with their projects.

The first column reports the condition of what is involved in, processed and/or transformed by the project, which is generally of three categories: "General Overview", "Scattered data" or "Legislative references". Apart from the first general considerations of what potential beneficiaries are currently missing, the other two categories chosen are directed at highlighting the shortcomings identified by AlmavivA, in which there is potential for innovation. The "Scattered data" lists are data that are (in most cases) publicly available and that are "scattered" in the sense that are not integrated, but are useful for the function described in the correspondent row. In the "Legislative reference" lists are included all the relevant pieces of legislation – or infringement procedures – which compliance could be improved by the function of the respective row.

In the second column is simply reported the function of "Water Scarcity" that the number is related to. This part is also dedicated to the smoothing of some complex interconnections among the functions of the project. In order to work at full potential, many functions require the implementation of the project as a whole. Moreover, in some sections, some innovative aspect of that precise function is reported, which is functional to the correct exertion of the innovative operation.

The "Innovation Brought" column is the heart of this research, as it summarizes all the complex applications of "Water Scarcity", and without understanding them properly it is not possible to assess the impact these could have, defeating the whole purpose of this document.

The last column on the right is devoted to the listing of the beneficiaries of the innovation explained in the same row, with their corresponding added value borne by the project. In this part of the table only direct impacts of the innovation have been included, and the secondary effects cascading on other stakeholders have been left out (e.g. Consortia are able to optimize their water management for irrigation, and therefore it is possible to save water to be used for other purposes like ecosystem conservation). Even though "Water Scarcity" mainly focuses on water use for humans, its One Health approach enables a series of cascading positive effects which would be very difficult to map. This is left to further research, as the purpose of this analysis was to identify the benefits of this projects, especially from the water management and compliance point of view.

5. Discussion

"Water Scarcity" as it has been conceptualized by AlmavivA is expected to revolutionize the management of water by the Reclamation Consortia and Regional and local public administration, which will be provided with an all-encompassing data-driven tool that, if well calibrated, could really simplify farmers' life. Nonetheless, as in many data-driven/platform projects, issues arise in the reliability of the information produced by the algorithm, which very often derive from the accuracy of the input data. Thus, it is essential that the input data are periodically (and possibly regularly) updated and automatically made available. So far, in the development of the PoC of "Water Scarcity", data have been collected "manually", meaning that there is human work behind data collection: this is costly and inefficient, as merely with a coordination joint effort they can be automatically collected and fed by the algorithm itself. Dr. M.C. indeed looks at this as one of the main obstacles in the long-term realization of the project, as this would imply concluding agreement with several public agencies to standardize the data publication modalities (at least for the purpose of this project). Mainstreaming data disclosure would require not just concluding an agreement, but also structuring the data stream and training the agency's personnel to maintain that flow. To ease this process, the institution of Permanent Basin Observatories as water data aggregators by Decreto Siccità could favor the mainstreaming process as seen in paragraph 2.2.. AlmavivA's expert stated that neither the company nor the Basin Authority reached out to the other[15], therefore this is left to further investigation of both actors.

Overall, "Water Scarcity" has been conceptualized to solve compelling issues for Regione Veneto, and it acts both on the correct legal basis and building up on the remarkable expertise of AlmavivA in building such a platform. Resulting from the meeting with both the SME for Agriculture and the Head of Geographic Information Systems (GIS) and Earth Observation Practice in which they pitched to me the PoC, it can be said that what as been developed so far works smoothly and efficiently. Apart from some minor errors caused by the lack of some data, the "Water Scarcity" GIS is today able to visualize the amount of precipitation by Municipality and by area, with the possibility to have on the same screen two time slots to graphically compare precipitation in different periods. The platform is also capable of graphically showing the water balance in an impactful way, highlighting critical areas, and with predictive potential. During the interview, the experts have been asked about how impactful this potential would be. They reported that after having interviewed Israeli specialists of the field, they found that the capacity of projection does not go further than one week/ten days with 90% success, and that if projections are made for one month this percentage would steadily go down. Furthermore, to have a window of time useful for intervention in the critical areas the prediction would be needed to be two or three months in advance. Therefore, by applying state-of-the-art predictive weather models, it is not possible to have a complete predictive weather model. Yet, less accurate expectations will be drawn by the algorithm on the basis of the 15 years history of the area already collected.

[15] Interview to Dr. M.C., Q1, 12 September 2023.

While the platform has never been tested externally[16], also because of the lack of several data that make the final output realistic and reliable[17], the function as shown in the interview if completed with the missing data would definitely support decision-makers like consortia and municipalities in taking appropriate measures.
All the functions not yet included in the PoC are devoted less space in this discussion, as most of them are dependent from the operations of Hydraulic Engineering required for the digitalization of the irrigation network and the analogue water quality assessment by area which could indeed unlock further functionality. As "Water Scarcity" is currently in the process of being expanded to a comprehensive One Health project, all the services that have been planned at first need to be upscaled in view of the other information that will be included in the project.
The data-driven decision-making, especially in the public sector, is to be handled with care. Indeed, the risk of a "tyranny of data" has been accounted for, if appropriate safeguards are not in place. That has been defined as the adoption of data-driven decision-making with a technocratic and top-down approach (Lepri et al., 2016). While AlmavivA's project is still in its early phases, such a risk needs to be brought in attention of Regione Veneto, in order for them to start preventing potential backlashes of the data-driven approaches like the lack of transparency, accountability and public participation. Figure 14 is a good starting point for this discussion, representing a summary of the requirements for a "positive data-driven disruption" (Lepri et al., 2016).

