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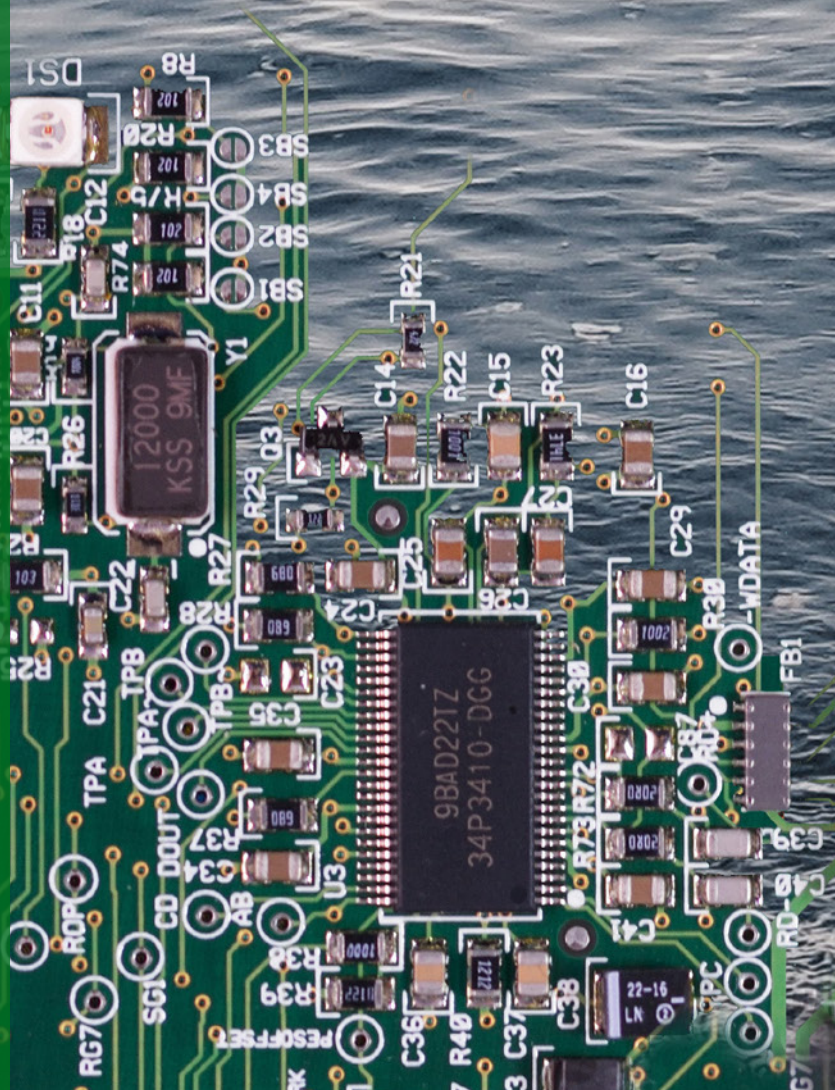
Knowledge in Action
for Urban Equality

The co-production of the Metropolitan Water Observatory (MWO) platform

By Andrea Jimenez,
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Cover image

Merging
The cover image represents the coming together of water and data in the same way these issues are merged in the context of Lima within this KNOW Working Paper

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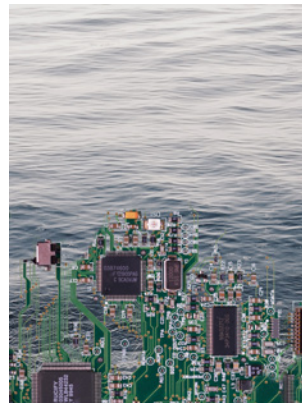
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Abstract

This working paper examines the development and design of the Observatorio Metropolitano de Agua para Lima-Callao (MWO): a co-produced digital observatory for water and data justice. The metropolitan city of Lima and Callao (hereafter referred to as Lima) faces a water security challenge, which results from the combination of scarce water resources with inefficient and unequal distribution. The lack or limited water access has been a crucial factor shaping inequality patterns in the city. Amongst the challenges for improving water distribution are the difficulties around mapping water needs and the lack of adequate and comprehensive data for all citizens since a significant part of the population is excluded from formal government datasets. Those living in subservice areas, who do not have access to administrative or political structures, and migrants are examples of such exclusion from formal government sources for evidence-based policy and implementation. The purpose of the MWO is to contribute to a fairer distribution of water resources amongst urban residents within Lima. By combining collaborative design approaches with the theory-informed data justice guidelines, we have developed a prototype of the MWO with participants from three districts in Lima. The MWO aims to challenge the hegemonic representation of Lima's water infrastructure and help communicate the experiences and views of residents currently overlooked. In addition, the MWO teaches us how to design digital platforms according to the principles of data justice in practice.

