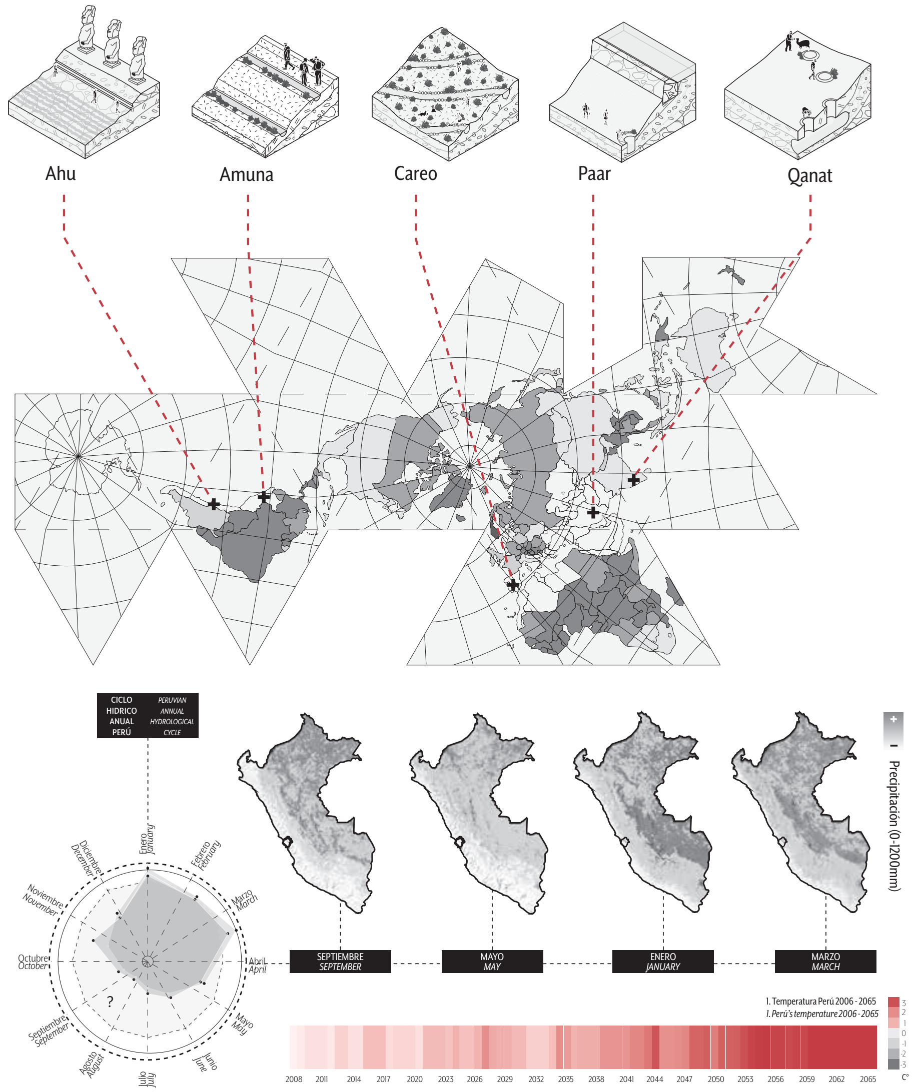
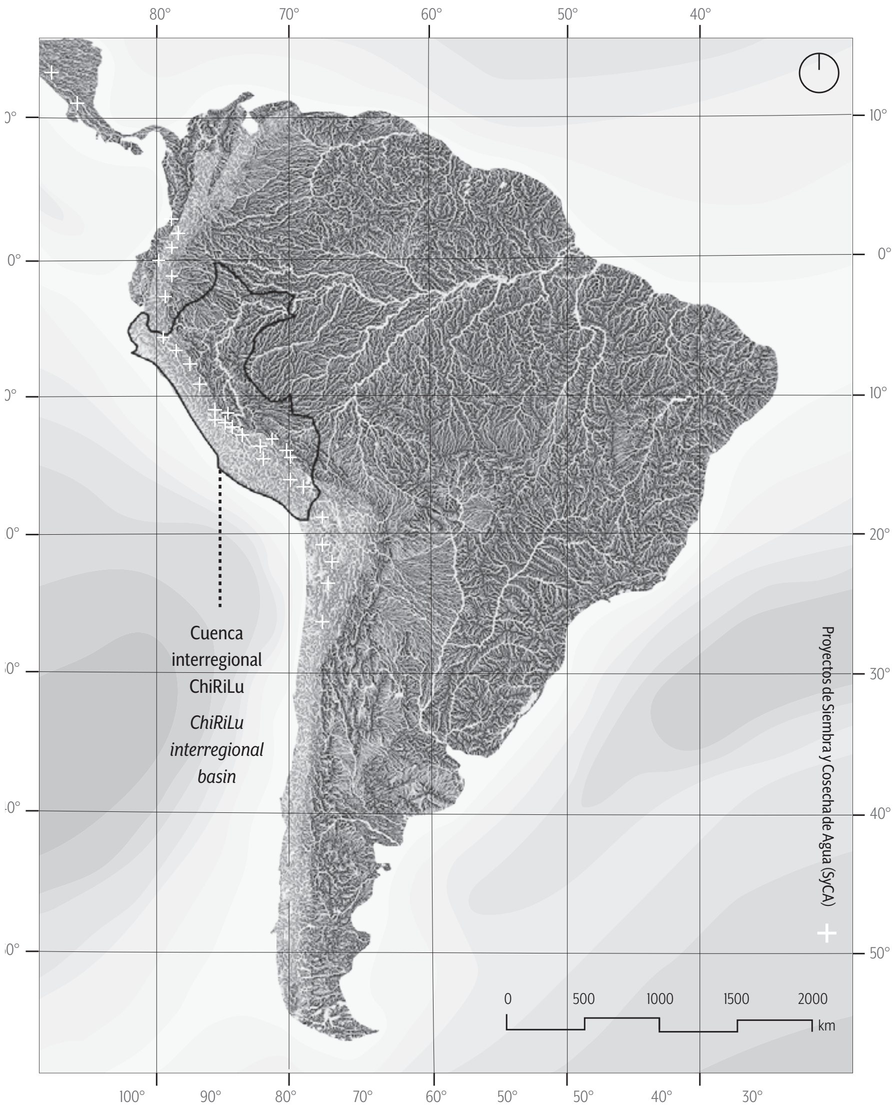


Diego Vivas Huaccho

Predocente TPA e investigador CONURB, Pontificia Universidad Católica del Perú, Lima, Perú