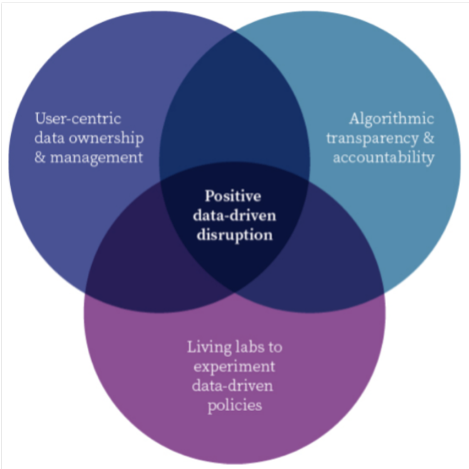

Figure 14. Lepri's Model for a positive data-driven disruption.

For example, in cases of extreme shortages, decision makers could establish that water should be rationed for agriculture, livestock, industries or even human population. If such an important measure is taken on the basis of an information deriving from an algorithm, the recipients should be entitled to know why they have been targeted and have redress mechanisms in place. Transparency and participation are also fundamental characteristics to establish trust towards the decision maker.
As it has been mentioned multiple times in this Dissertation, the project "Water Scarcity", as it has been thoroughly described, is currently not implemented as a whole and it is working just as a Proof of Concept. While being a deeply complex project, as mentioned in paragraph 3.1., "Water Scarcity" is just the first step

[16] Interview to Dr. M.C., Q2, 12 September 2023.
[17] Interview to Dr. M.C., Q5, 12 September 2023.

towards a data-driven integrated management of many aspects of human, animal and ecosystems health, achieving a comprehensive “One Health - One Earth” approach. Recently, AlmavivA agreed with Regione Veneto to gradually extend the scope of the water project to have a platform that assimilates very different datasets and that will leverage the human knowledge of interconnections between various factors with the ultimate aim of promoting the overall health of life on Earth. The main variables that are intensely interconnected and that have strong impacts on the latter have been identified as air, water and soil. A broad understanding of this and their interactions could unlock the power of data in favor of knowledge that can be used, for instance for prevention. Quoting the interview with Dr. M.C.:

“*While the Proof of Concept of the “Water Scarcity” project has been reimbursed, it is not yet under development as it was agreed that it was better to expand the domain of "Water Scarcity" to include all the features that would make it a broader and more structural One Health project by including health, air quality and disease management. In the notion of One health all these subjects are connected, as it is a peculiarity of One Health projects to process and integrate very different information. For example particulate matter, the waste product of diesel fuel, is scientifically proven to cause lung disease. The same particles also cause strokes. It has been correlated that these particles, specifically* $PM_{2.5}$ *and* PM_{10}*, in combination with high temperatures facilitate the occurrence of strokes, as the latter increases the permeability of blood vessels. One health software would have all the data (air quality and temperature, geolocated) to combine the factors to do prevention or take other actions to prevent this*.”[18]

Following this example, one can imagine the potential that data integration can have (e.g. water and soil, agriculture and humans, etc…). Nonetheless, the path to have such a system in place is still long and complex, also because other parameters need to be assessed to address the health of humans, for example. Indeed, human health and welfare is not only reliant on “natural” features, but also social and economic aspects which make their life better and healthier. AlmavivA is already considering how to include this in the development of decision-making scenarios: “*The model will also take into account socio-economic impact, as it allows for visualization, after anonymization, of how many employees a given business has. Perhaps data from the Chamber of Commerce will also be integrated. [...] Socioeconomic Impact must also be taken into account: if there are cuts in water consumption for industry, it must be considered how many workers end up laid off*.”[19].

The fruitful partnership of the company with Regione Veneto is already being recognized by other regions which have shown interest in the “One Health – One Earth” approach. Regione Lombardia, as also shown by in Figure 6 has been hit by a drought in a way similar to Veneto, and is already in contact with AlmavivA. The project, already in its extended version, has been presented to the Councilor for Agriculture, and after a reflection period they have also commissioned the realization of this service.

---

[18] Interview to Dr. M.C., Q7, 12 September 2023.
[19] Interview to Dr. M.C., Q5, 28 August 2023.

6. Concluding remarks

Water is an essential element for life, and it is a valid point to start from if one wants to develop a One Health project which, unlikely most similar ones, is more oriented towards the monitoring of the environmental side of the interconnections among humans, animals and ecosystems. The data-driven approach is becoming a widespread way of leveraging availability of different types of data to achieve a new type of knowledge, very often used to automate operations and support decision-making. As One Health is too often focused on zoonotic in the literature, it is hard to find projects comparable to the case study of this Dissertation, which aim at the combination of both a data-driven and a One Health approach with an environmental focus, in particular in the water sector.

The project analyzed in this Dissertation arises from the urgency of a severe drought that brought Regione Veneto first, and then Italy as a whole, to declare the state of water crisis. An unprecedented drought calls for the taking of extraordinary measures, and the various functions of "Water Scarcity" all have one ultimate purpose: having more water availability. The project does so in multiple ways, mainly focusing on agriculture irrigation, but also supporting infrastructural improvements, effectively reducing costs for both public authorities and farmers themselves. Moreover, it does aggregate data that are mostly already public, limiting the opportunity costs of having to publish data without exploiting their potential.