1.   INTRODUCTION

Expanding megacities like Lima face water challenges due to scarce water resources and inefficient and unequal distribution (Ioris, 2012; Miranda Sara & Baud, 2021). Water security threats are increasing and playing a significant role in shaping inequality patterns (Hoefsloot, Martínez & Pfeffe, 2022a). Much of this situation is due to governance challenges associated with mapping water needs and improving equalitarian distribution. There is a lack of adequate and comprehensive data for all citizens, as a significant portion of the population is excluded from formal government datasets such as the municipal cadaster and SEDAPAL's supervisory control and data acquisition system. People living in areas where administrative or political structures are unavailable (e.g., migrants[1], minorities groups) are examples of those excluded from formal government sources for evidence-based policy and implementation (Priestley & Grammenos 2021).

In this context, this project aims to contribute to a more equitable distribution of water resources among urban residents by collecting and disseminating data on access to, quantity, and quality of water for human consumption in the Lima and Callao metropolitan areas. This is sought through the co-creation of a digital, collaboratively developed platform called the Metropolitan Water Observatory (MWO). The MWO aims to collect and share data about water access and practises in Lima-Callao, Peru, to (1) raise awareness about water inequalities and (2) mobilise efforts with public institutions and policymakers about the opportunities and challenges that such data and knowledge can create.

The project involved a participatory consultation process with citizens from three districts of Lima between December 2019 and July 2021 to get a better understanding of how to co-produce an online platform that brings together existing formal sources of data about the connection and consumption of water with citizens' perspectives and data, as well as their challenges. In this regard, the MWO aims to be a one-of-a-kind digital platform that engages with current hegemonic and counter-hegemonic data representations of Lima's waterscape.

The MWO is co-produced with participants by jointly determining the key areas to report, monitor, analyse, visualise, and disseminate, as well as jointly identifying and agreeing on a set of - minimum but strategic - indicators to collect. The platform will also allow us to promote actions of political influence on strategic issues such as the right to water. Both the design of the platform, as well as the engagement with relevant organisations, are informed by a conceptual framework that acknowledges the importance of data justice and water justice as intertwined, overlapping dimensions (Vera et al., 2019).

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This project contributes towards the objectives of Knowledge in Action for Urban Equality (KNOW) by building an understanding of the ways in which co-production processes for digital platforms can be conducive towards urban equality while also highlighting the challenges linked to these approaches.

This report is organised as follows: we begin with a discussion of the literature on water justice in the context of urban equality. Section 3 introduces the notion of participatory data science, followed by our co-design process in Section 4, where we present the prototype of the MWO. We conclude this report by discussing reflections about the process so far, the MWO's future and the challenges that lie ahead.

2.   WATER JUSTICE AND URBAN EQUALITY

Water has been regarded as a monetary resource with technocratic and strategic political significance (Ioris, 2012). Governments increasingly see data and digital technologies as a priority in addressing the many social and environmental challenges for water management and service provision (Daigger, Voutchkov, Lall, & Sarni, 2019). Digital tools such as urban dashboards, digital observatories and indicator systems are used for integrating multiple data sources and visualisations to assist governments, citizens, and businesses in making decisions (Kitchin, Lauriault, & McArdle, 2015; Mattern, 2015). These digital technologies serve to inform planning, increase transparency in policy-making, and inspire future scenarios for the city (Valenzuela-Montes & Carvalho-Cortes Silva, 2015).

1

According to ENPOVE, 57% of Venezuelans live in overcrowded conditions, with more than three people sleeping in the same room. Regarding access to services infrastructure, although no aggregate effects are observed, the increase in the Venezuelan population could be putting pressure on demand at the district, as in the case of access to water (World Bank 2019)

However, authors argue that there is a lack of feedback between government-led water management systems and society, which leads to inefficient water distribution models (Srinivasan et al., 2017). Many of these government-led digital tools collect data about the city using formal procedures, which means that the experiences of those living on the outskirts are frequently overlooked. As a result, skewed and incomplete data are used to inform ostensibly evidence-based policies, giving a false narrative of effectiveness and objectivity.

