Parched Paradise

The Crisis of Modern Water and a Common Future

Introduction

Centuries of human habitation have transformed the Valley of Mexico's hydrological system. Beginning in the 14th century, the Aztec empire leveraged nature's existing system of interconnected lakes to sustain its capital, Tenochtitlan. During the subsequent period of Spanish rule, this system was slowly drained and colonial mismanagement led to the widespread erosion of indigenous aquatic livelihoods. However, it was not until the modern period of Mexican Independence that they would fully vanish. Under the aspirations of Modernity, the lake water was exploited to sustain the expansion of Mexico City. By the second half of the twentieth century, the lakes were effectively gone, with only small remnants of the lakes remaining today.

These societal developments in Mexico were fueled by what geographical philosopher Jamie Linton (2013) christened the "Paradigm of Modern Water." The Paradigm's intellectual origins began during the Scientific Revolution and culminated in Europe during the 19th and 20th centuries as its theorems were widely applied. Indigenous and pre-modern conceptions of water were interested in the myriad 'spacialites' of water as a foundational part of socio-cultural life. The modern period transformed water "from a class of infinitely varied substances to a monolithic substance containing a greater or lesser concentration of adventitious ingredients" (Hamlin, 2000). This ahistorical abstraction had drastic consequences as water could now be quantified, engineered and warped. Across the developed world, specialized water authorities were commissioned to consolidate both power and expertise over this resource, creating the "State-Water Paradigm" (Bakker, 2003). Emphasis was placed on the development of water supplies by state authorities, "...without explicit regard for the complexity of relations between water and ecosystem functions and between water and human society" (Linton, 2013). Universal access to water was promised. The subsequent social and environmental distortions inherent to maintaining this access birthed the Crisis of Modern Water. New schools of thought (Hydro-social cycle, IWRM) critique the over-simplification and separation of socio-environmental dimensions of water and argue for a reconfiguration of water, society, state, and environment.

In what ways has the Paradigm of Modern Water reshaped the hydrology of the Valley of Mexico, leading to the current crisis, and how can a reconfiguration of water and society help overcome these issues?

This research aims to determine transitional frameworks by analyzing the relationship of state, water and society alongside existing decentralized water practices (technological and governmental). The first chapter examines the premodern conceptions of water and how they influenced the relevant societies during the Aztecs and later the Colonial periods. The second chapter lays out the accelerated hydrological destruction of Modern Water and its consequences for society. The third chapter analyzes the *ejido*, an alternate land and water tenure system inspired by indigenous forms of land tenure pracices and legally enshrined in the Mexican Constitution. The fourth chapter argues for the translocation of central aspects of the ejidos system to urban settings to foster a more equitable and sustainable conception of the urban water commons.
Methodologically, research was conducted using a mixed-method approach to capture the intricacies of large-scale organizations and their local implications, including quantitative data (GIS, statistics, reports, paper analysis) and qualitative records (archives, newspaper reports, interviews).

Premodern Waters

Mexico City was founded in about 1344 on a small, muddy island in Lago de Texcoco. The city existed in a close relationship to its aquatic environment, albeit in a contradictory manner. The indigenous societies depended upon the rich lacustrine habitats or subsistence. Before the Aztec's arrival, local settlers had already cultivated the surfaces of lakes and shores through highly productive agricultural practices, such as the chinampas (artificial farming island) and irrigation farming respectively (Fox, 1965). Both practices were expanded upon by the Aztec rulers (Lahera Ramón, 2008).
However, the water of Lake Texcoco also posed an existential threat to the existence of the city. The heavy precipitation during the rainy season would inundate the capital regularly. After a particularly heavy episode in the 1440s, the rulers constructed the dike of Netzahualkoyotl, a 16 km long dike dividing Lake Texcoco and Lake Mexico (Fig. 1) (Fox, 1965; Maudslay, 1916). Similar dikes and causeways preceded the project to connect to the shores or to separate other lake parts. The almost total control of water was strategic in war and a subjugation factor through the technological control [...] generated by the Aztecs, in order to supply the precious liquid to the

region and to maintain [peopel under their rule] occupied" (Chávez, 1994).
The location in the middle of a lacustrine lake, while not without its strategic advantage, also constituted a natural scarcity of fresh water. Authorities ordered the construction of aqueducts along two major causeways, connecting to the abundant freshwater springs of *Chapultepec* and *Churubusco.* These springs were considered the property of the people (Chavez, 1994). The city authorities managed and monitored the infrastructure. All citizens were obliged to cooperate in these projects (Chavez, 1994). Internally water was distributed through fountains and ponds. Only the nobility received water through an individual faucet, the rest transported water with canoes filled at the bridges of the aqueducts (Chávez, 1994). To regulate the quality of water from the lakes and reduce potential health risks, authorities prohibited the disposal of waste into the channels or lakes around the city. Deviance was severely punished (Tortolero, 2000). From these descriptions, it is clear that water was valued highly. Physical and nonstructural measures were taken to preserve the fragile hydrological balance of the basin to ensure the coexistence of people and the environment. This is partially

The Spanish conquest in 1521 would see the end of Tenochtitlan and the sensible relationship to the ecological system of the Valley it resembled. The Capital of New Spain was built on its ruins. The new rulers were aware of the destructive force of Lake Texcoco. However, their invasion destroyed much of the indigenous infrastructure. A lack of understanding of the system of dikes would see the rest fall into disrepair. So it came that in the 1550s intense rainfall flooded the newly established city. Similar episodes struck in 1580, 1604, 1606, and 1607. However, the flood of 1629 proved to surpass any previous devastation (Musset, 1992). Authorities assumed the drying out of the lake and rivers, the foundation of Tenochtitlan, to be the only sensible solution. “It would appear that the first conquerors wished the beautiful valley of Tenochtitlan to resemble the Castilian soil, [...] dry and destitute of vegetation” (Humboldt, 1811). Technological and especially financial constraints would postpone these ambitions to the 17th century, with small drainage systems under Enrico Martinez.
Similarly to the Lake infrastructures, the aqueducts were not properly maintained. Both the governing authorities and the residents disregarded the freshwater supplying springs, lakes, and channels around the city. Wastewater and other by-products accumulated in all water bodies. Consequently, provisions were of low quality and became a source of infectious diseases (Tortolero, 2000). This only supported the ambitions to extract the ‘excess water’ from the basin, “just as a physician might extract ‘bad blood’ from an unhealthy patient” (Sosa-Rodriguez, 2010).
The relationship between the colonial authorities and its aquatic environment was shaped by antagonistic tendencies. Water was perceived to be a source of unhygienic conditions. However, this was not lastly due to a lack of comprehension of the indigenous adaptations and a disregard for their ‘contributions’. Despite the ambitions to drain the basin, only negligible measures were

taken. The destruction of the aquatic habitats would be at the hands of the dictatorship of Porfirio Díaz.