Although the legislative framework described in this thesis is not predominant, diving into it has been crucial as it both defined the sandbox in which AlmavivA has been experimenting and it has worked as a guideline to discover critical points of intervention for "Water Scarcity", calling for additional services of the platform. When fully implemented, some functionalities will eventually be able not only to optimize water use, but also finally cancel long-standing EU legislation infringements.

"Water Scarcity" is a project born from the compelling need to optimize water management, and is now being converted into a fully-fledged One Health approach. Thus, beginning to work from one single parameters of the three identified by AlmavivA that need to be monitored to prevent climate and environmental risks – water, air and soil – constitutes a good starting point in view of their ultimate goal.

Public administration of both Veneto and Lombardia have already invested in this project, which undoubtedly could have many clients and investors already in its early "Water Scarcity" stage, at first in Italy and perhaps later also abroad. It is indeed a project with elevated expectations and, as seen above, with its adversities, which requires both time and cross-cutting efforts to be realized. Yet, if timely realized, could turn out to be a precious ally in the fight against the climate crisis.

Bibliography

AlmavivA. (2023). *Rural2Digital*. Almaviva. https://www.almaviva.it/it_IT/Agricoltura_Rural-to-Digital

Andrews, L. (2019). Public administration, public leadership and the construction of public value in the age of the algorithm and 'big data.' *Public Administration*, *97*(2), 296–310. https://doi.org/10.1111/padm.12534

Battilani, A., Ruberto, M., Baralla, S., Zucaro, R., Truglia, C., & Gargano, M. (2023, July 8). *POLITICHE DI PREZZO PER L'ACQUA IN AGRICOLTURA: QUANTIFICAZIONE DEI VOLUMI PER L'APPLICAZIONE DELLA TARIFFA VOLUMETRICA*. https://www.anbi.it/art/articoli/7564-politiche-di-prezzo-per-l-acqua-in-agricoltura-quantificazio

Benenati, C. (2023, February 14). *Siccità, è già allarme in Pianura Padana. Gli esperti: Il deficit di acqua è del 35% rispetto all'ultimo decennio*. La Stampa. https://www.lastampa.it/cronaca/2023/02/14/news/siccita_italia_dati-12642715/

Brocardi. (n.d.). *Art. 822 codice civile—Demanio pubblico*. Brocardi.it. Retrieved September 16, 2023, from https://www.brocardi.it/codice-civile/libro-terzo/titolo-i/capo-ii/art822.html

Bronzwaer, S., Geervliet, M., Hugas, M., & Url, B. (2021). EFSA's expertise supports One Health policy needs. *EFSA Journal*, *19*(5). https://doi.org/10.2903/j.efsa.2021.e190501

Broomfield, H., & Reutter, L. (2021). Towards a Data-Driven Public Administration: An Empirical Analysis of Nascent Phase Implementation. *Scandinavian Journal of Public Administration*, *25*(2), 73–97. https://doi.org/10.58235/sjpa.v25i2.7117

Calleri, S. (2021, January 13). *Le procedure di infrazione europea a carico dell'Italia in materia di acque | SNPA - Sistema nazionale protezione ambiente*. https://www.snpambiente.it/2021/01/13/le-procedure-di-infrazione-europea-a-carico-dellitalia-in-materia-di-acque/

Cederberg, C., & Sonesson, U. (2011). *Global food losses and food waste: Extent, causes and prevention; study conducted for the International Congress Save Food! at Interpack 2011, [16 - 17 May], Düsseldorf, Germany* (J. Gustavsson, Ed.). Food and Agriculture Organization of the United Nations.

Charles, V., Rana, N. P., & Carter, L. (2022). Artificial Intelligence for data-driven decision-making and governance in public affairs. *Government Information Quarterly*, *39*(4), 101742. https://doi.org/10.1016/j.giq.2022.101742

Chartzoulakis, K., & Bertaki, M. (2015). Sustainable Water Management in Agriculture under Climate Change. *Agriculture and Agricultural Science Procedia*, *4*, 88–98. https://doi.org/10.1016/j.aaspro.2015.03.011

Chengalur-Smith, I. N., Ballou, D. P., & Pazer, H. L. (1999). The impact of data quality information on decision making: An exploratory analysis. *IEEE Transactions on Knowledge and Data Engineering*, *11*(6), 853–864. https://doi.org/10.1109/69.824597

Coldiretti. (2012, April 17). Via alla trattativa sulle tariffe idriche, serve tutelare le aziende agricole. *Il Punto Coldiretti*. https://www.ilpuntocoldiretti.it/attualita/via-alla-trattativa-sulle-tariffe-idriche-serve-tutelare-le-aziende-agricole/

Devos, Y., Arena, M., Ashe, S., Blanck, M., Bray, E., Broglia, A., Bronzwaer, S., Cafaro, A., Corsini, E., Dujardin, B., Dumont, A. F., Garcia, M. G., Gardi, C., Guerra, B., Kass, G. E. N., Maggiore, A., Martino, L., Merten, C., Percivaldi, C., … Hugas, M. (2022). Addressing the need for safe, nutritious and sustainable food: Outcomes of the "ONE – Health, Environment & Society – Conference 2022″. *Trends in Food Science & Technology*, *129*, 164–178. https://doi.org/10.1016/j.tifs.2022.09.014