Additionally, digital tools present the city as if it can be assessed at one glance, portraying an image of objective and value-free knowledge of the city and urban flows (Lock, Bednarz, Leao, & Pettit, 2020). Yet, as Mattern (2021) writes, in reality, urban dashboards often obscure as much as they make visible, are non-transparent about the way that data is produced or used, and are grounded in positivist epistemologies. Also, many of these digital tools adopt extractive practices and create a tension in trying to collect data for policy-making on the one hand and contradicting the process in which that data is collected on the other (Vera et al., 2019).

> In urban areas, water justice acknowledges the ways in which marginalised groups are further disenfranchised by water scarcity and inequitable redistribution (Sultana 2018). The lack of access to water contributes to increased vulnerability to climate change, extreme weather events and political unrest, particularly affecting the most vulnerable groups of the population

These challenges are reflected in Lima's water authority's current data practices. The supervisory control and data acquisitions system (SCADA) - the main dashboard where all data about the operation of Lima's water distribution systems used by SEDAPAL is gathered and monitored - only visibilizes sections formalised and datafied (Hoefsloot, Richter, Martinez, & Pfeffer, 2022b). Furthermore, built to increase efficiency through the monitoring and supervision of water infrastructure, the SCADA system represents an economic approach to water as a scarce resource, rather than reflecting other conceptualisations of water as life or water as spiritual that co-exist in Lima and Peru as a whole (Calderón, 2000; Miranda Sara, 2021). In other words, the SCADA system, as a digital dashboard, represents a particular view of Lima's water infrastructure, being a valuable one as it helps monitor the operations and increase efficiency. Yet, at the same time, it reproduces inequalities in the system and does not represent other discourses to water governance or conceptualisations of water.

Rather than a technological solution, this situation requires a water justice approach. Water justice is a global water crisis response based on the principles of fairness, equity, participation, and justice. This approach responds to mainstream approaches to water scarcity, which are frequently based on market-driven approaches and technological solutions (Miranda Sara & Baud, 2021; Zwarteveen & Boelens, 2014). It entails a relational, situated, and context-sensitive approach that necessitates acknowledging that water scarcity is more an unequal distribution and power relations than a natural problem exacerbated by climate change and overpopulation (Sultana, 2018). Where more democratic and participatory approaches are proposed (for example, integrated water resources management- IWRM), a water justice lens reminds us that efficiency and sustainability-focused strategies can sometimes inadvertently lead to dispossession and displacement (Zwarteveen & Boelens, 2014).

In this regard, we follow Zwarteveen and Boelens (2014) and examine water justice from two perspectives that are frequently presented as being in tension: the urgency of finding solutions to metropolitan water scarcity and the fair process of ensuring everyone's perspectives are considered/included (Kumar, Pols, & Höffken, 2021; Miranda Sara & Baud, 2014). For this to happen, current water distribution regimes are questioned, recognising how they fail to capture plural perspectives and experiences (Zwarteveen & Boelens, 2014).

In urban areas, water justice acknowledges the ways in which marginalised groups are further disenfranchised by water scarcity and inequitable redistribution (Sultana 2018). The lack of access to water contributes to increased vulnerability to climate change, extreme weather events and political unrest, particularly affecting the most vulnerable groups of the population. Thus, water scarcity not only has detrimental health impacts but also becomes a structural factor that shapes urban inequality and people's resilience towards disruptions.

We agree with Zwarteveen and Boelens (2014), water is an "intrinsically contested resource" (p.149) that requires acknowledging multiple perspectives that shape the redistribution, recognition and participation. The MWO is envisioned as a bottom-up and participatory counterpart of SEDAPAL's SCADA system. Our approach is not to introduce a new digital tool for capturing objective knowledge that contributes to policy. We propose the development of a participatory and co-produced platform that provides alternative discourses and conceptualisations of the water distribution system, including people and experiences currently overlooked in formal, government-led digital systems.