The Promise of Modern Water

Revolutionary Waters

On March 17, 1900, the long-term ambition to overcome Mexico City's historical flooding problem entered its final chapter. With the inauguration of the *Gran Canal del Desagüe* the last remnants of the original lake system of Mexico City would finally disappear from the surfaces of the Valley. Under the watching eye of the public, President Porfirio Diaz proclaimed the project the "greatest that modern man has been able to carry out" (Vitz, 2018) and inundations a thing of the past. Like future grandiosities, the canal would only be a temporary fix to the perceived problems at hand. Ironically, the project failed to eliminate flooding as torrential rainfalls began to regularly inundate low-lying areas of Mexico City. As Lake Texcoco lost much of its surface area, the underlying alkaline lakebed was exposed to harsh sunlight and strong winds, creating toxic dust storms. The interconnectivity of natural systems and the repercussions of modifying them is a lesson which has yet to be learned.

Historically the City relied on a patchwork of masonry aqueducts, wooden sluice-works, canals, public fountains, clay and in some cases metal pipes, and shallow wells, dating back to colonial times. To ensure stable access to the quickly expanding and industrializing capital new sources had been sought out. These culminated in the construction of the *Xochimilco Waterworks*. Its inauguration in 1910 connected some 85% of the city's residents to Modern Water. Like the *Gran Canal*, it was orchestrated, even if on a much larger scale, as "the solution to the capital's historic water woes" (Banister and Widdifield, 2014). Many Xochimilco *chinamperos* (chinampa farmers) lost access to land for the infrastructure or access to their freshwater sources to quench the thirst of the city.

This disregard for the living conditions of the rural and poor was a consistent national condition, a symptom of Diaz Administration policies which favored the interests of capital and industry. With many Mexicans living in poverty, restrictions on land access for peasants under the hacienda system, unsanitary living conditions, and political marginalization fueled grievances and dissatisfaction. The peasant uprising of 1911 marked the beginning of the Mexican Revolution, which continued

until 1920. While the conflict resulted in concessions for large swaths of rural peasants, the paradigm of Modern Water would excerpt its influence through the continuity of Diaz-era planners in the new state.

Technically, access to water was given through the new Infrastructure. On closer inspection, it becomes apparent that many poor suffered under precarious sanitary conditions. A tenement in Romita, a few blocks from the luxurious Roma subdivision, had ninety-seven rooms with an average of four inhabitants each, and only nine toilets (González Navarro, 1974). Other described buildings that possessed only two or three toilets for over two hundred inhabitants (AHDF, 1921). Despite the inadequacy of many units, rents increased drastically. Due to lackluster enforcement of the building code from 1903, many landlords continued subdividing their houses into ever smaller accommodations. The popular dissatisfaction culminated in multiple renter strikes during the Ninetwenthee's. Popular sentiment was that landlords "have not suffered in the least because of the Revolution. . . . The Revolution has respected the tenement buildings" (Jiménez Muñoz, 1993). Despite tenant dissatisfaction, the movement was suppressed by state and capital interest.

In response, the government proposed the first 'public housing project' in the Ex Hipodromo de Paralville. While limited in ambition, residents were invited to build their own houses on land provided by the government, albeit sans services, creating the first colonia popular. The site was rapidly settled as the poor longed to escape the "tyranny of tenancy"(Vitz, 2018). As a result, many lacked proper property titles and access to basic services (AGN, 1924). The residents were expected to cover the costs of urbanization. Many actors sought to take advantage either politically or economically of the precarious situation of the settlers.The coming decades would see hundreds more of these colonias, "adding a new interest group—self-help housing occupants—to postrevolutionary politics." (Vitz, 2018)
The election of the revolutionary Lázaro Cárdenas began a period of populist governance which manifested several demands of the revolution, especially labor rights and agrarian land reforms. To address the sanitary conditions in the City, a revised building code was passed. However lackluster enforcement resulted in the Post-revolutionary urbanization mirroring the staunch inequalities under Porfirio Diaz. Affluent neighborhoods followed sanitary guidelines and offered the full range of modern services. Middle and Lower Class communities suffered abysmal sanitary conditions. "[...] A hygienic home and neighborhood required the ability to pay" (Vitz, 2018).

Despite the Cardenas's revolutionary credentials urban needs were subordinated to the development of rural areas. Capital interests fled from the newly 'socialized countryside' into urban

centers, above all Mexico City. “Whenever they [capitalists] could salvage what they had invested in works of the countryside, they found refuge inside the city” (Hamilton, 1982). The unequal prioritization of the Cardenas administration fueled urban *ressentiments* (Davis, 1994). The resultant unrest almost cost the Partido de la Revolución Mexicana (PMR) the presidential election of 1940, leading their fundamental political affiliation to change. The close relationship of the Cardenas administration to urban labor was reshuffled under the pretext of “unidad nacional” (national unity), whereby the interests of national labor reigned supreme.

Hegemonic Waters

The focus on capital interests of the *Partido Revolucionario Institucional* (PRI) fueled the rapid the industrialization of Mexico City while making rural livelihoods less attractive. Many farmers fled the countryside for an adjacent urban center in search of more favorable economic prospects (Kemper & Cornelius, 1978). Combined with the ‘natural reproduction’ of residents this led to a population explosion in the Capital.