Douglas Heaven, W. (2020). *Predictive policing algorithms are racist. They need to be dismantled.* MIT Technology Review. https://www.technologyreview.com/2020/07/17/1005396/predictive-policing-algorithms-racist-dismantled-machine-learning-bias-criminal-justice/

Duff, R., & Lenox, M. J. (2019). *Path to 2060: Decarbonizing the Agriculture Industry*. https://www.researchgate.net/publication/336035735_Path_to_2060_Decarbonizing_the_Agriculture_Industry?enrichId=rgreq-961dafeb5802324c7fc61fecfce99185-XXX&enrichSource=Y292ZXJQYWdlOzMzNjAzNTczNTtBUzo4MDcwNzg4MDk1NzEzMjlAMTU2OTQzMzk5MTg3MQ%3D%3D&el=1_x_3&_esc=publicationCoverPdf

Elijah, O., Rahman, T. A., Orikumhi, I., Leow, C. Y., & Hindia, M. H. D. N. (2018). An Overview of Internet of Things (IoT) and Data Analytics in Agriculture: Benefits and Challenges. *IEEE Internet of Things Journal*, *5*(5), 3758–3773. https://doi.org/10.1109/JIOT.2018.2844296

Eslamian, S., & Eslamian, F. A. (Eds.). (2016). *Handbook of drought and water scarcity*. CRC Press.

European Commission. (2011). *Roadmap to a Resource Efficient Europe*.

European Commission. Joint Research Centre. (2023). *Drought in northern Italy March 2022: GDO analytical report.* Publications Office. https://data.europa.eu/doi/10.2760/781876

FAO. (2019). *World fertilizer trends and outlook to 2022*.

FAO Statistics Division. (2023). *Pesticides use and trade, 1990–2021*.

Frank, S., Havlík, P., Soussana, J.-F., Levesque, A., Valin, H., Wollenberg, E., Kleinwechter, U., Fricko, O., Gusti, M., Herrero, M., Smith, P., Hasegawa, T., Kraxner, F., & Obersteiner, M. (2017). Reducing greenhouse gas emissions in agriculture without compromising food security? *Environmental Research Letters*, *12*(10), 105004. https://doi.org/10.1088/1748-9326/aa8c83

Friha, O., Ferrag, M. A., Shu, L., Maglaras, L., & Wang, X. (2021). Internet of Things for the Future of Smart Agriculture: A Comprehensive Survey of Emerging Technologies. *IEEE/CAA Journal of Automatica Sinica*, *8*(4), 718–752. https://doi.org/10.1109/JAS.2021.1003925

Fukase, E., & Martin, W. (2020). Economic growth, convergence, and world food demand and supply. *World Development*, *132*, 104954. https://doi.org/10.1016/j.worlddev.2020.104954

Giannoccaro, G., Zanni, G., & Prosperi, M. (2008, June). *Politiche di tariffazione idrica per un utilizzo efficiente dell'acqua in agricoltura | Agriregionieuropa*. https://agriregionieuropa.univpm.it/en/content/article/31/13/politiche-di-tariffazione-idrica-un-utilizzo-efficiente-dellacqua-agricoltura

Harrison, T. M., & Luna-Reyes, L. F. (2022). Cultivating Trustworthy Artificial Intelligence in Digital Government. *Social Science Computer Review*, *40*(2), 494–511. https://doi.org/10.1177/0894439320980122

Il Post. (2023, May 4). *Nicola Dell'Acqua è stato nominato commissario contro la siccità*. Il Post. https://www.ilpost.it/2023/05/04/nicola-dellacqua-commissario-siccita/

IlPuntoColdiretti. (2022, July 11). Il Piano invasi di Coldiretti e Anbi "conquista" il Governo. *Il Punto Coldiretti*. https://www.ilpuntocoldiretti.it/attualita/economia/il-piano-invasi-di-coldiretti-e-anbi-conquista-il-governo/

Janssen, M., Brous, P., Estevez, E., Barbosa, L. S., & Janowski, T. (2020). Data governance: Organizing data for trustworthy Artificial Intelligence. *Government Information Quarterly*, *37*(3), 101493. https://doi.org/10.1016/j.giq.2020.101493

Janssen, M., Matheus, R., & Zuiderwijk, A. (2015). Big and Open Linked Data (BOLD) to Create Smart Cities and Citizens: Insights from Smart Energy and Mobility Cases. In E. Tambouris, M. Janssen, H. J. Scholl, M. A. Wimmer, K. Tarabanis, M. Gascó, B. Klievink, I. Lindgren, & P. Parycek (Eds.), *Electronic Government* (Vol. 9248, pp. 79–90). Springer International Publishing. https://doi.org/10.1007/978-3-319-22479-4_6

Joint Research Centre, & European Commission. (2023). *Drought in Europe: June 2023 : GDO analytical report.* Publications Office. https://data.europa.eu/doi/10.2760/575433

Kurylyk, B. L., & MacQuarrie, K. T. B. (2013). The uncertainty associated with estimating future groundwater recharge: A summary of recent research and an example from a small unconfined aquifer in a northern humid-continental climate. *Journal of Hydrology*, *492*, 244–253. https://doi.org/10.1016/j.jhydrol.2013.03.043