GROWING AND HARVESTING WATER

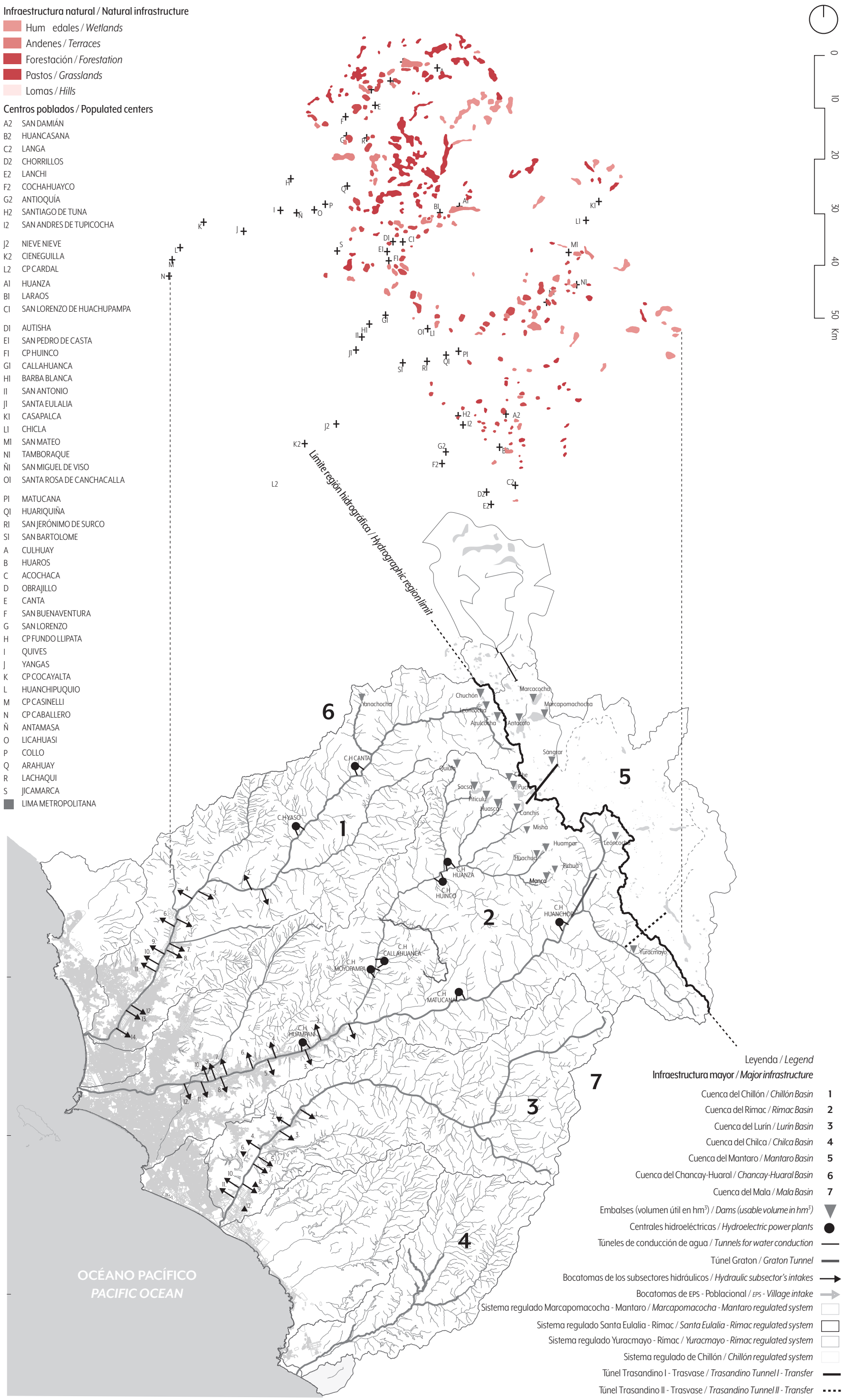
THE UPBRINGING OF THE ANDEAN LANDSCAPE THROUGH NATURAL INFRASTRUCTURE FOR WATER SECURITY



Decolonial theories propose we should rethink our extractive relationship with nature. In line with this premise, this essay analyzes the clash of two worldviews regarding the management and conservation of water. While the modern hydraulic paradigm measures its efficiency in extracted flows, the Andean cosmovision suggests that water can be grown and harvested. If we want to protect our biodiversity, the article suggests that we have much to learn from pre-Columbian infrastructures to retain, store and infiltrate rainwater.

01· Sistemas de cosecha del agua en el mundo, variabilidad climática e incremento de temperaturas en Perú entre los años 2006-2065. / *Water harvesting systems around the world, climatic variability and rising temperatures in Perú between the years 2006-2065.*
Elaborado por el autor y Alessandra Cordero en base a / *Made by the author and Alessandra Cordero based on* Ochoa Tocachi et al., 2019 y Senahmi, 2021.

Keywords: Governance
Natural resources
First Nations
Essay
Decolonize



02· Infraestructura natural, metrópoli, centros urbanos y centros poblados superpuestos al mapa del sistema hídrico mayor. / *Natural infrastructure, metropolis, urban centers and populated centers superposed to the map of the major hydric system.*
Elaborado por el autor, Lucía Tapia y Kelly Quispecondori en base a / *Made by the author, Lucía Tapia & Kelly Quispecondori based on* Observatorio del Agua Chillón Rímac Lurín, s.f.; 2019.

During Perú's 2021 runoff election, the same year of the bicentennial of its colonial liberation, two candidates were competing for the presidency. One of them, Pedro Castillo, aligning with an ancestral protest speech, promised to apply the 'sowing and harvesting of water' (SyCA) as a solution to face the climate crisis and the extreme poverty of many Andean communities. This was enough to reactivate, at a national and international level **[Fig. 01]**, the debate regarding the validity and respect for the ancestral knowledge of Andean territories and landscapes, which also sparked the resurfacing of different forms of epistemic violence that deny the '*serrano*,' 'indigenous,' '*cholo*' or '*andino*' as a path for development (Villasante, 2021).

In Perú, the 'sowing and harvesting of water' refers to the territorial management through infrastructures designed to retain, store, and infiltrate rainwater that is subsequently poured into springs during the dry season (Minagri, 2016). Pre-Hispanic cultures developed extensive modifications to the complex Andean territory by intervening various elements of natural infrastructure (NI) for the SyCA; these elements would eventually become a complex network of multipurpose systems for the support of the state during the Inca imperial stage (Canziani, 2007). *Yarqas* or infiltration ditches, *amunas* or *canals*, *oqhos* or high wetlands, *qochas* or lagoons, and platforms or terraces of cultivation were some of the ancestral infrastructure strategies used to modify the landscape, whose modeling was framed in the Andean cosmovision of the 'upbringing' or *uyway* (Oxa, 2004; De la Cadena, 2020), a communion where all beings and dimensions were connected and where water, through the *yaku uyway* or water rearing (Rengifo, 1994), which which integrated everything.

However, these kinds of knowledge are difficult to value today. Historically, water infrastructure in Perú has been directed through an extractive colonial (Bell, 2016) and modern-scientific perspective for urban-metropolitan purposes (Hoefsloot et al., 2022). Consequently, ancestral knowledge and the real needs of upstream communities were rendered invisible. Institutional policies for water providers and the diagnoses of the Water Resources Councils of Cuenca, that prioritize a solely gray intervention, make this evident (Hoefsloot et al., 2022). Recently, as a result of climate change (IPCC, 2021) and following the agendas of metropolitan water stress and vulnerability, points of contact have been generated with the paradigms of the ancestral SyCA infrastructure in the face of their potential contributions to water security (Ochoa Tocachi et al. 2019). Although the potentialities of the design of natural infrastructures for water security (INSH) have been little explored from the Andean cosmovision (Tomateo, 2021), recent approaches have emerged, such as landscape upbringing, that would allow us to address them.

Natural Infrastructure for Water Security

The limitations of the modern hydraulic and flow paradigm of gray infrastructure are evident in its high costs, complex planning and implementation, and low adaptability (Ochoa-Tocachi et al., 2019). During the 1980s, scientists and conservationists suggested that ecosystems and landscapes should be considered infrastructure (Cardoso da Silva & Wheeler, 2017), thus proposing the term 'natural infrastructure.' This notion was preceded by the concept of green infrastructure adopted by the United Nations Environment Program (2014), defined as a network of natural and semi-natural areas designed for the protection of biodiversity and the provision of urban and rural ecosystem services. In the Andean sector, these range from the conservation of wetlands and forests to the restoration of pre-Inca infiltration channels and the improvement of grazing practices for the sustainable management of water resources (CONDESAN, 2020); or by rescuing ancestral knowledge on the functions and cycles of the ecosystem and its relationship with communities for the generation of dignified and sustainable livelihoods (Cobo & Piñeiros, 2020).

In the Peruvian context, the concept of 'natural infrastructure' was introduced in 2015 during the approval of resolution No. 006-2015-EF/63.01 by the Ministry of Economy and Finance (MEF), aiming to regulate the public investment in biological diversity and ecosystem services. Perú's Planned and Nationally Determined Contribution (NDC) (MINAM, 2016) also included 18 measures linked to the natural infrastructures together with legislation updates, such as Law No. 30215 on Mechanisms of Remuneration for Ecosystem Services – Merese – (Congreso del Perú, 2016). It is important to note that, after the reconstruction and its changes, most investments in natural infrastructures in Perú are made through water and sanitation companies and regional governments (Benites & Gammie, 2021). The National Superintendence of Water and Sanitation (SUNASS) directs water operators to include 'compensation for ecosystem services' through the Merese legal framework, based on a water security approach aimed at safeguarding sustainable access to adequate amounts of water of acceptable quality as an umbrella for multiple additional ecosystem benefits, for example, support, regulation, culture, and resource provision (UN-Water, 2013; Cassin & Locatelli, 2020).