3. PARTICIPATORY DATA SCIENCE

In addition to water justice, we follow a data justice lens. Data justice is defined as "fairness in the way people are made visible, represented and treated as a result of their production of digital data" (Taylor, 2017, p. 1), emphasises justice, as the datafication of society becomes a collective concern connected to broader patterns of injustice (Hintz et al. 2018). Data justice three pillars include visibility, engagement with technology and non-discrimination. Critically engaging with how we collect water data will aid in addressing water access disparities, providing evidence for better action for both citizens and government. In our view, data collection (and, more broadly, governance improvement) can only take place through a collaborative process in which citizens actively participate in co-creating a more inclusive and resilient water management system.

Importantly, the data justice framework enables us to recognise that the goal of data collection is not to produce 'objective' data but to acknowledge the need for balancing and integrating different discourses and experiences into data creation/ collection, as well as to seek autonomy and integrity. In the context of urban planning, it entails accepting that the city is always incomplete and in the process of being created (Amin & Thrift, 2017).

In addition to bringing to light people who are currently unnoticed, the MWO's collaborative design process allows residents to develop performance indicators for the water distribution system that are meaningful from the perspective of the water consumer rather than the water producer and distributor. This involved adopting a data justice approach, considering the principles of visibility, engagement and non-discrimination. More specifically:

Visibility: we show that it is possible to ensure that the platform would allow for people to input their own data and for them to be able to share their experiences. But this needed to be done in a way that also gave them the opportunity to have their data removed should they want to.

Engagement: we ensured that people were involved in the design of the platform, from what services the platform would have to what type of data would be collected. Moreover, it also was important that we would aim to ensure the MWO would contribute to a conversation about the challenges and opportunities with key stakeholders.

Non-discrimination: this means that the MWO contributes to the transparency about the data practices, from how data is collected to how it is used. This means that the MWO demonstrates that it is possible to have clear information about the data and provide users with the opportunity to download the data available.

4. COLLABORATIVE DESIGN OF THE MWO AND THE CREATION OF 'ESPACIOS DE CONCERTACIÓN'

Our methodological approach was informed by co-production and design of the platform through the iterative development and evaluation of the observatory, led by the participant's perceptions around water challenges and solutions. In the case of the MWO, we mainly focus on two users. First of all, the MWO is meant for Lima's residents (during our research, they were represented by residents from three selected neighbourhoods, as detailed below). Secondly, the MWO seeks to function as a tool for civil society organisations and/or administrative bodies in Lima to make informed decisions regarding water management and governance (represented by SEDAPAL, Lima Municipality, Professional associations and others). As detailed further below, both user groups have been involved in various phases of the design process.

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We had to pivot several times in the project and research design due to the onset of the pandemic and the resulting meeting and mobility restrictions. The initial structure of the activities presented here was sketched before the Covid-19 crisis. In December 2019, we started the participatory design process starting with an exploratory phase in which we conducted a series of focus groups to understand the main challenges that people faced and identified the primary focus of an 'Observatorio Metropolitano'. We managed to finish this phase of the research in February 2020, before Covid-19 crisis reached Peru.

The second phase, which focused on the platform's design in collaboration with residents from the three districts and civil society organisations, was postponed and redesigned. Covid-19 crisis caused a delay in the platform's development. Still, the transition from in-person to and online participatory design processes also provided important insights into the use of, and level of comfort with, digital technologies amongst communities from various socio-economic backgrounds and locations throughout the city. The main steps in the MWO's design are described in the following sections.

STAGE 1

December 2019-February 2020
Exploration and identification of main challenges

The goal of this stage in the research was to gain an in-depth understanding of the challenges that the residents of Lima face with regard to water security. We chose focus groups as they allow for collaborative brainstorming and to gather a broad range of perspectives. Through these focus groups, we aimed to identify the different types of knowledge already in use, how this knowledge is shared, and what the current knowledge gaps are.

We collaborated with residents from three districts representing different socio-economic realities in Lima: Jose Carlos Mariátegui, Barrios Altos, and Miraflores. José Carlos Mariátegui is a young peri-urban neighbourhood characterised by high degrees of poverty, vulnerability, and fragmented service provision (Jaime, Gallardo, Bernales, & Herndon, 2021). Residents often engage in collaborative work for community development and breaching the gap within the infrastructural provision. Concerning water infrastructure, this entails that much of the water infrastructure is still self-built and relies on the continuous labour of residents to operate, manage, and maintain the system.