Lepri, B., Staiano, J., Sangokoya, D., Letouzé, E., & Oliver, N. (2016a). *The Tyranny of Data? The Bright and Dark Sides of Data-Driven Decision-Making for Social Good* (arXiv:1612.00323). arXiv. http://arxiv.org/abs/1612.00323

Lepri, B., Staiano, J., Sangokoya, D., Letouzé, E., & Oliver, N. (2016b). *The Tyranny of Data? The Bright and Dark Sides of Data-Driven Decision-Making for Social Good* (arXiv:1612.00323). arXiv. http://arxiv.org/abs/1612.00323

Liu, Y., Ma, X., Shu, L., Hancke, G. P., & Abu-Mahfouz, A. M. (2021). From Industry 4.0 to Agriculture 4.0: Current Status, Enabling Technologies, and Research Challenges. *IEEE Transactions on Industrial Informatics*, *17*(6), 4322–4334. https://doi.org/10.1109/TII.2020.3003910

Magnarelli, M. (2022a). *I CONTRATTI DI FIUME NEL SISTEMA DI GESTIONE E TUTELA DELLE ACQUE. NATURA GIURIDICA E FUNZIONI*. Università degli studi di Milano. https://air.unimi.it/handle/2434/972989

Magnarelli, M. (2022b). *I CONTRATTI DI FIUME NEL SISTEMA DI GESTIONE E TUTELA DELLE ACQUE. NATURA GIURIDICA E FUNZIONI*. Università degli studi di Milano.

Maino, G. (2022, June 16). Preparedness and collaboration from a One Health perspective. *Secondo Welfare*. https://www.secondowelfare.it/primo-welfare/sanita/preparedness-and-collaboration-from-a-one-health-perspective/

Matheus, R., Janssen, M., & Maheshwari, D. (2020). Data science empowering the public: Data-driven dashboards for transparent and accountable decision-making in smart cities. *Government Information Quarterly*, *37*(3), 101284. https://doi.org/10.1016/j.giq.2018.01.006

Means, T. (2023, May 11). *Climate change and droughts: What's the connection? » Yale Climate Connections*. Yale Climate Connections. http://yaleclimateconnections.org/2023/05/climate-change-and-droughts-whats-the-connection/

Misra, A. K. (2014). Climate change and challenges of water and food security. *International Journal of Sustainable Built Environment*, *3*(1), 153–165. https://doi.org/10.1016/j.ijsbe.2014.04.006

Molle, F., & Berkoff, J. (2007). Water pricing in irrigation: The lifetime of an idea. In F. Molle & J. Berkoff (Eds.), *Irrigation water pricing: The gap between theory and practice* (1st ed., pp. 1–20). CABI. https://doi.org/10.1079/9781845932923.0001

Ntoutsi, E., Fafalios, P., Gadiraju, U., Iosifidis, V., Nejdl, W., Vidal, M., Ruggieri, S., Turini, F., Papadopoulos, S., Krasanakis, E., Kompatsiaris, I., Kinder-Kurlanda, K., Wagner, C., Karimi, F., Fernandez, M., Alani, H., Berendt, B., Kruegel, T., Heinze, C., … Staab, S. (2020). Bias in data-driven artificial intelligence systems—An introductory survey. *WIREs Data Mining and Knowledge Discovery*, *10*(3), e1356. https://doi.org/10.1002/widm.1356

OHHLEP. (2022). *One Health Joint Plan of Action, 2022–2026*. FAO; UNEP; WHO; World Organisation for Animal Health (WOAH) (founded as OIE); https://doi.org/10.4060/cc2289en

OHHLEP, Adisasmito, W. B., Almuhairi, S., Behravesh, C. B., Bilivogui, P., Bukachi, S. A., Casas, N., Cediel Becerra, N., Charron, D. F., Chaudhary, A., Ciacci Zanella, J. R., Cunningham, A. A., Dar, O., Debnath, N., Dungu, B., Farag, E., Gao, G. F., Hayman, D. T. S., Khaitsa, M., … Zhou, L. (2022). One

Health: A new definition for a sustainable and healthy future. *PLOS Pathogens*, *18*(6), e1010537. https://doi.org/10.1371/journal.ppat.1010537

Paoloni, M. (2022, June 21). *Siccità: Perso 89% acqua piogge, subito piano invasi*. Coldiretti. https://www.coldiretti.it/economia/siccita-perso-89-acqua-piogge-subito-piano-invasi

Regione Veneto. (2022, Luglio). *Comunicato n°1595*. https://www.regione.veneto.it/web/guest/article-detail?articleId=13631389

Regione veneto. (2023). *SICCITA'. ASSESSORI CANER E BOTTACIN INCONTRANO A PALAZZO BALBI A VENEZIA I CONSORZI DI BONIFICA E ANBI VENETO*. https://www.regione.veneto.it/web/guest/article-detail?articleId=13739607

Russo, G. (2014). *56 Il ruolo dei Consorzi di Bonifica nella difesa del suolo e nella tutela del Vincolo Idrogeologico*. *2*.