However, diagnoses such as those made by the Water Resources Council in the ChiRiLu interregional basin (Chillón Rímac Lurín Water Observatory, 2019) mention the INSH very superficially. On the other hand, public-private initiatives, such as the Natural Infrastructure Project for Water Security (PINSH), make progress in articulating a multilevel collaboration, with a gender focus and seeking to reconcile ancestral knowledge with contemporaries. Despite all of this, several authors identify gaps for a better application of the INSH in Peru. These include the governance of water resources and the undervaluation of peasant organizations (OECD, 2021); maintaining the urban discourse in territorial planning and management (Hommes & Boelens, 2017); the absence of connections and responses to the rural worldviews and needs (Tomateo, 2021); the deficits of benefits in the first years of investment (Minagri, 2016); and the material and access difficulties of the rural territory (Municipalidad Distrital de San Mateo de Huanchor, 2017). Given this, it is questioned whether design, through the recovery of the ancestral knowledge of the SyCA, can contribute to closing the gaps in the application of INSH in Perú and the Andes. For this, it is essential to revisit the idea of the landscape.

Landscape Upbringing

Although there are several theoretical approaches, Berque (2018) argues that there is a particular line in landscape's modern Western tradition. In Perú, beginning in the conquest era, this line sought to suppress the 'cosmic' of the ancient Peruvian inhabitants by objectifying their landscapes and establishing a relationship of duality that separated their knowledge from their rites, the affective and the productive, posing today a double challenge: first, to overcome the simplifying gaze of modernity towards the territory, and, second, the need to take the ancestral knowledge that still endures in some communities as inspiration. This challenge is further complicated by the deficit in the production of knowledge about the architecture of the Andean landscape.

One of the first to approach this topic was Wiley Ludeña, who carried out, in a historial key, the first typological systematization of Andean landscaping (1997; 2008).[1] For his part, following a cultural interpretation, José Canziani made an account of the cultural landscapes in the Andes (2007).[2] Additionally, and much more recently, Jean Crousse (2016), through dialogue with the previous authors and with the mediation principles of Berque's (1995) landscape, identified the prototypical features that categorized ancestral societies of the Andes as landscapers: systemic order, metavisuality, continuity, aesthetic sense, and preaching. Likewise, he recovers the concept of *uyway* or 'upbringing' to propose a classification based on the beings that made up the Andean cosmovision: water, earth, sky, deities, human beings, flora, and fauna. These systems follow the principles of articulation, verticality, continuity, identity/diversity, reversibility, allowing both a critical analysis of the existing and a projective view of reality.

To achieve articulation, Crousse (2016) proposes that interventions in the landscape must create systems of governance and territorial relationship that optimize the use of resources and promote exchange, interdependence, and complementarity, starting from a metavisual and multi-basin perspective (Valladolid, 1994), thus affecting not only one's plot, but all the others (Rengifo, 1994). In a complementary manner, verticality encourages rational and collaborative occupation among ecological grounds (Itier, 1997). This implies the creation of microclimates that prevent landscape degradation, improving the water and productive supply (IICA, 2018). On the other hand, despite the extirpation of idolatries, the pre-Columbian understanding of the territory as a living landscape in constant becoming still survives (Crousse, 2016), 'trajections' or systems of mediation with those worldviews (Berque, 1990), such as the ancestral infrastructures of SyCA.

Likewise, rescuing the value of identity is linked to respect for local diversity in all its dimensions. Its recognition allows the diversity not only of human action, but also biological, of fauna and flora, something visible in the aesthetic will of various representations of the infrastructural interventions made by the communities in their landscapes (Crousse, 2016). Finally, the understanding of time as a multicyclic phenomenon allows us to integrate the evolution of material action on the environment, turning it into a landscape and an experience forested in communion with the systemic order and local material logic, thus considering its reversibility (Crousse, 2016).

The ChiRiLu Interregional Basin

Perú's water stress scenario is critical due to the enormous Andean water variability between the months of drought and rainfall (Ochoa-Tocachi et al., 2019). This causes, in the summer, a dramatic reduction in surface water reserves, leading to Peruvian high basins, especially those located on the Pacific slope (Senamhi, 2016), to high vulnerability since they have only 1.8% of the country's water, but more than 60% of the population (PNUD, 2010).

Specifically, the ChiRiLu interregional basin is located on this slope and extends its limits from the metropolitan area, in the lower valley at 0 m.a.s.l., to 5,585 m.a.s.l. (Vega-Jácome et al., 2018). The basin has a significant number (El Comercio, 2014; Ochoa-Tocachi et al., 2019; López, 2017) of ancestral infrastructures that have been systematically abandoned throughout their pre-Incan, colonial, republican and modern history, removing or implanting identities linked only to productive capacities and political wills of the day (Cáceda, 1947), which superimpose in the territory a trajectory of conquests and coloniality.[3]

In order to analyze how water resources and infrastructure are managed in the ChiRiLu, and the opportunities for intersection with the Andean landscape worldview, it is necessary to review the initial diagnosis for the Basin Water Resources Management Plan (PGRHC). In a valuable effort, although pressured by the financial agreements signed by the state and under a process not necessarily representative (Villanueva, 2016), in 2016, the Water Resources Management Council of the ChiRiLu Interregional Basin was created, together with the basin's Water Observatory (Chillón Rímac Lurín Water Observatory, 2019).

In this case, the initial diagnosis for PGRHC ChiRiLu is weak in the articulation dimension. In this, governance is mentioned as a suggestion to be developed (Observatorio del Agua Chillón Rímac Lurín, 2019). Despite it includes the associations and boards of irrigation users, a low perception of the importance of ancestral water governance knowledge is evident, something exacerbated by the technical centralization present in the CGRHC ChiRiLu (Robert, 2019). Thus, the diagnosis persists in the center/periphery dichotomies and a centralized and deterrent scheme supported by laws, such as Law No. 29338 on water resources (Congress of Peru, 2009), which perpetuate asymmetries (Salazar, 2020).