As the Xochimilco water system was not scaled to meet the needs of both the growing population and the expanding industrial sector, the central government looked for alternatives (Sosa-Rodriguez, 2010). While independent, decentralized artesian wells were introduced throughout the 19th c., they proliferated during this period. Often, these were expanded via deep welling and could reach a depth of 100-200 meters, thereby “completely [distorting] the water table” (Fox, 1965). Despite the nationalization of water resources early in the century, well utilization continued to be in “a state of virtual anarchy” until the beginning of the 1950s (Fox, 1965). The uptake in welling lowered the groundwater table and the stability of the ground itself- The resulting land subsidence intensified from minor occurrences in the late 19th c. to a widespread phenomenon in the mid-century. It peaked between 35 and 46 cm/year in respective areas in 1951. The precarious situation led to the prohibition of water extraction in 1954 in the Federal District, decreasing the subsidence rate to around 6cm annually (Academia de la Investigación Científica et al., 1995), a rate which continues until today.

With the dangers of overexploiting the aquifers in mind, authorities planned four additional projects. The System of Peñon (1958) Chalco and of Chiconautla (1957) exploited groundwater resources in the Nord- and Southeast of the Valley (Fox, 1965). These types of “small-scale” welling operations would expand in the coming decades to quench the thirst of a growing capital. The last of the four projects, the Lerma system, aimed to leverage a major source of water located sixty-two kilometers outside of the Valley of Mexico for the first time. For almost a decade, the fourteen-kilometer-long Atarasquillo-Dos Rios tunnel was dug alongside five deep wells, each reaching between 50 and 308m in depth. At the inauguration, it was proudly proclaimed “that the revolutionary government had conquered nature by finding the means to carry water from the

basin of Lerma (on the Pacific) to the Valley of Mexico and from there to the Pánuco (on the Gulf of Mexico)" (Aguilar et al., 2012). Little attention was given to the environmental devastation it caused to the Lerma Lake system, some of which fully disappeared in the 1960s. As rapid urban growth quickly outpaced the initial stage's water transfer rate of $4m^3$ per second, authorities requested an additional $14m^3$ per second. In the negotiations, the Distrito Federal (D.F.) (ab)-used the asymmetrical power balance between the federal and state governments to green-light the second stage. Built between 1965 and 1979, this stage consisted of an additional 230 wells, but due to environmental concerns, the initial rate had to be reduced to $6m^3$ per second (Castelán, 2001).
As a result of the limited water supply, local agriculture has seen a drop in agricultural productivity, changing their lives drastically (Castelán, 2001). The reduced output of the Lerma system led the government to search for additional means once more. In 1974, the Plan de Acción Inmediata (PAI), originally a temporary effort, distributed the additional needs via a network of wells in the southern fields of Mexico, the Distrito Federal, and even the neighboring state of Hidalgo. By 1992, it would supply $15m^3$ per second, a metric reduced in 2003 to 8.3 m^3 per second (CNA, 2004).
Since the 17th century, wastewater has been transferred to the Mezquital Valley, transforming an arid region into a vibrant agricultural center. Nevertheless, the Lerma project and the PAI represent a crucial turning point in the design of the Valley's hydrological systems. These reinforced manmade political boundaries by connecting two geographically separated basins through technological and social forces, not by leveraging natural terrain or the forces of gravity. The technocrats of the revolutionary party celebrated these feats of engineering as a triumph over nature, thinking they could break through its boundaries. Yet they would soon learn that in place of liberation, they had simply moved the goalposts. Time would reveal these claims of abundance as an environmental disaster for residents.

The rapid growth of the City did not only put a strain on the water supply but also the availability of affordable housing. In 1950 4,5 people inhabited a house on average. This number rose to 5,8 in 1970 (Conelly, 1982). The typical rental accommodation, *vecindades*, were originally old aristocratic houses compartmentalized to fit multiple tenants (often more than several dozen families). Dwelling units typically bordered a central courtyard, which served as a communal space and housed shared amenities (Conelly, 1982). The sanitary conditions of these houses suffered under the degree of overcrowding and negligence of profit-seeking landlords (Vitz, 2018). Many *vecindades* fell into disrepair in the 1940s as capital interest retreated from lower-class housing into more profitable areas (industry or upper-class urbanization). The absence of a public housing sector led to a rise in many poor residents resorting to more affordable solutions.
Before 1940, the central areas of Mexico City absorbed most of the population growth, whereafter the population settled in what Ward (1990) designates as the first and second rings. The original pattern of segregation whereby the south and west were settled by the wealthy would continue with

the population growth in the 1940s. These areas offered "positive externalities" (Ward, 1990) above all readily available access to spring waters. These were exploited through private water supply systems (Vitz, 2018). The harsh terrains and salty storms of the eastern Texcoco Lake bed and the high degree of industrial use in the north made these areas comparatively cheap, making them accessible to lower economic classes. Service construction depended on a regularization process of the lands by authorities (legal acknowledgment of ownership combined with installment of services).

Land acquisition differed between the social classes. Upper-class residents had the financial resources to buy much of their lands legally (Ward, 1985). The urban poor resorted initially to land invasions and later to buying illegally subdivided land from neighboring communes, *ejidos,* or private landowners. Both avenues seemed to be outside of capitalist commodification logic (Conelly, 1982; Ward, 1990). The legality of these settlements constitutes a lack of proper land titles, as these areas were not officially intended for urban expansion. This included an absence of general services such as roads and electricity but also sewage and freshwater supply. While most informal lands were later legalized (Varley, 1985), the process generally was not immediate. In the meanwhile many residents were left to their own devices. In Tlalnepantla, it was usual for residents to illegally tap into the water of the neighboring railway and build artesian wells to extract water from the aquifer. While the water was initially clean, the rapid settlement exhausted the source quickly, mudding up the water. "I felt impotent and reminded of our poverty," mentioned one resident as she had to prepare for her nursery training. As demand for the dwindling resource increased social infighting became more typical. The abuse was not only contained within communities.

The regularization also opened the vulnerable population up for political and economic exploitation.