The second neighbourhood, Barrios Altos, is part of the historical and commercial centre of Lima and houses the main commercial markets of the city. A large part of the population in Barrios Altos earns less than minimal income and lives in precarious housing (Jaime & Bernales, 2021). Although the majority of the households are connected to the formal water infrastructure, their connections are unreliable due to an overburdening of the system, frequent rupture due to a lack of maintenance, public investments, and a high degree of clandestine connections (ibid).

Thirdly, Miraflores is generally defined by its up-scale housing and for being the touristic centre of the city. Water service provision and water access and security are generally high in Miraflores. Nevertheless, residents often have constructed backup systems in case of maintenance work or an emergency interrupting the water delivery involving a tank below and on the roof of their houses or apartment building, keeping water stored in jerry cans, or even buying water pumps.

Jose Carlos Mariátegiu
Peri-urban
High degree of extreme poverty

Barrios Altos
Historical centre
Poor and middle class

Miraflores
Touristic centre
Upper-class

Figure 1
Aerial and street views images from Google Street View and Google Maps of the three research areas.
Figure source: Hoefsloot, Martínez, Richter and Pfeffer (2020).

In total, seven in-person focus groups were held before the pandemic: two rounds of focus groups with residents of each district and an additional focus group with youth. All focus groups were audio-recorded and transcribed. The results of the

> These conversations with residents pointed us to the large diversity in the experiences with the water distribution system - the physical infrastructure and the institutional system – and the participants' perceived influence on these dimensions.

focus groups were thematically analysed. A two-page report was written, which summarised the discussion in each focus group. These reports were shared with the participants and used as input for the next steps in the collaborative design of the MWO.

These conversations with residents pointed us to the large diversity in the experiences with the water distribution system - the physical infrastructure and the institutional system – and the participants' perceived influence on these dimensions. In José Carlos Mariátegui and Barrios Altos, where residents are highly involved in the construction and operation of the water systems in the area, participants mainly focussed on the issues hampering their daily water security. For example, participants expressed a need for easier application processes, formalisation of their water systems, transparency over metering and billing practices, and accurate information about breakage or construction work on the pipes.

In Miraflores, the conversations focussed on the macro-scale challenges faced by the water sector. The most significant issues concerning Lima's current and future water resources were the uncertain effects of climate change on the water sources and reserves; the lack of knowledge and transparency about the quality of water in the city; the knowledge of the residents of Lima concerning responsible water consumption; and the prevalence of corruption in Peru and it's the water sector.

Finally, as part of identifying what the main objective for the MWO should be, and how it is positioned in the wider water sector of Lima, we organized two expert meetings, one with engineers and researchers from SEDAPAL, and one with representatives of civil society organizations, research, and government. These expert meetings aimed to establish relations with relevant actors in the field and help pinpoint what the MWO can contribute to their ongoing work in the field of water management. The issues raised by the participants and experts informed the focus of the MWO and helped define the main features and indicators that had to be included in the design.

STAGE 2

February–March 2021
Defining indicators and features of the MWO

In the second stage of the project, we aimed to collaboratively design the platform. With the insights of the first phase regarding the main challenges that people experience, in this next stage, we wanted to work together to specify how the platform could support residents in improving these challenges. Hence, we moved from thinking about the challenges related to water security to discussing the platform's features, functionalities, and usage potential.

Due to Covid-19 lockdowns, this stage was conducted online using WhatsApp groups and Zoom. Particularly during the first months of the pandemic, we noticed that WhatsApp groups became popular and effective in the mobilisation of communities for environmental goals in Lima. Our considerations for using a particular software or platform have primarily been accessibility and ease for all participants. There was a large disparity amongst the groups regarding access to, and experience with, online conferencing amongst age and socio-economic groups. Since many residents in Jose Carlos Mariátegui and Barrios Altos only have easy access to the internet via their smartphones, we needed a platform that was accessible on those devices and which would not use too much data. Additionally, there was a variance in the participants' digital literacy depending on their educational background and age. This excluded the use of collaborative design software.

Before we began, we obtained ethical approval from the University of Sheffield, where we explained how we would obtain informed consent. To mitigate privacy risks, we made sure that all participants were aware of these issues before participating in the WhatsApp focus groups by calling everyone individually to explain the implications and rules of conduct for participating in this conversation. We specifically encouraged participants to share their ideas and information in ways they felt most comfortable with. All types of contributions, including written text, voice messages, videos and photos were welcomed.