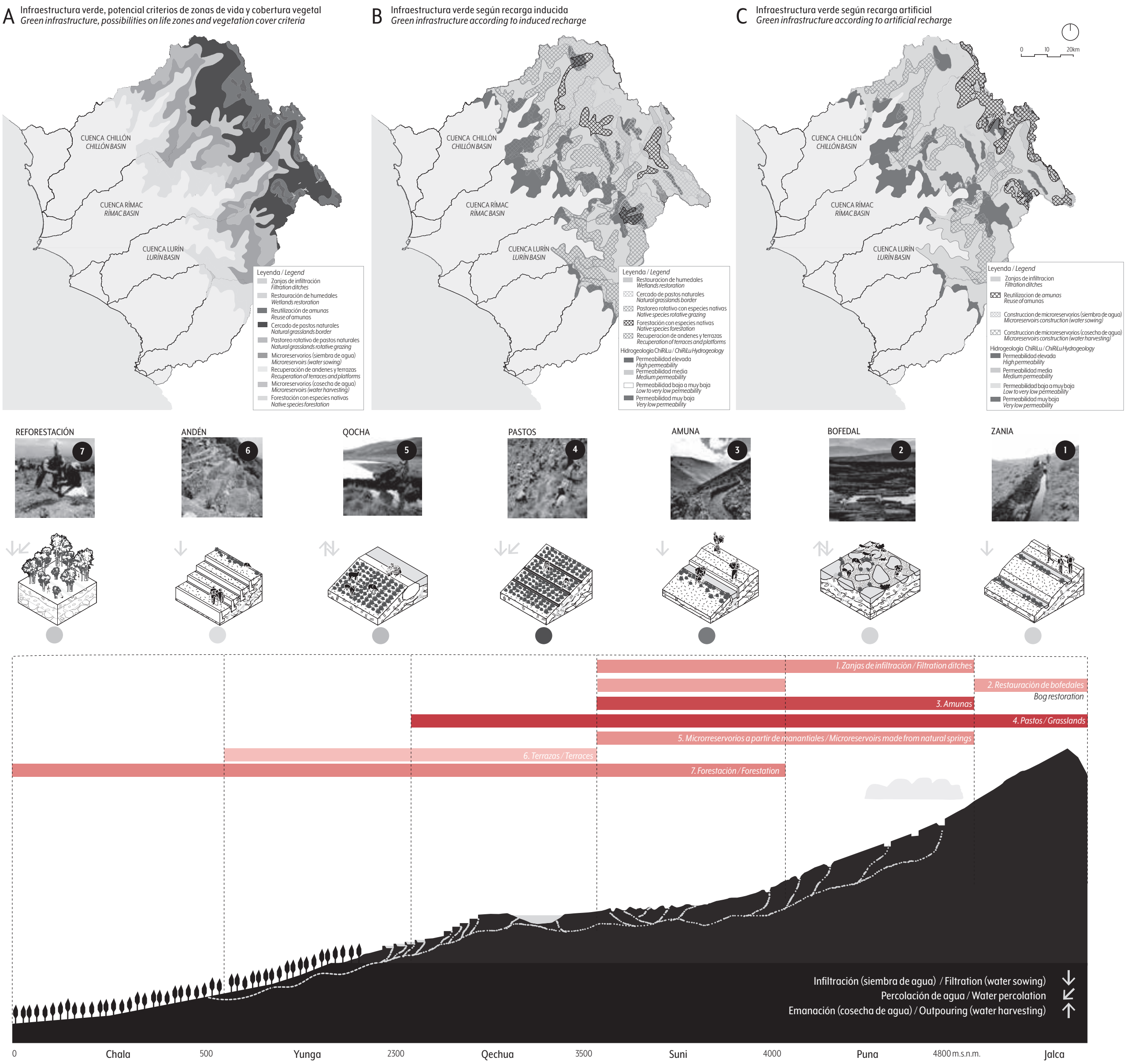
Added to this, the currently accepted colonial vision of Peruvian territory, a product of the Iberian morphologies – coast, mountains, jungle – and not of its natural regions,[4] persists in certain sectors of the diagnosis. Along with this, it's worth noting the lack of an interpretation that correlates ecological, water, social, and cultural layers, and which could reveal environmental injustices (Hall et al. 2021). Likewise, the extractive approach to water is manifested in the projected transfers on the Mantaro basin (ECLAC, 2011) and the network of major gray infrastructures of Sedapal, supplying Metropolitan Lima (Chillón Rímac Lurín Water Observatory, 2019). If we also consider the absence of inhabited centers in the cartographies, a representation that converges INSH and greater infrastructure, and the scarce presence of existing ancestral infrastructure (abandoned or restored), a centralist vision of urban territorial development is perpetuated (Hoefsloot et al., 2022) [**Fig. 02**]. Although approaching the territory through basins is favorable for available water resources, any articulation for territorial development must consider other levels of definition that collect, as a priority, development models at the local level (Robert, 2019).

The continuity of spatial practices linked to the ancestral worldview and the upbringing of beings and water are still preserved in many communities in the middle and upper basins. This can be seen in the communities of San Pedro de Casta, San Mateo de Huanchor, San Andrés de Tupicocha, among others (Gelles, 1984; De La Torre, 2017). Each of them preserves rituals and spatial practices linked to upbringing, especially that of water. The Fiesta del Agua, the Fiesta de las Cruces (two ancestral celebrations linked to water) and the tasks of cleaning channels are clear demonstrations of the existence of these worldviews in the territory (Molina, 2019). The initial diagnosis for the PGRH ChiRiLu does not mention this dimension nor the processes in rural communities.

Meanwhile, the cumulative deficit of benefits in the first ten years of the implementation of INSH interventions is directly linked to design (Varillas, 2020). The aesthetic will, that is, the design resulting from the specific dialogue between the landscapes and infrastructures, the identity and material, technical and cultural diversity of the communities, has not been explored and there is no consistent literature on this topic. Significant advances have been made from the categories defined by the PINSH and Aquafondo (2017) [**Fig. 05**], allowing the generation of guidelines and execution matrixes based on the qualities of each typology – included, albeit generically and incompletely, in the DIPGRH ChiRiLu – however, they do not explore the design dimensions in depth. The notion of identity and the search for diversity are not possible if the design systems of INSH are not de-standardized and guidelines are not linked to spatial coincidences that transcend the generic typologies and a classification that considers only ecosystem benefits, insisting on an extractive vocation of ancestral knowledge (Tomateo, 2021).

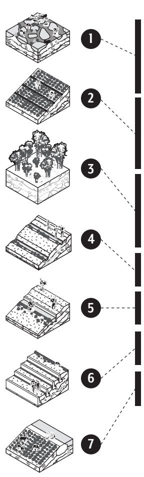
On the other hand, the understanding of the material regarding water infrastructure remains little studied. The predominantly gray hydraulic infrastructure has traditionally intervened through civil engineering in the ChiRiLu basin using reinforced concrete (Santivañez, 2020). These interventions and their nuances support their need in the face of metropolitan demand, but, in the long term, they are expensive, difficult to adapt, and dependent on the technical inputs. The need for a different material approach does not exist in the initial diagnosis for PGRH ChiRiLu. The mixed use of gray and natural infrastructure is still a feasible option (Varillas, 2020); however, there is an absence of debate on this specific topic to inderpinning the concept of reversibility in water interventions.

The ChiRiLu basin would be configured, as defined by Molle, Mollinga and Wester (2009), as a space that is still part of the industrial paradigm based on the so-called hydraulic



03· Mapa y corte de posibles proyectos de infraestructura verde para las cuencas Rímac, Chillón, Lurín (ChiRiLu), de acuerdo a Aquafondo (2017). A. Ubicaciones con posibilidades de desarrollo de infraestructura verde de acuerdo a criterios de zonas de vida y cobertura vegetal. B. Ubicaciones con posibilidades de desarrollo de infraestructura verde para recarga inducida. C. Ubicaciones con posibilidades de desarrollo de infraestructura verde para recarga artificial. Edición del autor.
Map and section of possible green infrastructure projects for the Rímac, Chillón, Lurín (ChiRiLu) basins, following Aquafondo (2017). A. Locations with possibilities for the development of green infrastructure according to the criteria of life zones and vegetation cover. B. Locations with possibilities for the development of green infrastructure for induced recharging. C. Locations with possibilities for the development of green infrastructure for artificial recharging. Edited by the author.
Fotografías / Photographs: Hidráulica Inca, 2011. Helvetas Swiss Intercooperation / Proyecto PACC, 2018. Florent Kaiser, GFG, 2018. Aquafondo, s.f. Diego Pérez / WCS Perú. Agrorural, 2020.

04· Mapa parlante subcuenca de Río Blanco. / *Map of Río Blanco's sub-basin.* Fotografía / *Photograph*: Omar Varillas, 2015. Municipalidad de San Mateo de Huanchor, 2017.