Government attitudes towards the regularization process developed over time. Ward (1990) divides these into three distinct phases. Before 1970, title recognition was generally marked by a "laissez-faire" attitude. This coincided with a drastic increase in irregular settlements, from 14% in 1952 to about 50% in 1970 (Ward, 1976). As demands increased the government created a multiplicity of competing housing authorities with overlapping regularisation duties from 1970-1977. Many of these formed "patron-client" relationships and offered varying degrees of financial and political support in exchange for political support of the PRI. Communities were treated differently to erode inter-community alliances. In cases where communities did not align

with the political agenda of the party could be observed in the case of a settlement in Ixtacalco. On October 2, police violently crushed the demands of Pancho de la Cruz and his community, a warning to others (Ward,1990). Nevertheless, the web of organizations gave the impression "that much was being done" while giving authorities a mechanism of "divide-and-rule" (Ward, 1990). Since 1977, the government sought to achieve control by "delivering the good" through a more technocratic bureaucracy (Ward,1990). The shift is conceived as a mechanism to incorporate the residents of irregular settlements into the tax base by regularization land titles. After registration authorities demanded charges for the process and historical and future costs for service provisions. The many "arbitrary charges" demonstrate the intention of authorities to "raise treasury resources as well as to use the procedure as a dimension of political mediation and control" (Ward, 1990).

Neoliberal Waters

The election of Carlos Salinas de Gortari, in 1988, would mark a partial retreat from the prevailing state-centric (water) governance. His National Development Plan under the auspices of the neoliberal ideology foresaw the reform of all major public services, including the National Water Law in 1992. The legislation aimed to instate a "decentralized water system management from the federal level to state and municipal governments and opened the door for privatization of municipal service provision" (Wilder & Lankao 1982). Authorities proclaimed "water has ceased to be a free good and from now on it is a resource which has an economic value and society must pay for it" (Castro 334).

Anticipated growth of the Metropolitan area, neither the PAI nor Lerma system would 'quench the thirst' of the ever-growing metropolis, Authorities embarked on another search for water alternatives across several regions but landed on imports from the Cutzamla watershed (Castro, 2006). The design foresaw three stages: The first stage connected the Victoria Dam to the infrastructure of the Lerma system via a seventy-seven-kilometer-long aqueduct, facilitating additional flows of $4m^3$ per second. The second stage accessed the Valle de Bravo with an additional sixteen kilometers of tunnels in 1985. The third stage, built in 1993, added the flows of the Colorinos, Tuxpan Dam, and El Bosque Dam. The completion of the system transferred $19m^3$ per second through seven distinct reservoirs, pumping stations, tunnels, and aqueducts, traversing a height of 1100 m and a distance of 127 km to Mexico City.

A fourth stage was considered and planned This would have included a pumping station, eighteen kilometers of canals, and twelve kilometers of tunnels. Once completed, an additional $5m^3$ per second would have been transferred. However, due to political and social backlash, the project

never moved forward (CNA, 1997). After witnessing the environmental damage caused by the other stages, many locals raised apprehensions about the likelihood of negative impacts on their agricultural lands. The National Water Commission (CNA) offered to build small infrastructural offsets, "...but so far the people are more interested in their own welfare, rather than in the population of the metropolitan area" (Tortojada, 2006). This self-preservation of the campesinos interest was in 'wise foresight' as "... governmental institutions have generally ignored the potential social conflicts which could result from interbasin transfers" and their environmental implications (Tortojada, 2006). Cost analyses of the project's completion put it at around 1,3 billion USD (CNA, 1997). While extraordinarily high, it is worth pointing out that these costs exceed all investments in the public sector in that period. Affected communities received some compensation. The negative consequences of Cutzamala, mostly concerning water shortages and sanitary issues, were tackled through subsequent construction projects. The high operating costs are offset by government subsidies. As aquifer wells were employed continuously, even in reduced form as infrastructure improved, land subsidence continued in Mexico City. Over time, this has affected drainage infrastructure's ability to properly function as its necessary slopes have declined and pipes fractured. Some estimates put the loss of water due to ailing pipes at 30-40% of flow volume (Tellman et al., 2018). Repairing these would relieve pressure on the water supply, "however, this type of efficient planning and management is basically absent in Mexico at present" (Tortojada, 2006). As the *Gran Canal del Desagüe* proved no longer sufficient to drain the Mexican basin, authorities constructed the Deep Drainage in 1975. At its inauguration, officials framed the project as a definitive solution but "the deep Drainage system will be a complete solution to all of the complex problems of Mexico City" (DDF 1975:257-260). Ironically, a series of floodings in the following decades would also prove the Deep Drainage system's inadequacy to combat inundations.

The economic hardship and high rates of inflation at the end of the 1970s and '80s made self-building less viable for the urban poor. The government finally had to act in the late '80s, partially as a response to civil unrest like the student protests in 1968. Through new government subsidies, around one-fifth of the working-class housing demand became satisfied through private capital in the construction sector. At last an affordable alternative to self-build housing was established. Regularization processes brought many *colonos* under the umbrella of the supply and sewage system of the city. In 2015, the consensus recorded a 98% coverage rate for households in Mexico City (CONAGUA, 2018). This however did and does not assure people of access to water.
As in previous decades, water access strongly correlates with the social and economic status of residents. Around 14% rely on *pipas,* water truck provisions, as they lack a water supply in their homes (González and Ziccardi, 2012). These are highly unreliable as one resident remarked, " in times of scarcity, we might have to wait up to a month and a half for the water tanker; that is, today, we can pay for it today, but it's going to arrive at some point in 45 days!" (Eakin, 2016).

In about one-third of dwellings, water is non-permanent as a result of the system of *tandeo* (Schwarz, 2021). The system distributes water according to a specific schedule. Three times a week, there will be 18 hours of water supply, followed by a 6-hour break. This affects the different boroughs divergently (González and Ziccardi, 2012) as better-off neighborhoods are excluded from the system.

Despite the established schedule for water delivery for those on the tandeo system, the delivery often does not adhere to the schedule creating a large amount of uncertainty in anticipating water delivery. Depending on a variety of factors people had to adapt to the uncertainty. Schwarz (2021) describes these as a process of "hydrological standby". Especially marginalized people are in a constant state of alertness awaiting the arrival of water. They listen to a potential rumbling of water filling the pipes or check if the tap started to run. In anticipation of future shortages or loss in pressure, many rely on water storage methods. This includes grey, rain, or tap water. It is common to see rooftop water tanks, *tinacos*. Those who can afford it, opt for a sensor to automatically fill the tank when water arrives. But for the poorest, this is unattainable. One resident laments, "Those who have a cistern don't need to be alert. But I don't have one, so I need to fill my tubs. (...) I get up; I almost don't sleep in order to fill them. (Schwarz, 2021)". But even those who own an automated system installed are not " entirely independent of unpredictable supply patterns", as these systems break down. These adaptations sow conflict when these storages are shared, as a kind of first come first serve mentality exists. Water scarcity is exacerbated as its quality varies. This is the case for both tap and pipa water. Virtually all social classes rely on bottled water to circumvent water-related illnesses. An average resident consumes 250l typically in the form of *garafones* (20 water jugs) (Rodwan, 2018).