Servizio Studi del Senato. (2021). *TUTELA DELL'AMBIENTE IN COSTITUZIONE*. Senato della Repubblica Italiana. https://www.senato.it/service/PDF/PDFServer/BGT/01299303.pdf

Stahl, K., Kohn, I., Blauhut, V., Urquijo, J., De Stefano, L., Acácio, V., Dias, S., Stagge, J. H., Tallaksen, L. M., Kampragou, E., Van Loon, A. F., Barker, L. J., Melsen, L. A., Bifulco, C., Musolino, D., de Carli, A., Massarutto, A., Assimacopoulos, D., & Van Lanen, H. A. J. (2016). Impacts of European drought events: Insights from an international database of text-based reports. *Natural Hazards and Earth System Sciences*, *16*(3), 801–819. https://doi.org/10.5194/nhess-16-801-2016

Stocker, T. F., Dahe Qin, Plattner, G.-K., Tignor, M. M. B., Allen, S. K., Boschung, J., Nauels, A., Xia, Y., Bex, V., & Midgley, P. M. (2014). *Climate Change 2013 – The Physical Science Basis: Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Vol. 9781107057999). Cambridge University Press. https://doi.org/10.1017/CBO9781107415324

TGR Piemonte, tgr. (2023, May 3). *Coldiretti: Con invasi piogge avrebbero messo al sicuro stagione*. RaiNews. https://www.rainews.it/tgr/piemonte/articoli/2023/05/coldiretti-con-invasi-piogge-avrebbero-messo-al-sicuro-stagione-3e469e39-081b-4ba6-84df-c7fe16d951ed.html

UN. (2015). *THE 17 GOALS | Sustainable Development*. https://sdgs.un.org/goals

United Nations. (2022). *World Population Prospects 2022*. Department of Economic and Social Affairs. https://population.un.org/wpp/Publications/

Vanham, D., Bouraoui, F., Leip, A., Grizzetti, B., & Bidoglio, G. (2015). Lost water and nitrogen resources due to EU consumer food waste. *Environmental Research Letters*, *10*(8), 084008. https://doi.org/10.1088/1748-9326/10/8/084008

European Union Legislation

Treaty on the Functioning of the European Union

Framework Directive 2000/60/CE establishing a framework for Community action in the field of water policy.

Italian and Regional Legislation

Decreto-Legge 14 aprile 2023, n. 39. “Disposizioni urgenti per il contrasto della scarsita' idrica e per il potenziamento e l'adeguamento delle infrastrutture idriche”.

Piano Nazionale di Adattamento ai Cambiamenti Climatici, Dicembre 2022.

Ordinanza del Presidente della Giunta Regionale (Regione Veneto) n. 37 del 03 maggio 2022. “Carenza di disponibilità idrica nel territorio della Regione del Veneto”.

Legge Regionale (Regione Veneto) 08 maggio 2009, n. 12. “Nuove norme per la bonifica e la tutela del territorio”.

Decreto Legislativo 3 aprile 2006, n. 152. “Norme in materia ambientale”.

Legge 5 gennaio 1994, n. 36. “Disposizioni in materia di risorse idriche”.

Decreto del Presidente della Repubblica 24 luglio 1977, n. 616. Attuazione della delega di cui all'art. 1 della legge 22 luglio 1975, n. 382.

Regio Decreto 13 febbraio 1933, n. 215. “Nuove norme per la bonifica integrale”.

Regio Decreto 8 maggio 1904, n. 368 “che approva il regolamento per la esecuzione del testo unico delle leggi 22 marzo 1900 e 7 luglio 1902, nn. 195 e 333, sulle bonificazioni delle paludi e dei terreni paludosi”.

Codice Civile

Costituzione Italiana

Case Law

Corte Costituzionale, 10-26 Luglio 2002, Sentenza n. 407.

AlmavivA internal documents

AlmavivA. (2023a). *Manuale Tecnico Operativo: Calcolo Modello Idrico Zootecnico*.

AlmavivA. (2023b). *Manuale Tecnico Operativo: Modello Idrico Irriguo Agricolo*.

AlmavivA. (2023c). *One Health—One Earth: Un approccio innovativo*.

AlmavivA. (2023d). *Rural Smart Water Management*.

Annex 1. Interview to Dr. M.C. - 07/28/2023

Q1 - In what context was the project conceived? What is the state of the art of the project to date?

The One Health Project was initially implemented as a Proof of Concept (i.e., a working prototype but not complete, just with all the minimum functionalities) for the Veneto Region, while instead it was recently presented to the relevant Councillor of Regione Lombardia.

A1 - The PoC, which is used to understand the feasibility of the project, has already been delivered in Veneto, but the entire project would still take a couple of years to fully develop due to agreements with data providers and full platform development. For now, PoCs are inexpensive and serve to demonstrate that data collection and integration works. The PoC in Veneto, for example considers only corn and soybean crops, which amount to 80 percent of water use, not considering orchards and other crops. In Lombardia, the PoC is stuck as they are waiting for funding to move forward.

Q2 - What is the relationship with Regione Lombardia? Simple customers or a partnership?

A2 - Often these projects are included as part of other projects that have already started with the regions because otherwise things would be taken for a long time. So these collaborations are open.

Q3 - From what stimuli and needs emerges the need to have a project like Lombardia One Health?