INTERVENCIONES / *INTERVENTIONS*	Regulación hidrológica *Hydrological regulation*	Recarga subterránea *Underground recharge*	Rendimiento hídrico *Hydrological performance*	Control de la erosión *Erosion control*	Filtración contaminantes *Pollutants filtration*
Conservación de humedales *Wetlands conservation*	+	+		+	+
Restauración de humedales *Wetlands restorations*	+	+	-	+	+
Conservación de pasturas *Grasslands conservation*	+			+	+
Restauración de pasturas *Grasslands restoration*	+		- +	+	+
Restauración de bosques (evitar deforestación) *Forest restoration (to avoid deforestation)*	+			+	+
Restauración forestal / restauración *Forest restoration / restoration*	+		-	+	+
Zanjas de infiltración *Filtration ditches*	+	+	-		
Restauracion de *amunas* Amunas *restoration*	+ +	+			
Terrazas *Terraces*	+		-		
Qochas o represas rústicas Qochas *or rustic dams*		+	+		

Leyenda / *Legend*: Impacto positivo alto / *High positive impact*; Impacto negativo alto / *High negative impact*; Impacto negativo / *Negative impact*; Impacto neutral / *Neutral impact*; Impacto desconocido / *Unknown impact*

05· Impacto de las intervenciones de infraestructura natural para la seguridad hídrica. / *Impact of the interventions of natural infrastructures for hydric security.*
Elaborado por el autor y Valeri Chávez en base a / *Made by the author and Valeri Chávez based on* Forest Trends, s.f., Helvetas 2017 y Minagri, 2014.

mission that privileges the exploitation of the resource. However, the SyCA, from the perspective of the INSH, has begun to promote a transition in the basin.

Advances and Guidelines for the Upbringing of the Andean Landscape Through Natural Infrastructure for Water Security

Just for 2022, the proposed budget for SyCA (ANDINA, 2021) is 305 million PEN, which would generate a direct local transformation in more than 500,000 hectares to which the concatenated impacts downstream would have to be added. The implementation of Law No. 30989, which declares water sowing and harvesting to be of national interest and public necessity (Congreso del Perú, 2019), could close gaps identified in the initial diagnosis for the ChiRiLu Basin Water Resources Management Plan (Chillón Rímac Lurín Water Observatory, 2019). However, it is necessary to review and question the current paradigms under which the water infrastructure system is conceived, considering both approaches of upbringing for the intervention of the INSH in the landscape and the people for whom the projects are actually designed.

It is necessary, therefore, to promote a holistic view (Llamazares, 2011) of governance that resolves the asymmetries through multilevel dialogue and effective participation, reflecting on the need to incorporate the approach of upbringing for a better management of water resources. Advances in the incorporation of dialogue tables and multilevel initiatives for the implementation of adaptation strategies prioritize local water governance for the execution of projects. When understanding the initial diagnosis for the PGRHC ChiRiLu as one of the first attempts to articulate a common database, it is important to 'make space' (Latulippe and Klenk, 2020) for ancestral communal water governance systems and, through those, achieve an effective articulation.

Likewise, there are advances in methodologies of overlapping variables for decision-making in natural water infrastructures – such as those made by Aquafondo (2017) **[Fig. 03]** for the identification of potential sectors and the guidelines formulated by the PINSH for the hydrological modeling of the natural infrastructures (Ochoa-Tocachi et al., 2022), as well as several policy summaries and systematic reviews of academic and technical literature. These first efforts of systematization and representation are crucial to understanding verticality in its most specific sense, allowing the crossing of variables that integrate the 'rural' and the 'ancestral.' Overcoming the colonial perspective in territorial development and planning is only possible when there is a critical understanding of the instruments of representation (Bellone et al., 2020) and the systems these correlates.

On the other hand, the National Water Sowing and Harvesting Program (Minagri, 2016) and organizations such as HELVETAS (Varillas, 2020) are testing views of water upbringing in the development of institutional projects in the ChiRiLu basin. Methodologies such as talking maps allow us to understand the roles of actors and their territorial development (Municipality of San Mateo de Huanchor, 2017) **[Fig. 04]**. However, their applications in design are still insufficient to achieve a discourse that reflects multidimensional continuity in local design. Taking in the 'multipurpose water infrastructures' view (Naughton et al., 2017; Moreno, 2020) could manage to translate the needs identified in their spatial practices into the design of INSH. These advances could help to consolidate the internalization of the value of water in the areas where it is brought up.

In the same way, considering local needs is urgent to generate – from design – the greatest possible value and sustainability for investments in INSH. Through the theorization of the spatial principle of *amunas*, a first topological approach to INSH interventions can be made, understanding them as retention infrastructures (Vivas, 2021). This conceptualization could recover its original Quechua meaning: 'to retain' (Ochoa-Tocachi et al., 2019), thus understanding infrastructures and their ancestral knowledge as open, collaborative, and non-definitive definitions (Whyte, 2013), susceptible to modeling according to the diversity of needs and spatial practices of local communities and based on a notion of identity from its fundamental structuring principles **[Fig. 06]**.

Finally, the material dimension continues as a space of exploration for design. Therefore, INSH interventions in the landscape must be part of an ecological circuit that considers the material available in its proximity. Together with this, local technical and artisanal capacity as an ancestral value (Minagri, 2016) should also be considered since it generates agency before, during, and after the intervention in a life cycle that incorporates reversibility and possibilities of growth or decrease according to the need of the user, adopting a support condition (Vivas, 2021) **[Fig. 07]**.

By understanding the history and relationship between the INSH and the upbringing of the landscape, it is possible to reflect on the current situation and think of opportunities to decolonize our Andean territories. The articulation of local governance of water resources, a vertical systemic comprehension for an adequate territorial planning that serves as a framework for the continuity of spatial practices, and the emergence of the design identity and diversity that meets specific needs, – under a reversible material approach of the intervention processes in the landscape –, could allow proposing other projects that, from the upbringing of the landscape, protect the water security of the entire ChiRiLu interregional basin and the Andes, giving visibility to those who raise the water. **ARQ**

NOTES

Acknowledgements: This article is the product of an academic research carried out in the bachelor's program PFC Periferias PUCP. The author received funding from the Premio Nacional Cultura del Agua - H2O Investigaciones through a cooperation agreement between the Peruvian National Water Authority and the Forest Trends Association on behalf of the Natural Infrastructure for Water Security Project. The Project is also funded by USAID and the Government of Canada, which were not involved in the research or its publication. The author thanks Nathaly Veliz for her assistance in editing this article.

1. Ludeña (2008) defines the landscape as a place interpreted culturally and ideologically – mostly uncharted in the Latin American context – dividing it, in the Peruvian case, into three time periods: 1) Inca and pre-Inca landscaping, 2) colonial landscaping and 3) republican landscaping. Regarding the Inca and pre-Inca, Ludeña characterizes them in surface landscapes, in plains and slopes; in surface, in-line; of stone and water; of land, water and wind; evoked; and from below.

2. Canziani (2007) makes an extensive and systematic account of the diverse cultural landscapes of Perú, cataloging various infrastructural devices made by pre-Hispanic peoples supported by archaeological, anthropological, and historical studies from the perspective of architecture, urbanism, and territory.

3. The intervention of pre-Inca conquest on the 'original' population of Huarochirí (De Ávila, 1966; Lumbreras, 1969; Rostworowski, 1978), the conversion into the reduction of Indians and idolatrous extirpation (Poma de Ayala, 1980 [1616]), industrial and modernizing interventions (Chacón, 2002), as well as the exploitation of its water resources with mainly metropolitan destination, reveal the basin as a complex space and multilayered landscapes, where the colonial powers exercised from the distance of regional administrations perpetuate the invisibilization of ancestral discourses (Hommes & Boelens, 2017).

4. Pulgar Vidal (1987), based on an ethnographic and geographical analysis carried out during his thesis, identifies eight natural regions classified from altitudinal floors, fauna, and flora. These are: *Chala* or coast, *Yunga*, *Quechua*, *Suni*, *Jalca* or *Puna*, *Janca* or *Cordillera*, *Rupa-Rupa* or high jungle, and *Omagua* or low jungle.

BIBLIOGRAFÍA / BIBLIOGRAPHY

ANDINA. "Gobierno destinará S/ 305 millones para riego, siembra y cosecha de agua". *ANDINA Agencia Peruana de Noticias,* 2 de noviembre de 2021. Disponible en / *accessible at*: <https://andina.pe/agencia/noticia-gobierno-destinara-s-305-millones-para-riego-siembra-y-cosecha-agua-860137.aspx>.