But scarcity is only one side of the coin. During the rainy season, low-lying and often marginalized neighborhoods flood regularly (SOURCE). STAT. The large volumes overstrain the sewage system resulting in a mixture of fecal matter and rainwater covering large swaths of streets and ground floors. It is mostly 'housewives ' that "battle with water", from entering the homes with "brooms, buckets and [self-built] brick barriers" (Eakin et al.,2016). Those who are employed usually miss work either to safeguard the home or clean after the catastrophe has come. This translates into lost income for the household on top of the destruction caused by the floods.

As a result of both scarcity and inundations residents make their demands publicly heard in protests. But often these fall on the deaf ears of authorities. One resident laments, "they do not pay any attention to us. They tell us that they will provide water but it's just talk .." (Eakin et al., 2016). In the cases where officials listen to the demands, residents are aware that it is often tied to votes: ... it's when the politicians go looking for votes is when they say they're going to try to fix the water situation ... " (Eakin et al., 2016). But people are disillusion with collective action, "... really resolving the problem is beyond our reach, [...] unless the authorities want to do something, we can't really accomplish anything." (Eakin et al., 2016).

The False Promise of Modern Water

Indigenous traditions were started to be eroded during the colonial period.However, it would not be until the period of Independence that they found their demise under the paradigm of Modern Water. The lacustrine livelihoods of Lake Texcoco were replaced with suburban housing. The supply for the city was sustained on the waters of Xochimilco destroying large swaths of the chinampas. Only small portions are left mostly as a tourist attraction. The Lerma-Cutzamala system has caused similar damage in the respective catchment areas. In its decay many rural residents became houseowners in the growing metropolis. The City grew from 300.000 inhabitants to over 22 million in the span of only 100 years. The rapid explosion made universal access to water a demanding task. But it was government incompetence and/or apathetic intent that discerned the Promise Water to be a false one. The specific flavor of Mexican Modern Water made the resource a class attribute. Its access is enjoyed by those who can afford it. This has been the case regardless of the political shifts or later private partnerships. Modern Water seems to be a historical contingency.
Beyond its social upheavals, the paradigm has caused severe environmental distortions. The once-present lakes played a vital role in the storage and infiltration of the annual precipitation. In its place, the city relies heavily on groundwater to meet its supply. The overexploitation, in some regions up to 650% (SOURCE), has caused immeasurable damage to buildings and ecosystems. The Water transport through the Cutzamala system threatens the local environment similarly. It is unclear how long the system will supply enough before new sources will 'need to be' exploited. The changing climate threatens to only make things more uncertain. However, authorities have held onto the paradigm of Modern Water. "All the signs indicate that progress is likely to continue [...] as has been the case in the past, and business-as-usual will likely be the order of the day, until a catastrophic water-related crisis hits the region. If the present trends continue, that crisis may not be very far off" (Tortojada & Castelán, 2003). Under these pressing circumstances, it is imperative to consider alternative configurations of society and the environment.

Reinstating the Aquatic City

The environmental deterioration of the past centuries has led many (government and bourgeois society) to the aquatic city of the past. The latest of these 'water-nostalgic' plans for a sustainable Mexico City were proposed by Alberto Kalach, Teodoro Teodoro González de León, and Iñaki Echeverría and would " require a massive reform in urban land speculation and democratic

accountability[...]. Yet Kalach has called for expert commissions along the lines of those during the Porfiriato" (Vitz, 2018). Under these conditions the utopian environmentalist ambitions would turn out to be "evil paradises" (Davis & Monk, 2007). "Hundreds of thousands of working-class residents" would be likely evicted to construct upper-class amenities and housing (Vitz, 2018). One should be cautious which aspects one wishes to revive and weigh them against the socio-spatial realities at hand.

Given the dependence of many indigenous practices on the existence of the lake system, it is hard to imagine it being rejuvenated on a large scale without enabling the social distortions of Modern Water. Locally this might be possible, such as the chinampas in Xochimilco. However, the close relationship of Aztec life with the environment is undeniably desirable. The newest generations of Planners aspire to reshape the mentalities to promote water recycling, river regeneration, and water savings. It is here that the examination of Aztec water conceptions might be useful. During the precolonial era, water was omnipresent. Its quality was sustained through non-structural measures, if when broken punished. More crucially water was considered the property of everyone in a forthright manner, unlike the abstract public ownership through the State. The infrastructure was constructed and maintained by the hands of residents. To revive this concept of water, one must look at the physical framework conditions, as the indigenes did before.

The supply-sided focus of Modern Water relied on large sources of water in the aquifers and the Cutzamala rivers. The ambition to expand upon this system is "a reflection of the unstable hydro-social contract [...], which undermines current government responses to natural resource limits" (Brown et al., 2009). It is in a state of technological 'lock-in'. Crucially it overlooks many aspects of the hydro-scoial system at present.

Mexico City receives large amounts of precipitation between June and November. The water would usually flow into the sewage system, but locally these volumes overwhelm drainage capacity, leading to inundations. The resource is treated as an urban nuisance. In reality, it constitutes an invaluable source of potable water. Some residents already exploit the rain through rainwater harvesting systems. Isla Urbana, an NGO, estimates between six to eight months of domestic water needs could be supplied through the system (SOURCE). Although precipitation patterns vary widely in the Basin, these volumes are hardly negligible. Grey water, an even larger source of potential water, is only used to a small degree. Most of the water is mixed with excrement in the drainage, supplying the Mezquital Valley. Some of it is treated in industrial-scale sewage plants (STATE) (SOURCE). Godoy-Lorite & Barkwith (2021) estimate in a theoretical model that large parts of the city could exploit this grey water by introducing Constructed Wetlands. They outcompete the industrial plants both in energy and economic efficiency (SOURCE) while providing vital green spaces.