The results of these conversations served as a starting point for the conceptualisation of what the MWO should become, what features it should have, and what goal it should serve. Additionally, they remain functioning as a sounding board group to collect potential feedback on the early prototype of the platform.

Nevertheless, discussing the platform's design entails a level of abstraction that we did not manage to reach via the WhatsApp chat. While people seemed to feel comfortable with sharing their thoughts or experiences about daily challenges regarding the water infrastructure, we did not receive many responses

to questions regarding the platform's design during the WhatsApp conversations. At that point, participation of residents was constrained to a consulting role rather than co-producers, and the design was not as collaborative as we had initially planned for.

To overcome this limitation, we organised a call participants from the three groups, where we evaluated existing urban observatory designs, identified strengths and weaknesses, and established which features should be most important in the design of the MWO. In doing so, the residents were able to contribute to formulating design principles for the MWO. We organised the recommendations from the conversations with participants from the three districts for the platform's functionalities and design into a table and classified them based on their importance in achieving the MWO's goals and their feasibility.
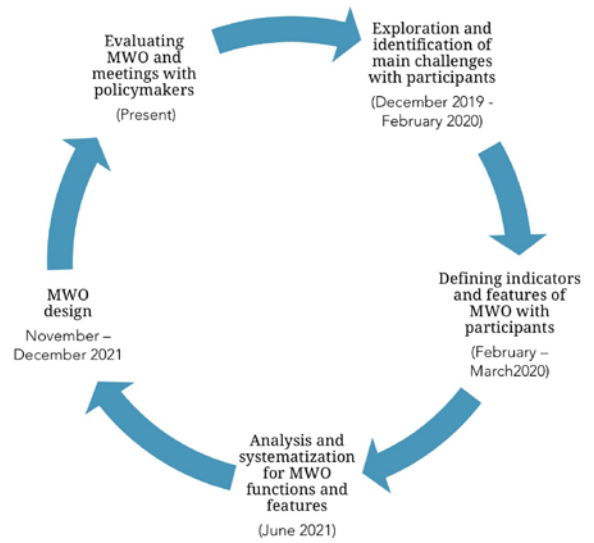

Figure 2
Stages cycle and dates. Source: By the Authors, (2022)

Knowledge/idea exchange	Visualisation and interface	Network building	Types of data
• Function to upload data on household water access. • Function to download (geo)data in different formats. • Forum or chat function and integration of social media platforms.	• An interactive map • Tables and figures that are easy to understand. • Should be a web app that is also accessible on a cell phone.	• Mapping civil society and communities organisations working on water issues in the Metropolitan region. • Work together with the water company and the regional water authority.	• Indicators focused on access, coverage, consumption, quality, and sustainability. • Collect experiences, testimonies, and visual data.

Table 1
Summary of requirements for the functionalities for the MWO, drawing from the online resident focus groups.

The MWO is designed to adhere to open science principles in order to increase transparency and openness in the collection and use of data about water distribution in Lima. To begin with, all data collected by the MWO can be downloaded in a variety of data formats, making it accessible to a wide range of users. Second, the MWO is based on open-source components (including geo- and database servers). Finally, the MWO's source code will be made open.

The platform (https://know.ncn.pe/#) works both on a laptop and a mobile device. There are many functionalities based on what our participants have told us they wanted. Some of the functionalities include those listed in the right box out.

- Storage of different types of GIS information (Georeferenced Information System).
- Public information is stored in a way that protects people's data. For example, instead of recording a person's exact address or location, it redistributes their geographic position with a buffer area of 20-50mtrs. An interactive map in which users can select which data and indicators are mapped, offering the opportunity to explore multiple datasets (e.g. daily consumption per district; meterless connections).
- Option to download the data in various file formats (.csv / .pdf / .geoJSON). Moreover, we include detailed information on how the data can be used can be used for different purposes.
- A chat option where users can exchange information.
- A social media section gathers posts from Twitter and Instagram, following key hashtags.
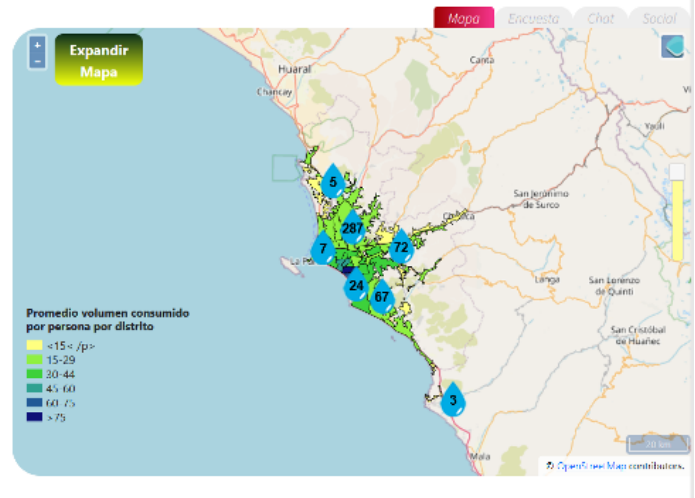
Figure 3
First prototype of the MWO web-platform <https://know.ncn.pe/#>