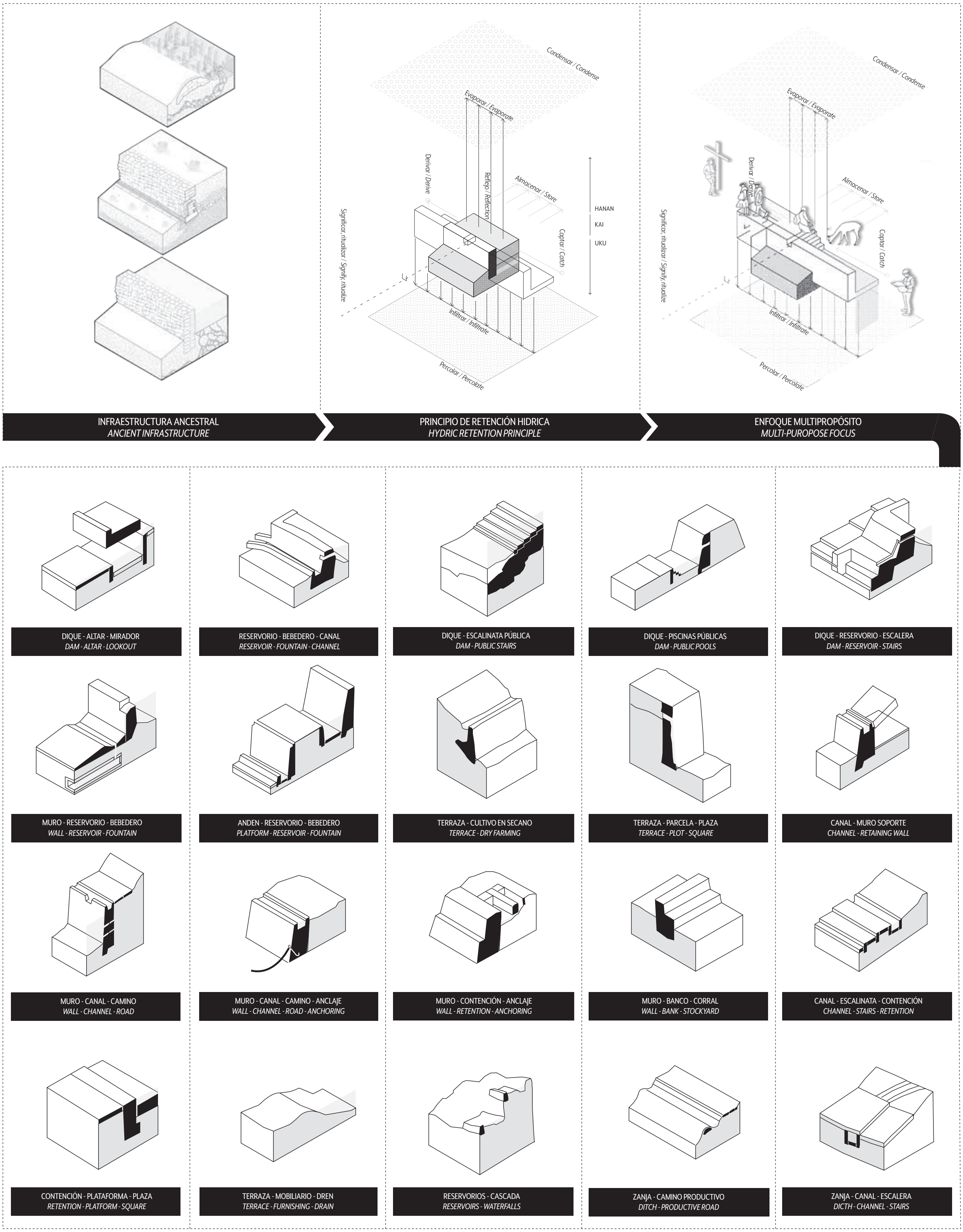
AQUAFONDO. "Áreas potenciales para el desarrollo de proyectos de infraestructura verde en las cuencas del ChiRiLu". *Aquafondo*, noviembre de 2017. Disponible en / *accessible at*: <https://aquafondo.org.pe/areas-potenciales-para-el-desarrollo-de-proyectos-de-infraestructura-verde-en-las-cuencas-del-chirilu/>.

BELL, Martha. "Delimitar y gobernar las aguas de Lima: relaciones urbano-rurales y rivalidades administrativas en Lima colonial". *Histórica* 40, no. 1 (2016): 7-33.

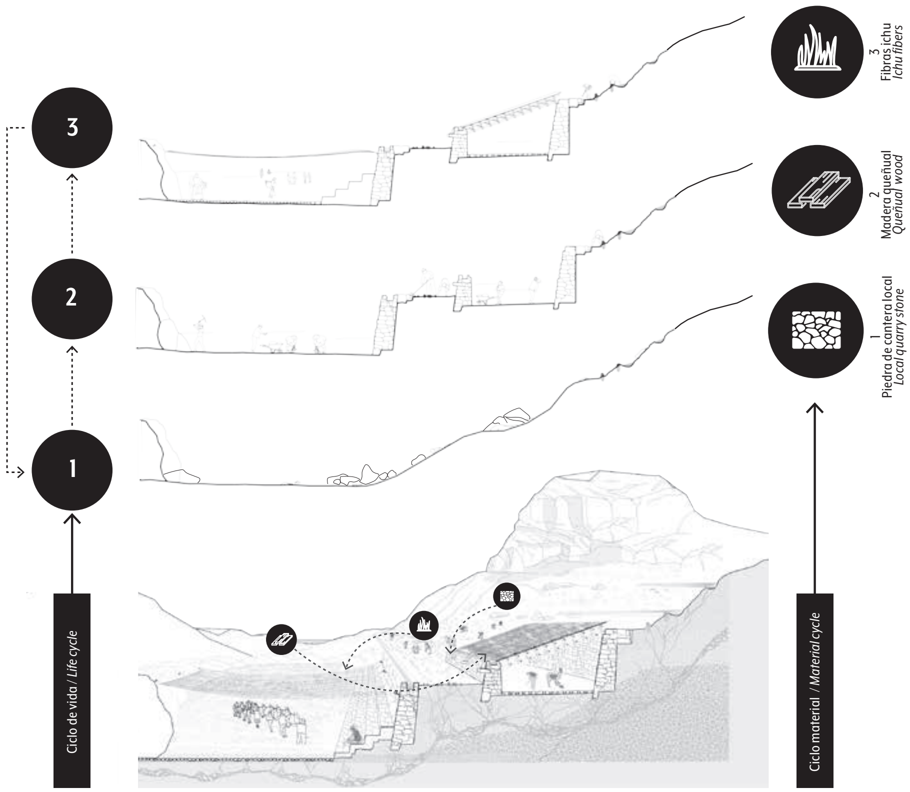
BELLONE, Tamara; ENGEL-DI MAURO, Salvatore; FIERMONTE, Francesco; ARMANO, Emiliana; QUIQUIVIX, Linda. "Mapping as Tacit Representations of the Colonial Gaze". En SPECHT, Doug (ed.). *Mapping Crisis: Participation, Datafication and Humanitarianism in the Age of Digital Mapping*. Londres: University of London Press, 2020, 17-38.

BENITES, Lucas; GAMMIE, Gena. "Abriendo el caño: estado del financiamiento en la infraestructura natural para la seguridad hídrica en el Perú, 2021". *Forest Trends*, diciembre de 2021. Disponible en / *accessible at*: <https://www.forest-trends.org/publications/abriendo-el-cano-estado-del-financiamiento-en-la-infraestructura-natural-para-la-seguridad-hidrica-en-el-peru-2021/>.

BERQUE, Augustin. *Médiance. De milieux en paysages.* Francia: Belin, 1990.