Despite the advent of these promising decentralizing technologies, there still is a limited vision for its management system. This limits the adoption of new systems. Rainwater harvesting systems are

typically designed for individual use, both in domestic and industrial settings (Isla Urbana). The same applies to constructed wetlands (Interview). The individual approach isolates people in different ways. More affluent residents might have less incentive to install these technologies as a result of their satisfactory water access. Poorer residents are 'gate-kept' from adopting the technology for a lack of space and financial resources. Were it not for the work of *Isla Urbana* (NGO) it is unclear whether most Rainwater Harvesting Systems would have been installed. Constructed wetlands suffer similar problems. Some researchers also mention a strong de-adoption rate from a lack of maintenance knowledge (JUNE). A solely technological approach will have a hard time overcoming these crises. Quite the contrary, it could threaten to perpetuate the existing inequalities. Similar to self-help housing before, 'self-help water' might just be another path to exploiting the vulnerabilities of the poor, albeit a more sustainable one.

Examining the Rural Commons

From Commons to Commodity (?)

The decades following the Independence War in Mexico City are strongly linked to the Dictatorship of Porfirio Díaz. He ruled the country from 1876-1880, and again from 1884-1910. His modernization efforts foresaw land grabs by Spanish settlers from indigenous or seemingly vacant lands under the hacienda system (Barnes, 2009). Many indigenous people were exploited under this semi-feudal system. By the end of the century, only 15% of the lands were in indigenous ownership. The exclusion from political and economic decision-making fueled rural discontent and culminated in a popular uprising under the Mexican Revolution.

After disposing of Diáz's authoritarianism, Revolutionaries confirmed the Mexican Constitution in 1917. The call for *tierra y libertad* (land and freedom) was implemented through Article 27, the Agrarian Law. It would see widespread land reparations to indigenous and farmer communities, which were to be managed communally, the *ejidos* (Knowlton and Orensanz 1998; Perramond 2008). Emilio Kuri argues that the revolutionaries were inspired by the Aztec system of the *calpulli*, in which households received a portion of land to provide for the household. Individual parcels were clustered into the larger system of the *calputlalli* community (SOURCE).

Between 1917 and 1930 the new state calibrated the original legislation through additional texts such as the Irrigation Law, the Free Land Law, and the Forest Law among others. The Populist orientation under the Presidency of Cárdenas in the '30s saw an uptake in the redistribution efforts. By 1936, some 8 million hectares fell under the custody of different *ejidos* (SOURCE), making *Ejidos* a powerful political and economic entity on the municipal level (Ward & Jones,. Neglect of government support in the 1970s and 1980s, such as the discontinuation of maize subsidies and other agricultural staples, led to *ejido* isolation. "Since [the presidency of Luis Echeverria Alvarez, 1970-1976], we knew we're going to be skewed" (Perramond, 2008). Many communities were unable to adapt to the new environment as they lacked both knowledge and financial support. This culminated in the neoliberal reforms of 1992. By then, around 50% of the country's land base had been redistributed to *ejidos* (Perramond, 2008). Scholars interpret the effectiveness of the *ejido* system differently. Whereas early academics emphasized their social character as a way to protect the commons of the Mexican people by reinstalling the social function (Ankers & Ruppert, 2006), later academics saw it as a mechanism to keep rural support to the political hegemony of the *PRI* (Jones & Ward, 1998). I would like to argue that these interpretations are not mutually exclusive, but rather reflect the political deviation of the *PRI* in the twentieth century. Despite the political calculus, it is undeniable that many powerless peasants received an opportunity for self-determination and many did and do so successfully.

The presidency of Carlos Salinas de Gortari would be a historical caesura for the *ejido* system. The usufruct rights of *ejidatarios* (*ejido* members) were originally passed through inheritance to one family member. The title and the associated land could not be sold as private property. Salinas proclaimed the *ejido* tenure and their inherent incentives as extremely inefficient (Salinas, 1982). As part of opening up the Mexican economy to global markets, most notably the NAFTA negotiations, his cabinet would reform the Agrarian Law (Barnes, 2009). The change was further encouraged by the World Bank and International Monetary Fund (Jones & Ward, 1998), as capital influx was proclaimed to streamline the ineffectiveness of the sector (Dower & Pfutze, 2013).

To implement the reforms, a new governmental program was created in *PROCEDE*. The institution was tasked with titling, mapping, and certifying *Ejido* lands, as no official cadaster existed before. Participation on the side of the *ejido* was voluntary. Due to the relative complexity of

the registration process, many *ejidatarios* started the process but never finished it. In everyday interactions, this remains consistent, as individuals are aware of their ownership of the title. Nevertheless, by 2006, around 95% of all ejidos were geographically fixed, certifying communal and individual land rights (Perramond, 2008). Certification allows ejidos to decide democratically "whether to privatize all, none or a few portions of their land", "through the existing internal governance system" (Flores Hernandez, 2020; Perramond, 2008).

Despite the neoliberal pressures on ejidos, the system has shown to be more resilient than many scholars anticipated in the early '90s. Certification allowed many communities to formalize their previously informal landholdings and 'defend' them against outside claims. Furthermore "[...] very few widespread privatization schemes have taken hold" (Perramond, 2008). Privatization is mostly being used to formalize previously informal agreements (Perramond, 2008). The scheme ultimately reflects the perceived atomization of Mexican society under a market-led system, one that proved to be contested in the case of *ejidos*.

At Odds with

Deconstructing the Ejido

The technical definition of the Ejido system is contested. Technically the government held the properties granting *ejidatarios* 'usufruct rights' to the land and waters for communal management. But until today scholars debated whether Ejidos were national property or pertained to the people living in the territory (Jones & Ward, 1998; Barnes, 2009). While authorities have made use of eminent domain, especially for infrastructural or urban expansion, the 1992 reforms, with its avenue to private ownership tip the balance for the latter. The same Contestation also applies to the organizational structure. It has been described as both a 'corporate private property' (Siembiedad, 1996) and 'community-based land tenure' (Barnes, 2009. "In terms of its performativity however, Ejidos are neither public nor private, but 'social property' [...] (Flores Hernandez, 2020).