A3 - Normally drought is characteristic of southern Italy and the Islands, and in the North they have never had this problem, as the higher rainfall, alpine snowfall, and the presence of permanent glaciers ensured that Venetian agriculture had 50/60% of the available water. These conditions to this day do not exist because of climate change, which has reduced rainfall (months without rain), it no longer snows and the permanent glaciers, which usually melt only below 3000m and gave a lower contribution above, are almost totally melted. So 50 to 60 percent is being lost, and this is a major water shortage never before experienced in the two regions. Another factor to consider is the rising of the saline wedge, a phenomenon whereby due to the low pressure of river water, sea water is able to overcome this pressure by entering the rivers, rising them and infiltrating into the aquifer. As a result, the groundwater becomes saline and no longer usable. While this has already happened in the Po for a substantial stretch of 20-30 km, recently and for the first time the phenomenon has been found in the Adige, causing great concern. In Lombardia, one alderman said they had in June filling of lakes (of which there are many and large in Lombardia) below 30-40% of capacity due to "climatic upheavals."

Q4 - Regarding data collection, how are the water needs categorized?.

A4 - Major freshwater consumption comes from: agriculture, industry, livestock, and population. Consequently, following abnormal drought periods due to climate change, the public administration is faced with important choices, which may go to limiting consumption in one or more of the 4 sectors as needed.

Limiting water use to the population is drastic; animal husbandry in Veneto and Lombardia is highly developed and employs many workers; the agricultural sector mainly raises corn and soybeans that serve as feed for livestock; the industrial sector also needs to produce and not put workers on layoff. So there is a need to understand how much usable water there is, the needs of the 4 sectors, and whether the balance is positive (i.e., water can meet all needs) or not.

AlmavivA created both an overall regional water model and four sub-models estimating the needs of the 4 sectors.

The information to know when calculating livestock requirements, for example, are: where the stables are, which animals they contain, whether they are dairy or beef (they have different consumption). In Lombardia, for example, there is a greater presence of cattle. Despite this, intensive turkey and chicken farms are still large consumers of fresh water. This information is public, because following the mad cow disease epidemic, all EU member states began to manage animal herds by collecting information, in our case through the ASLs. It is a public database, everything is known, and each region has its own subset of the data in the Regional Zooprophylactic Institutes. Then these data are compared with the bibliography, which reports that, for example, "a dairy cow consumes x liters of water," and the livestock model is built.

Almaviva has been working with the agricultural sector for years and knows all the public databases also for agriculture and what they produce. In this case it is more complicated to calculate consumption: it depends on rainfall distribution, temperature (the hotter it is the more water evaporates), etc... Therefore, complex models of Potential Evotranspiration have been developed where based on temperature, wind, irrigation, water table, the week-by-week requirements are worked out. So not only is there a need for producer and crop data, but meteorological data are also needed. The latter are reported by ARPA, and the other data by the so-called "paying agencies": AVEPA in Veneto and OPLO in Lombardia are organizations that pay for EU agricultural supports (CAP), and to receive supports you have to justify saying what you are going to grow and where, and these data are also geo-referenced and public.

So, public data to support the necessary technical models already exist, but they are vertical and not integrated. Without public data, this project would never have been possible. So also by leveraging collaboration with the region, it is possible to collect this data. The data flow is being structured and automated. Collecting data in the field is feasible but would take an unlikely amount of time.

Q5 - What is the ultimate purpose of data collection?

A5 - The first step is to integrate the data: in the region the data are already there, but fragmented in the different offices. So you place all the information layers you need on a GIS, making it visualize by selecting the relevant layers. The model also takes into account socio-economic impact, as it allows for visualization, after anonymization, of how many employees a particular activity has. Perhaps data from the Chamber of Commerce will also be integrated.

The second step is to show patterns of water consumption and availability. For example, water consumption for animal husbandry in a certain area, etc....

Models of can be viewed separately or together compared with total availability.

The project provides the decision support system. The decisions that the software is intended to support are policy decisions of the relevant Councillor.

For example, chicken and turkey farms are defined as "empty-empty." Farms buy 20 thousand chicks, fatten them, and slaughter them all; afterwards they sanitize, therefore leave empty, and buy the chicks back. What can happen is that because they consume so much water, the region can incentivize these large water consumers to stop production in times of crisis by supporting them with a payment.

Socioeconomic Impact must also be taken into account: if there are cuts in water consumption for industry, it must be considered how many workers end up laid off.

Q6 - What are the challenges of data integration?

A6 - For example, ARPA data is open data, in xls format, and therefore not dynamic in that it does not update over time. What will be attempted in the future is to write API interfaces that download the data automatically and process it.

In addition, with regard to all data from companies that consume fresh water, it is not necessary to know who owns it, OPLO data for example should be anonymized: to do this there needs to be an agreement that allows this type of use with the relevant agencies, and this can take time.

Ultimately, it is necessary to implement a data flow, possibly an automated one, that allows the integration of all the different data in real time.

Q7 - Is this a replicable system?

A7 - The system is exactly replicable because the data is common in all regions, the formats may change, but those have to be conformed.

Interview to Dr. M.C. - 12/09/2023

Q1 - The Drought Decree (Art. 11 c.2.) obliges all authorities dealing with water (administrations, agencies, reclamation consortia, water service management companies, etc...) to "make available continuously and in open format the data and information in their possession to the territorially competent District Basin Authority." Has consideration already been given to establishing relationships with the Basin Authorities in their new role as accumulators of information?