06· Tipologías de acuerdo al principio de retención hídrica de las amunas. Diagramas teóricos de otros dispositivos hídricos multipropósito. / *Typologies according to the hydric retention principle of the amunas. Theorical diagrams of other hydric multi-purpose devices.*
Elaborado por el autor y Joyce Vivas / *Made by the author and Joyce Vivas.*



07· Ciclo de vida y circuito material. / *Life cycle and material circuit.*
Elaborado por el autor y Jean Salvador / *Made by the author and Jean Salvador.*

Diego Vivas Huaccho
<diego.vivas@pucp.edu.pe>

Architect, Pontificia Universidad Católica del Perú (PUCP), 2021. He has received the Premio Nacional Cultura del Agua 2021; the first place in the International Architecture Biennial of Lima (BIALIMA) in the category urbanism and landscaping. He has been an exhibitor at congresses and master's programs in Chile, México, Argentina, and Ecuador. He is currently a researcher in the CONURB Research Group of the Centro de Investigación de la Arquitectura y la Ciudad of the PUCP and responsible for the documentary fund at the PUCP Architecture Archive.

BERQUE, Augustin. *Les raisons du paysage. De la Chine antique aux environnements de synthèse*. París: Hazan, 1995.

BERQUE, Augustin. *Recosmiser La Terre. Quelques Leçons Péruviennes*. París: Editions B2, 2018.

CÁCEDA, Ruperto. *La Nación de Los Yauyos y San Mateo de Guanchor*. Lima: Línea Andina, 1947.

CANZIANI, José. *Paisajes culturales y desarrollo territorial en los Andes*. Lima: Fondo Editorial Arquitectura PUCP, 2007.

CARDOSO DA SILVA, José Maria; WHEELER, Emily. "Ecosystems as infrastructure". *Perspectives in Ecology and Conservation* 15, no.1 (2017): 32-35.

CASSIN, Jan; LOCATELLI, Bruno. "Guía para la evaluación de intervenciones en infraestructura natural para la seguridad hídrica: escala de efectividad, equidad y sostenibilidad". *Forest Trends*, septiembre de 2020. Disponible en / *accessible at:* <https://www.forest-trends.org/publications/guia-ees/>.

CHACÓN, Raúl. "El Nacimiento del ecologismo popular en el Perú o la lucha sin fin de las comunidades de Vicco y San Mateo". *Ecología Política*, no. 24 (2002): 113-128.

COBO, Emilio; PIÑEIROS, María Laura. *Infraestructura natural. Oportunidades para optimizar la gestión de sistemas hídricos*. Quito: UICN, 2020. Disponible en / accessible at: <http://www.waterandnature.org/sites/default/files/infraestructura_natural_uicn.pdf>.

CONDESAN. "Proyecto Infraestructura Natural para la Seguridad Hídrica (INSH)". *CONDESAN*, noviembre de 2020. Disponible en / *accessible at*: <https://condesan.org/wp-content/uploads/2020/10/TdR_Especialista-Hidrologia-SEH.pdf>.

CONGRESO DE LA REPÚBLICA DEL PERÚ. Ley Nº 29338. Ley de Recursos Hídricos. *Normas legales*. Lima, 2009.

CONGRESO DE LA REPÚBLICA DEL PERÚ. Ley N°30215. Ley de Mecanismos de Retribución por Servicios Ecosistémicos. *Normas legales*. Lima, 2016.

CONGRESO DE LA REPÚBLICA DEL PERÚ. Ley N° 30989. Ley que declara de interés nacional y necesidad pública la implementación de la siembra y cosecha de agua. *Normas legales*. Lima, 2019.

CROUSSE, Jean Pierre. *El paisaje peruano*. Lima: Fondo Editorial PUCP, 2016.

DE ÁVILA, Francisco. *Manuscrito de Huarochirí*. 1947. Traducido por José María Arguedas, 1966.

DE LA CADENA, Marisol. "Cosmopolítica indígena en los Andes: reflexiones conceptuales más allá de la «política»". *Tabula Rasa* 33, (2020): 273-311.

DE LA TORRE, Juan. "Las Amunas de Huarochirí: Agua, Innovación y Desarrollo". En PORTOCARRERO, Gonzalo (ed.). *Ecos de Huarochirí: Tras la huella de lo indígena en el Perú*. Lima: Grupo Los Zorros, 2017, 273-292.

EL COMERCIO. "Lima y Cusco cuentan con la mayor cantidad de andenes". *El Comercio*, 5 de junio de 2014. Disponible en / accessible at: <https://elcomercio.pe/economia/peru/lima-cusco-cuentan-mayor-cantidad-andenes-171876-noticia/>.

GELLES, Paul. "Agua, faenas y organización comunal: San Pedro de Casta - Huarochiri". *Anthropologica* 2, no.2 (1984): 305-334.

HALL, Monique Mae; WEHI, Priscilla M.; WHAANGA, Hēmi; WALKER, Erana T.; KOIA, Jonni Hazeline; WALLACE, Kiri Joy. "Promoting Social and Environmental Justice to Support Indigenous Partnerships in Urban Ecosystem Restoration". Restoration Ecology 29, no.1 (2021): 1-7.

HOEFSLOOT, Fenna I.; MARTÍNEZ, Javier; PFEFFER, Karin. "An Emerging Knowledge System for Future Water Governance: Sowing Water for Lima". Territory, Politics, Governance (2022): 1-21.

HOMMES, Lena; BOELENS, Rutgerd. "Urbanizing Rural Waters: Rural-Urban Water Transfers and the Reconfiguration of Hydrosocial Territories in Lima". *Political Geography* 57, (2017): 71-80.

IICA. "'Los atajados', tecnología para la cosecha de agua. Bolivia". En MORÁN, Luis; HILBORN, Paul; VILLANUEVA, Paca; VARILLAS, Omar (eds.). *Inventario de tecnologías en manejo de agua para la agricultura familiar*. Lima: Inventario de tecnologías de manejo de agua para la agricultura familiar, 2018.

IPCC. "AR6 Climate Change 2021: The Physical Science Basis". Publicado en 2021. Disponible en / *accessible at*: <https://www.ipcc.ch/report/ar6/wg1/>.

ITIER, César. "El zorro del cielo: un mito sobre el origen de las plantas cultivadas y los intercambios con el mundo sobrenatural". *Bulletin de l'Institut français d'études andines* 26, no. 3 (1997): 307-346.

LATULIPPE, Nicole; KLENK, Nicole. "Making room and moving over: knowledge co-production, Indigenous knowledge sovereignty and the politics of global environmental change decision-making". *Current Opinion in Environmental Sustainability* 42, (2020): 7-14.

LLAMAZARES, Ana. *Del reloj a la flor de loto. Crisis contemporánea y cambio de paradigmas*. Buenos Aires: Del Nuevo Extremo, 2011.

LÓPEZ, Yván. "Análisis espacial de las áreas priorizadas incluyendo mapas de ubicación de las intervenciones en infraestructura verde en las cuencas Chirilu". USAID, agosto 2017.

LUDEÑA, Wiley. "Notas sobre paisaje, paisajismo e identidad cultural en el Perú". *Arquitextos* no. 7 (1997): 9-24.

LUDEÑA, Wiley. "Paisaje y paisajismo peruano. Apuntes para una historia crítica". *Textos-Arte, Facultad de arte de la Pontificia Universidad Católica del Perú* (2008): 59-84.

LUMBRERAS, Luis. *De los pueblos, las culturas y las artes del antiguo Perú*. Lima: Moncloa-Campodónico, 1969.

MEF. Resolución Directorial N° 006-2015-EF/63.01. Aprueban instrumentos metodológicos para la aplicación de herramientas participativas en los proyectos de inversión pública y para la formulación de proyectos de inversión pública en diversidad biológica y servicios ecosistémicos. *Diario Oficial El Peruano*, Lima, 5 de agosto de 2015.

MINAM. *La Contribución Nacional del Perú - iNDC: agenda para un desarrollo climáticamente responsable*. Lima: Ministerio del Ambiente, 2016. Disponible en / *accessible at*: <http://www.minam.gob.pe/cambioclimatico/wp-content/uploads/sites/11/2015/12/LA-CONTRIBUCI%C3%93N-NACIONAL-DEL-PER%C3%9A1.pdf>.

MINAGRI. *Rumbo a un Programa Nacional de Siembra y Cosecha de Agua: Aportes y reflexiones desde la práctica*. Lima: Ministerio de Agricultura y Riego, 2016.