Ejidos are parceled into a variety of land management arrangements, mainly urbanized lots for housing, private farming lots, and remaining land for communal use. These often constitute a natural resource, such as pasture or forest. Originally these lands were equally distributed but the reform in 1992 allowed some *ejidatarios* to acquire larger swaths of land (Monroy-Sais et al., 2020). The original constitution included other plots for women specifically or urban services among others (Ley Agraria, 2017). The diversity of plot configuration alludes to the egalitarian ideal for ejido communities. In reality, the egalitarian spirit only included *ejidatarios* to the exclusion of other groups.

The *Ejido* title could be accessed through the original land distribution schemes, by ejido acceptance (after living a year in the territory), or through inheritance by a family member. The title included them both in the ejido assembly and the access to communal lands with the linked monetary benefits. The Agrarian Law "systematically excluded women from official entitlement and political participation" (Hausmann, 2014). Constitutional additions in 1971 reworked the status of women, "meaning that land could be willed to individuals irrespective of sex" (Hausmann, 2014). However, it did not translate into improvements for female *ejidatarios,* as they were excluded from leadership roles. Women only account for 18% of registered ejido members (Radel 2011).
Ejido territory often includes other interest groups. *Avecindados* (neighbors) were allowed to settle in the urban plots. In some cases, they did not own any. They mostly satiate important urban services as off-farm workers, such as carpenters, or day laborers on the farms. Lacking the title they are excluded from governmental assistance or the returns on communal land. With permission from land-holding groups, they can forage some resources from the communal areas. The reforms of 1992 allowed non-title holders to purchase lands in the *Ejidos*, creating the *posesionario*s. Similar to the Ejidatarios they possess land but are not part of the decision-making process or the returns of communal resources. Despite their lack of title, these groups can still influence the decision-making process informally, dissolving the "binary [of] the land question.

The governance is directed by the *Asemblea Ejidal* (General Assembly)*,* composed of all ejidatarios. On a triannual basis, elections are held to form the *Ejidal* Commissary and a Surveillance Council. The Commissary is split into the President, Secretary, and Treasurer. Together they coordinate the daily operations, organize meetings and communal works, address conflicts, and communicate with authorities. The Surveillance Council intervenes in cases of Commissary misconduct. Ejidatarios also have the option to instigate Internal procedures and regulations. The Members meet regularly in the General Assembly in specially built buildings (Ejido Houses) (SOURCE). Attendance is compulsory and absence is fined. Together they discuss and decide by majority vote all collective matters. "The Assembly is the most symbolic space where social structures take shape, social interaction occurs, and collective agency may be fostered [...]" (Méndez-Lemus et al., 2020).
Outside the formal framework "most ejidatarios conduct themselves according to common values and principles such as respect, honesty, equity, and loyalty" (Méndez-Lemus et al., 2020). However, the social structure, a result of the scale of the community, the social ties through their common ownership, and shared normative and cultural attitudes (Barsimantov et al., 2010) allow for the collective scrutiny of individual behavior through self-defined enforcement mechanisms (Ostrom, 1995). This is supported by countless examples where individuals in the ejido tried to abuse the commons for personal gain. In an ejido in Michoacan, the president once stole ejido pine timber and sold it for profit. Upon discovery, the close-knit community swiftly found the culprit. He had to repay the communal losses and a hefty fine on top (Augustin, 2024). These show the

determination to overcome what Ostrom (2009) titled the free-rider temptation.
The *Asemblea Ejidal* has long functioned as a platform for collective action, mainly to co-manage the communal lands. This takes mostly the form of a communal pasture or forest. Tasks but also benefits are distributed fairly. In some cases, these tasks are remunerated with ejido funds. Older *Ejidatarios* are even rewarded without the requirement for work in some cases (Augustin, 2023). In the literature collective vision and the capacity for action differ widely between individual Ejidos. Some divide the communal areas into parcels administered by individual *ejidatarios* (Schroeder & Castillo, 2013). Others decide to keep the community alive. Nevertheless, collective action seems to have suffered under the 1992 reforms. This is rather a reflection of preexisting arrangements than the cause (Schroeder & Castillo, 2013; Perramond, 2008). Selforganization is dependent on a combination of the respective resources and social attributes of the particular resource system operating in a specific socio-spatial context (Ostrom 2003).
However there exist very strong cases for successful collective management. Contrary to most communal pastures, some resources are more challenging to manage individually. The two most prevalent examples are forests and water. In the past decades, many successful Community Forest Enterprises have flourished. They provide a substantial income for the *Ejidos* while conserving large areas of forest (Barton Bray, 2003). These notably show the coexistence of economic and ecological incentives through collective action.
Water is an essential resource for both domestic and productive activities within Ejidos. As a result, it is often subject to collective management in many cases: After suffering multiple droughts in the 1980s communities in Jalisco constructed a connection to a source 18km away "with great pleasure, as water was a big problem". This was despite many *ejidatarios* otherwise abstaining from collective action or inter-community cooperation. The system has been maintained even after the shocks of the reforms of '92 (Schroeder & Castillo, 2013). In the state of Veracruz, watershed protection was enshrined in the Internal Code of an *Ejido.* Under the guise of new female leadership narratives around water stewardship led to the invigoration of collective enthusiasm and social cohesion (Hausmann, 2014). One of the most notable examples comes from the volcano region of the State of Mexico. The community has been managing a water system since the 1950s, that has sustained its residents even as the population grew drastically (López-Villamar, 2013).

The Ejido system offers an alternate path to the subverted role of the state, society, and environment (Hausmann,2014). While historically being the antithesis of urbanity, this stems from its 'seemingly undetachable' connection to agrarian notions. Disconnected from these, many performative functions of the ejido could be translated into urban communities. In combination with the new water technologies they might establish a distinctly Mexican version of what has been described as a 'water-sensitive community'.

Imagining the Water Commons

Water-sensitive communities (WSC) constitute one of three central pillars of water sustainable city, the other two being the provision of ecosystem services and the city as a water supply catchment (Wong & Brown, 2009). These communities are characterized by a myriad of attributes (Chadfield et al., 2020). The following three topics will address and combine the central characteristics.