A1 - Basin Authorities have not been contacted, nor have they been interested in the project. Regardless, AlmavivA has already identified and is in contact with other entities to provide necessary data for the projects.

Q2 - Is the "Water Scarcity" project already operational and has it brought initial results? If yes, is it possible to obtain the progress of the project?

A2 - Proof of Concept is ready but not operational. It has never been externally tested. The "Water Scarcity" project for Regione Veneto lost hype because it was developed at a time of very severe water crisis, such that Regione Veneto set up a dedicated Commissioner. then it rained and went on to develop the One Health project, because there is a need for systemic water management anyway.

Q3 - Is the process of digitization of consortium networks and hydraulic modeling developed?

A3 - Depends on the consortium. Reclamation and irrigation consortia have dual purposes (there are 133 in Italy) . When it rains they take water away from the fields (hence, "consorzi di bonifica"), otherwise the fields flood. Consortia manage their own canals, have water-supply plants, operate dams, reservoirs, etc..... In the summer, on the other hand, they do irrigation, but only for agricultural use, because the water does not meet standards necessary for drinking or anything else. For example, they are not able to provide water for animal husbandry, because it has to maintain certain standards. Reclamation consortia also use wastewater.

A national project is underway for ANBI by AlmavivA where among many services is digitization of networks. To date, some have it others do not. Without digitization it is impossible to do modeling. The project aims at zoning, then doing hydraulic modeling using management software (moving water in a convenient way). There is already predominantly American management software that works very well on human use, city aqueducts (managing pressure, flow, availability, hydro valves, jumps, etc...). However, they too have management problems at times.

Q4 - What are the most innovative aspects of the project?

Most importantly, it is a data-driven project. The data exist and are already public, but they are not aggregated and analyzed, remaining inaccessible in a drawer. Taking the data and integrating it into the Veneto Data Platform (standardized, homogenized, and made comparable) could unlock so much potential. The problems are that each regionally directed entity collects them for its own uses (ARPA for ex for meteorological use only), without making them available. So for now the data must be retrieved manually (often they are excel files to be downloaded from public sites and re-uploaded into the platform).

Q5 - From the material I have available, it seems to me that there are substantial differences between the Proof of Concept done for Regione Veneto, which was more focused on irrigation management, and the project submitted to Regione Lombardia, which was presented as an all-round One Health project. Why the choice to present the projects slightly differently?

Considering human and industrial water consumption in a calculation is easy: human consumption can be found at ACEA-type utilities. For industry the same applies. Unfortunately, in Veneto these two types of data are not yet made available, but AlmavivA is working on this. Of course, for industries a more complicated model was thought of because they were classified on the basis of water consumption. The proposal submitted to Regione Lombardia was focused on the agricultural and livestock part because water criticalities had emerged (lakes at 50 percent capacity).

Q6 - Could you tell me some normative references that I have not cited in the thesis so far?

A6 - We are in EU infringement with the EU because water is measured not in quantity, as required by the EU, but farmers pay for water on an estimate. Let me explain better: we often use flow or submerged irrigation systems in Italy. In these cases there is a professional figure, the *acquaiolo*, who is in charge of raising canal bulkheads for example for 2 hours. So water from the canal flows into the field, and the payment is estimated on the basis of time and not the precise amount of water. Consequently we are in violation because water is measured "fiscally" and not quantitatively. Smart bulkheads exist, but converting the entire Lombard agricultural system from manual to digital would require a huge economic effort.

In addition, since water is managed on a rotational basis, it is not uncommon for some farmers to force bulkheads or go with motor pumps to bring water that is not available to them to their fields. This is without considering the problems of lateral infiltration, as irrigation consortia canals are often simply made of earth. One way to catch these individuals is to check with satellite, based on the rota and soil characteristics, what the soil moisture levels should be and compare this value with the current value. In this way it is easy to verify

Q7 - What are the goals that AlmavivA has set out to achieve?

A7 - In developing the project, Regione Veneto put AlmavivA to the test a lot. When the "Water Scarcity" solution was presented to Regione Veneto, they were amazed as the work done was impressive and important. AlmavivA's many years of expertise in the domain not only of agriculture and hydraulics, but of developing integrated data-driven services. This first conception of a project has been reimbursed, but it is not yet under development as it was agreed that it would be better to expand the domain of "Water Scarcity" to include all the features that would make it a broader and more structural One Health project by including sanitation, air quality and disease management. In the One health concept all these subjects are connected. The peculiarity of One Health projects is to process and integrate information. For example, particulate matter, the waste product of diesel fuel, is scientifically proven to cause lung disease. The same particles also cause strokes. It has been correlated that these particles (pm2.5 pm10) along with high temperatures facilitate the occurrence of stroke, as it increases the permeability of blood vessels. One health software would have the data (air quality and temperature, geolocated) to combine the factors to do prevention or otherwise.

Q8 - And how long will the implementation of a comprehensive One Health project take for Regione Lombardia?

A8 - AlmavivA's goals are to conclude the project planning within the year, and implement it within 2 to 3 years. For now, in the case of the Proof of Concept of "Water Scarcity" the data (all public) are collected by hand, not automatically. To fully have all the functions of a One Health project there is a need to automate the data flow so that the algorithm can return results.