MOLINA, Joaquín. "Al canto del agua. poesía, testimonio y libro de la comunidad andina de San Pedro de Casta, Huarochirí". *Chungará* (Arica) 51, no. 3 (2019): 509-512.

MOLLE, Francois, MOLLINGA, Peter; WESTER, Philippus. "Hydraulic Bureaucracies and the Hydraulic Mission: Flows of Water, Flows of Power". *Water Alternatives* 2, no. 3 (2009): 328 349.

MORENO, Osvaldo. "Teoría del paisaje contemporáneo". Diapositiva de PowerPoint, Maestría en Arquitectura y Procesos Proyectuales PUCP, 2020.

MUNICIPALIDAD DISTRITAL DE SAN MATEO DE HUANCHOR. *Plan de acción local de cambio climático del distrito de san mateo de Huanchor. Fortaleciendo la capacidad de adaptación de la agricultura y ganadería 2017-2022*. Lima: Municipalidad Distrital de San Mateo de Huanchor, 2017. Disponible en / *accessible at*: <https://pdf.usaid.gov/pdf_docs/PA00N2GR.pdf>.

NAUGHTON, Meleesa; DESANTIS, Nicole; MARTOUSSEVITCH, Alexandre. "Managing Multi-Purpose Water Infrastructure: A Review of International Experience". *OECD Environment Working Papers* 115. París: OECD Publishing, 2017.

OBSERVATORIO DEL AGUA CHILLÓN RÍMAC LURÍN. "Diagnóstico inicial para el Plan de gestión de recursos hídricos en el ámbito de las cuencas Chillón, Rímac, Lurín y Chilca". Observatorio del Agua Chillón Rímac Lurín, agosto de 2019. Disponible en / *accessible at*: <https://hdl.handle.net/20.500.12543/3901>.

OBSERVATORIO DEL AGUA CHILLÓN RÍMAC LURÍN. "Sistema Hidráulico", s.f. Recuperado el 20 de febrero de 2022. Disponible en / *accessible at*: <http://observatoriochirilu.ana.gob.pe/index.php/caracterizaci%C3%B3n-de-cuencas/sistema-hidraulico>.

OCHOA-TOCACHI, Boris; BARDALES, Juan; ANTIPORTA, Javier; PÉREZ, Katya; ACOSTA, Luis; MAO, Feng; ZULKAFLI, Zed; GIL-RÍOS, Junior; ANGULO, Oscar; GRAINGER, Sam; GAMMIE, Gena; DE BIÈVRE, Bert; BUYTAERT, Wouter. "Potential contributions of pre-Inca infiltration infrastructure to Andean water security". *Nature Sustainability* 2, no. 7 (2019): 584-593.

OCHOA-TOCACHI, Boris; CUADROS-ADRIAZOLA, José; ARAPA, Edwing; ASTE, Natalia; OCHOA-TOCACHI, Eric; BONNESOEUR, Vivien. "Guía de modelación hidrológica para la infraestructura natural". Forest Trends, enero de 2022.

OECD. *Water Governance in Peru*. OECD Studies on Water. París: OECD Publishing, 2021.

OXA, J. "Vigencia de la cultura andina en la escuela". En *Arguedas y el Perú de hoy*, C. M. Pinilla (ed.). Lima: SUR, 2004, 235-242.

PNUD. *Informe sobre Desarrollo Humano Perú 2009. Por una densidad del Estado al servicio de la gente*. Lima: PNUD, 2010.

POMA DE AYALA, Felipe. *Nueva corónica y buen gobierno*. Caracas: Bilioteca Ayacucho, 1980 [1616].

PROGRAMA DE LAS NACIONES UNIDAS PARA EL MEDIO AMBIENTE. *Green Infrastructure Guide for Water Management. Ecosystem-based management approaches for water-related infrastructure projects*. United Nations Environment Programme, 2014. Disponible en / *accessible at*: <https://www.unepdhi.org/wp-content/uploads/sites/2/2020/05/WEB-UNEP-DhiGroup-Green-infrastructure-Guide-EN-20140814.pdf>.

PULGAR VIDAL, Javier. Geografía del Perú: las ocho regiones naturales, la regionalización transversal, la microrregionalización. Lima: Editorial Peisa, 1987.

RENGIFO, Grimaldo. "El suelo agropecuario en las culturas andinas y en Occidente Moderno". En *Crianza andina de la chacra*. Lima: Pratec, 1994.

ROBERT, Jérémy. "(De)construcción de gobernanza del agua urbana en Lima. La experiencia del Consejo de Recursos Hídricos". *Medio Ambiente y Urbanización* 90, no. 1 (2019): 83-110.

ROSTWOROWSKI, María. "Mediciones y cómputos en el antiguo Perú". En *Cuadernos Prehispánicos* 6. Valladolid: Universidad de Valladolid, 1978.

SALAZAR, Jeanette. "La interacción de los usuarios en la Junta de Usuarios del Sistema Hidráulico Rímac y la presencia de la Ley de Recursos Hídricos". Tesis de Maestría. Pontificia Universidad Católica del Perú, 2020.

SANTIVAÑEZ, Miguel. "El río trabajador. Transformaciones del paisaje hídrico urbano en la cuenca hidrográfica del río Rímac (1955/2015)". Tesis de Bachillerato. Pontificia Universidad Católica del Perú, 2020.

SENAMHI. *Vulnerabilidad Climática De Los Recursos Hídricos En Las Cuencas De Los Ríos Chillón, Rímac, Lurín Y Parte Alta Del Mantaro: Resumen Ejecutivo*. Lima: Servicio Nacional de Meteorología e Hidrología del Perú Ediciones, 2016.

TOMATEO, Claudia. "Indigenous Land Systems and Emerging of Green Infrastructure Planning in the Peruvian Coastal Desert: Tensions and Opportunities". *Journal of Environmental Policy & Planning* 23, no. 5 (2021): 683-700.

TUCK, E.; YANG, K. W. "Decolonization is not a metaphor". *Decolonization: Indigeneity, education & society* 1, no. 1 (2012): 1-40.

UN-WATER. "What is Water Security? Infographic". UN-Water, 8 de mayo de 2013. Disponible en / *accessible at*: <https://www.unwater.org/publications/water-security-infographic/>.

VALLADOLID, Julio. "Agricultura campesina Andina. Crianza de la diversidad de la vida en la chacra". En *Crianza andina de la chacra*. Lima: Pratec, 1994.

VARILLAS, Omar. "La siembra y cosecha de agua: de las experiencias locales a la idea de una política nacional". Video de YouTube. Publicado el 7 de junio de 2020. <https://www.youtube.com/watch?v=PuMdhaG1eow>.

VEGA-JÁCOME, Fiorella; LAVADO-CASIMIRO, Waldo; FELIPE-OBANDO, Oscar. "Assessing Hydrological Changes in a Regulated River System Over the Last 90 Years in Rimac Basin (Perú)". *Theoretical and Applied Climatology* 132, (2018): 347-362.

VILLANUEVA, Jacqueline. "La gobernanza de los recursos hídricos en la cuenca del río Lurín en el marco de la creación del Consejo de Recursos Hídricos de cuenca Chillón, Rímac, Lurín". Tesis de Maestría. Pontificia Universidad Católica del Perú, 2016.

VILLASANTE, Mariella. "El racismo: conceptos y elecciones de 2021 desde la antropología social". IDEHPUCP, 22 de junio de 2021. Disponible en / *accessible at*: <https://idehpucp.pucp.edu.pe/notas-informativas/el-racismo-conceptos-y-elecciones-de-2021-desde-la-antropologia-social/>.

VIVAS, Diego. "Amunas. Infraestructuras de retención hídrica frente a la escasez. Caso de la microcuenca del Jocohanca-San Mateo de Huanchor en el Valle del Rímac". Tesis de Licenciatura, Pontificia Universidad Católica del Perú, 2021.

WHYTE, Kyle. "On the Role of Traditional Ecological Knowledge as a Collaborative Concept: a Philosophical Study". *Ecological Processes* 2, no. 7 (2013).