STAGE 3

December 2021 - Present
Discussions with governmental and civil society stakeholders

This final stage involved organising meetings with governmental and civil society stakeholders to present the initial prototype of the MWO and receive feedback on the effectiveness of its design and features. This also gave us an opportunity to ask them questions about the advantages and disadvantages of a platform like this and get a better understanding of what they considered contributes to water inequalities in Lima and how they can be fixed.

In doing so, we were enabling "espacios de concertacion", which involve "the validation (or contestation) of the knowledge of a variety of participating actors, and a highly sensitive and complex process of dialogue-negotiation-concertación-conflict management and consensus-building (or not)." (Miranda Sara & Baud, 2014). In this stage, we organised three meetings with representatives from three government institutions working on water issues. These meetings were held with the entire MWO team, including the platform's developer.

These meetings were beneficial in understanding how the MWO can assist theirs organisations in their work. Two of them explicitly stated their desire to support the MWO and collaborate with us. They see the MWO as a user-friendly platform that will provide citizens with relevant information that is simple to access and understand. They were especially interested in sharing information with MWO that would normally be difficult for them

This also gave us an opportunity to ask them [stakeholders] questions about the advantages and disadvantages of a platform like this and get a better understanding of what they considered contributes to water inequalities in Lima and how they can be fixed.

to communicate due to their complicated and formal websites. They also saw potential issues with the MWO, particularly with regard to potential misconceptions about the platform's role in taking over some of the work that these organisations are doing. They were concerned that there might be overlaps between what MWO was attempting to accomplish and some of the initiatives they already had in place. Furthermore, one of the representatives expressed concern about the implications of the data showing clear inequalities and how this could lead to even more social outrage in a city/country already struggling with various political and social crises.

5. REFLECTION AND FURTHER WORK

As we have now completed the design phase of the MWO, the next steps in the project are (1) to continue piloting the platform amongst the communities we have been collaborating with and (2) to launch the MWO and promote its use in the Metropolitan city as a whole. However, it is important to reflect on some of the challenges we have encountered so far, which include:

- Combining different perspectives from participants, potentially leading to multiple functions that the MWO will have. This in itself has technical difficulties, as it requires an extensive server that can capture a vast amount of data.
- The sustainability of the platform. For the platform to work, it needs constant monitoring of the database, checking for redundancies. Also checking for data participants who wish to be deleted (or included) from the database.
- We also found that government representatives may consider the MWO as a challenge to their work, which may result in less impact. So we need to pay special attention to the ways in which our discussions with them can be conducive at the same time as still being based on citizens' perspectives.
- The need for a communication and dissemination campaign for a widespread use of the MWO which may need new financial resources to continue.

Our hope is that the elaboration of the MWO can be adopted by citizens from various districts in Lima. By involving actors such as SEDAPAL, residents, and civil society groups, it also becomes a space of sustained dialogue, negotiation and policy change. Following the principles and ways of working that enable co-production (Visman et al, 2018), we are attempting to maintain enough flexibility to address concerns emerging from the project, implementing new approaches, and commissioning additional research as needed.

The quest for urban equality is complicated, long-term, and inherently challenging.

The quest for urban equality is complicated, long-term, and inherently challenging. However, through a co-production process centred on water and data justice, the authors of this working paper, along with citizens from three Lima districts, were able to design a platform that seeks to represent the city's invisible voices, and engage in a process of dialogue, negotiation, and consensus-building. We will continue working on this endeavour to contribute to a fairer distribution of water in Lima Metropolitana.

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