Participation and Collective Governance

The formulation of decentralized Water systems needs to be based on community participation for collective decision-making. Floyd et al. (2014) defined this as the central prerequisite of a water-sensitive community. Like in the countryside, a new ejido would be structured around a General Assembly of all community members. However, new Ejidos would need to address the exclusion of certain community groups that their rural counterpart traditionally exhibited. Through frequent meetings in a formalized setting, people could discuss and decide how to address social and environmental needs; such as relevant free spaces for rainwater harvesting or greywater reuse systems. Community Members would be given a safe space to express and debate concerns in an inclusive setting, strengthening community cohesion. The decision-making process would be guided by the values and perspectives of residents to promote the well-being of their community. Some communities might prioritize flood adaptations over supply Furthermore, specific regulations and procedures could be democratically negotiated and inscribed in the *Codigo Ejidal*. Deviant Individuals could be held accountable through similar methods such as the fines their rural counterparts use, a homage to Aztec water rules. The Assembly would be able to coordinate dialogue with authorities to lobby for funds or expertise. This type of cooperation has become more feasible as some authorities have shown interest in these types of projects such as the Sheinbaum administration (Ciudad de México, 2019).

Ownership and 'Water Culture'

People have been excluded from governing the Water in Modern Mexico. Water gets transported from distant sources and almost carelessly consumed. The implementation of decentralizing technologies allows for a different type of relationship. Instead of harvesting their fields, a new ejido could harvest the clouds in its territory. The negative associations of limited access and the flooding of homes could be turned into enthusiastic anticipation and preparation. Such has been the case of

neighborhoods in the south of the city that installed Rainwater Harvesting Systems (city, 2024). The individual approach has shown promising improvements. However, a widespread adoption will need to integrate novel governance structures and management mechanisms. The Ejidos have proved to be particularly effective in combining individual and communal tenure arrangements. The different parcels of individual, social, and communal could be adapted to fit an urban context. Houses would constitute individual plots, streets, open spaces and delegated public spaces communal plots, and specially designated spaces the social. The constellation would allow to capture or reuse of more water resources in the area than an individualized approach. But a collective approach would also encourage the pooling of financial and labor costs achieving higher 'efficiencies' through the economies. Furthermore, individual misfortunes would not be less detrimental as the reciprocal and sharing mentality of common ownership has been shown to lower vulnerabilities (Méndez-Lemus et al., 2020).

The physical infrastructure of the novel technologies would allow for water to become physically present, in contrast to the 'invisible' infrastructure currently. Critically, the collective interactions around water in the Assemblies would also make water 'socially visible'. According to Brown (2017), combining "social and physical visibility" is a key determinant for public conservation and by extension for 'water culture'.

Autonomy and External Relations

The concept of water-sensitive communities originates from a Western context. Consequently, assumptions are implicitly made. Most influential for the Mexican Context is a semi-functioning and -productive relationship with the authorities. While these have become more feasible in recent years as indicated recently, history has shown countless counterexamples. Therefore the new Ejidos should be cautious and prioritize an autonomous and protective livelihood to authorities. This includes the active shielding of internal decision-making but also a reserved reliance on external support. They would be based on their recognition as 'legal entities' with a right to management and usufruct to assure that "only those who care and work the land are entitled to extract a value from" (Flores Hernandez, 2020). I want to stress that this arrangement would not be one-sided. Authorities would benefit, as substantial labor and financial resources would be unchained.

Beyond the autonomy of new Ejidos, the communities should avoid falling into a parochial and exclusionary modus operandi. The strength of this new approach would not only rely on the autonomy of neighborhoods but rather on an inter-ejido relationship. The aforementioned examples in the volcano region and Jalisco have shown this to be a productive strategy. Only then will the intertwined hydrological challenges of the Valley stand a chance to be resolved.

The hydrological system of Mexico City is distant from the idea of a Water Sustainable City. Historically, cities have moved linearly across hydrological developments. However, “there is no evidence to suggest that cities could not move in both directions across the continuum as well as jumping and/or straddling phases based on changing circumstances”(Wong & Brown, 2009 referencing Keath & Brown, 2008). The new Ejidos would be a viable mechanism to transform the ravaged Hydrology of Mexico City while addressing crucial aspects of participation, exploitation, and equal distribution.

Conclusion

Under Modern Water indigenous Mexican conceptions of water as a common good were replaced by a strict utilitarian relationship. Modern Residents grew the expectation of water supplied by state authorities. However, this expectation has not been met universally. The promise of modern water has been systematically denied to marginalized residents. This is the case for the rent strikers of the 20s, for the self-help housing expansions until the 90s, and for the *tandeo* system of the current period. Rather, the Promise was and is politically weaponized in many cases to keep receivers in line with the benefactor's interests. Furthermore, both supply and drainage systems heavily strain the hydrological limits of the basin and beyond. Local aquifers are exploited at an unprecedented rate, leading to subsidence and infrastructural failure. The interbasin transfers plunder water sources of neighboring watersheds and can not operate at full capacity as they destroy local agricultural livelihoods. The high degree of surface sealing leads to severe local flooding in some parts of the city. Sewage is only partially treated. Most of these 'black waters' are transported to the Mezquital Valley, where they are used in agricultural production. In light of the myriad of social and environmental distortions, it is undeniable that Modern Water is in Crisis.

The changing climate and self-inflicted damage threaten to worsen the existing distortions. Consequently, the conservation of the current system is a sysiphonic challenge with unimaginable consequences. Nevertheless, current administrations favor a continuation of Modern Water, as new and larger interbasin transfers are planned. Contrarily, decentralized water practices have emerged as an alternative to the state provisions. Thus the NGO *Isla Urbana* has helped to install rainwater harvesting in around 100.000 households. Constructed wetlands are theorized to lower water vulnerabilities on large scales in the city. However if done on an individual level these solutions may become just another form of "exploitation" as self-help housing was before (Ward, 1990). The fragmentation of communities and their interests has been a fundamental factor in shaping the exploitative nature of Modern Water in Mexico City.

Consequently, new constellations will have to address not only the physical infrastructure but also the role of communities as co-producers of urban water. This corresponds with the demands of water sustainability frameworks for 'water sensitive communities'. Mexico has had a long-lasting experiment in communal land and water tenure in the Ejidos. Many of its performative aspects would benefit the atomizing forces of Modern Water in Mexico City. They are a form of decentralized governance complementing the decentralized water supply practices. When combined, these could seriously challenge the hegemony of Modern Water by reinstating the lost water commons.

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